POSSUM 3D MULTI-CLIENT MARINE SEISMIC SURVEY

ENVIRONMENT PLAN

Searcher Seismic Pty Ltd

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Rev 1.0

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EP SUMMARY

This Environment Plan (EP) summary has been prepared from material provided in this EP. The summary consists of the following as required by OPGGS(E)R Regulation 11(4):

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1 INTRODUCTION

Searcher Seismic Pty Ltd (Searcher) proposes to acquire three-dimensional (3D) multiclient marine seismic surveys (MSS) within the Possum operational area, located within the north-west marine region (NWMR) offshore from Western Australia (WA). The Possum 3D MSS operational area comprises approximately 13,450 square kilometres (km^2) and extends across exploration permits WA-436-P, WA-479-P, WA-487-P, WA-527-P and WA-540-P (Figure 1.1).

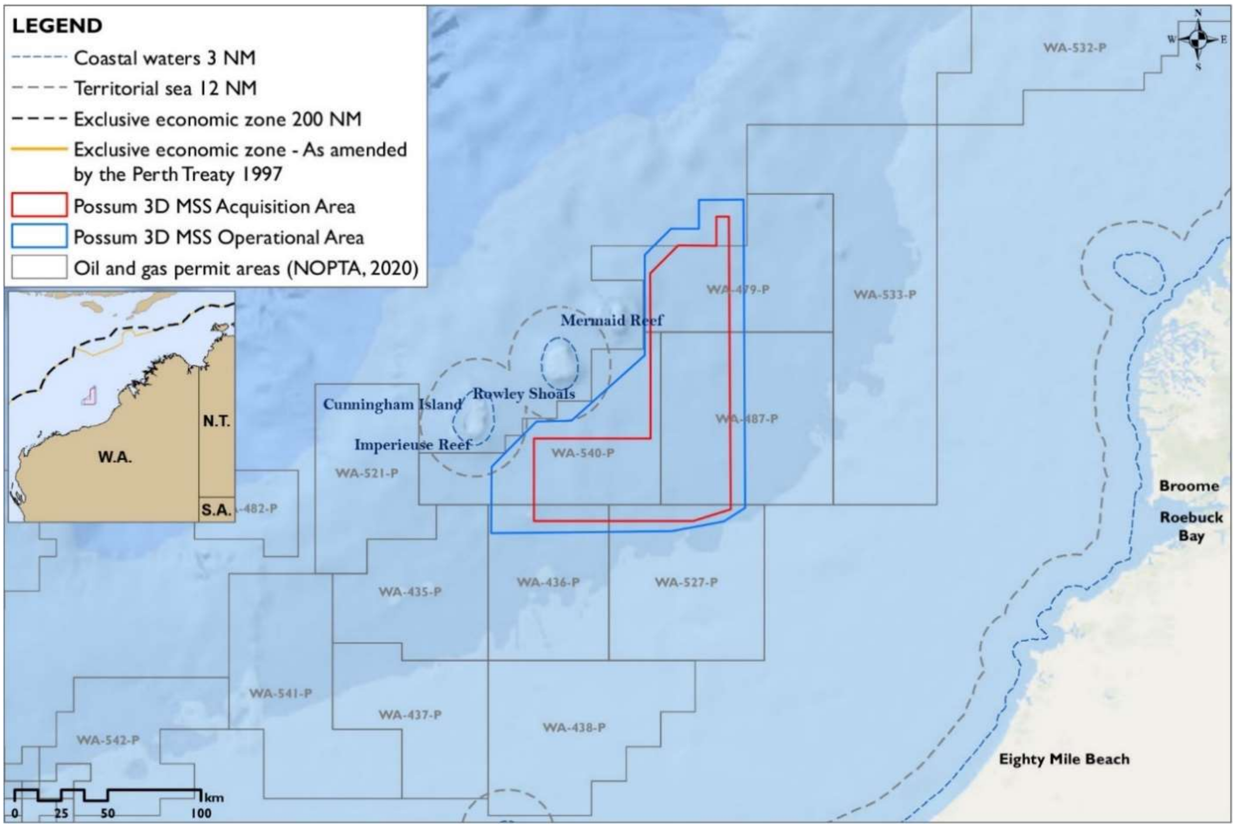


Figure 1.1 - Location of Searcher Possum 3D MSS

1.1 PURPOSE

This Environment Plan (EP) and the supporting Oil Pollution Emergency Plan (OPEP) for the Possum 3D MSS was prepared to meet the requirements of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS(E)R) and administered by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA). Prior to activity commencement, the EP must be published on the NOPSEMA website for a public comment period of 30 days, and then assessed and accepted by NOPSEMA. It should be noted that all significant changes, from comments received during the public participation process undertaken on the draft report, are underlined and in a different font (Times New Roman) to the rest of the text. When accepted, this EP will become a legally binding document between NOPSEMA (as Regulator under the OPGGS(E)R) and Searcher (as Titleholder of the Special Prospecting Authority, NEATS Ref: T79PTR (SPA) and Access Authorities, NEATS Ref: 2PBV4C (AA) under the OPGGS Act from the National Offshore Petroleum Titles), thus establishing the criteria against which compliance and environmental performance will be monitored.

The overall purpose of this EP is not only to comply with statutory requirements but also to ensure that the seismic acquisition is planned and conducted in accordance with Searcher environmental policies and standards, including the corporate Environmental Policy (APPENDIX A). This EP will also serve as an environment management tool to implement targeted environmental control measures throughout the proposed seismic surveys.

The objective of this EP is to ensure that potential adverse environmental impacts and risks associated with the proposed activities (during both routine and non-routine operations) are continuously reduced to as low as reasonably practicable (ALARP) and acceptable levels. To facilitate these objectives, a comprehensive environmental risk assessment was performed to determine which activities and environmental aspects could cause an environmental impact or risk. The outcomes from the assessment form the foundation upon which relevant preventative and mitigation measures are identified and implemented, thus ensuring that adverse environmental impacts and risks are avoided and/or minimised.

1.2 SCOPE

The scope of this EP covers seismic data acquisition activities and normal movements and operations of the survey vessel within the operational area while engaged in the petroleum activity. Specifically, the EP includes 3D seismic acquisition within the Acquisition Area and associated vessel operations: within the Operational Area:

- deployment and retrieval of all towed seismic array components (e.g. source array, streamer and associated equipment, etc.);
- seismic testing
- line run-ins, run-outs and turns; and
- operation of support vessels.

The petroleum activity commences when the seismic source is first deployed within the Operational Area and extends until the seismic source has been retrieved and the seismic vessel has exited the Operational Area. The EP applies to both planned activities in the operational area, and also activities which may be undertaken in response to unplanned event such as a fuel spill (which could occur outside of the operational area and within the environment that may be affected (EMBA) by an oil spill). Helicopters may be used for crew transfer throughout the survey, in an emergency or in response to an unplanned fuel spill.

This EP does not cover transit of the survey and support vessels to and from the survey location (i.e. from port to the operational area, and upon survey completion, from the operational areas to either port or another location). This EP does not cover periods when the survey and support vessel are not engaged in survey or associated activities, as at those times the vessel and/or helicopter are deemed to be operating under the Navigation Act 2012 and not performing a petroleum activity. These actions include:

- cyclone or dangerous weather avoidance;
- maintenance activities outside the Operational Area;
- port calls; and
- crew changes via helicopter/support vessel.

This EP contains:

- an overview of the environmental legislation applicable to the proposed activities;
- a description of proposed activities;
- a description of the existing environment;
- an identification of environmental aspects and potential environmental impacts and risks of described activities;
- appropriate environmental management and mitigation measures that will allow identified environmental impacts and risks to be avoided or reduced to ALARP and to an acceptable level;
- an implementation strategy, consisting of the processes and practices which will be implemented by Searcher to ensure that the environmental performance outcomes (EPOs) and environmental performance standards (EPSs) in this EP are met; and that the environmental impacts and risks are continually reduced to ALARP and acceptable levels The OPEP and associated Operational and Scientific Monitoring Plan (OSMP) are core elements of this implementation strategy;
- an outline of stakeholder consultation that has been undertaken prior to and during preparation of the EP and that will be undertaken prior to and throughout the life of the EP; and
- the EPOs, EPSs and measurement criteria that apply to the activity.

1.3 DESCRIPTION OF TITLEHOLDER

Searcher is an independent multi-client company providing high quality, non-exclusive seismic datasets and associated products to the global oil and gas industry. Searcher has extensive experience in the management of seismic acquisition and processing in a variety of geological and geographical settings. Searcher's head office is in South Perth, WA.

As required under Regulation 15 of the OPGGS(E)R, details for Searcher as both the Titleholder and nominated liaison person are as follows:

Contact:	Katrina Devlin
Name:	Searcher Seismic Pty Ltd
Business address:	Suite 1, Level 4, South Shore Centre, 85 South Perth Esplanade, South Perth, WA 6151
Telephone:	+61 8 9327 0300

Email address: k.devlin@searcherseismic.com
ABN: 16 117 264 347

NOPSEMA will be notified according to the requirements of Regulation 15(3) of the OPGGS(E)R of changes to the titleholder or nominated liaison. Searcher will submit in writing to the Regulator and within 30 days of the change, information regarding a change in:

- the titleholder;
- the titleholder's nominated liaison person;
- contact details for the titleholder; or
- contact details for the liaison person.

1.4 DEMONSTRATION OF FINANCIAL ASSURANCE

Under Regulation 5G of the OPGGS(E)R, NOPSEMA must be reasonably satisfied that Searcher is compliant with Section 571(2) of the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (OPGGS Act) and that the compliance is in a form acceptable to NOPSEMA. Searcher will submit a financial assurance declaration (as described in the Financial assurance for petroleum titles guideline Rev 7, 2019) to NOPSEMA. Searcher will review the level of financial assurance in the event of changes in the survey plan or circumstances that affect the insurance risk profile.

2 LEGISLATIVE AND REGULATORY FRAMEWORK

The legislative requirements established under relevant Australian Commonwealth (Section 2.1) WA State legislation (Section 2.2), and guidelines, standards and codes of practice (Section 2.3) relevant to the environmental management of the Possum 3D MSS are presented in this section.

2.1 COMMONWEALTH LEGISLATION

2.1.1 Offshore Petroleum and Greenhouse Gas Storage Act (OPGGSA)

The Australian Commonwealth OPGGS Act controls petroleum exploration and production activities beyond three nautical miles (nm) to the outer extent of the Australian Exclusive Economic Zone (EEZ) at 200 nm. NOPSEMA has the responsibility for administering the OPGGS Act. The OPGGS(E)R support the OPEGGS Act.

The objective of the OPGGS(E)R is to ensure that any petroleum or greenhouse gas activity in an offshore area is carried out in a manner consistent with the principles of ecologically sustainable development and in a manner by which the environmental impacts and risks of the activity are ALARP and of an acceptable level.

Pursuant to regulation 10A of the OPGGS(E)R an EP must:

a) be appropriate for the nature and scale of the activity;
b) demonstrate that the environmental impacts and risks of the activity will be reduced to ALARP ;
c) demonstrate that the environmental impacts and risks of the activity will be of an acceptable level;
d) provide for appropriate environmental performance outcomes, environmental performance standards and measurement criteria;
e) include appropriate implementation strategies (including an OPEP) and monitoring, recording and reporting arrangements;
f) demonstrate that the operator has carried out consultations and the measures that the operator has adopted, or proposes to adopt because of consultations are appropriate; and
g) comply with the OPGGSA and the OPGGS(E)R.

OPGGS(E) Regulation 3 states that any petroleum activity carried out in an offshore area is carried out in a manner consistent with the principles of ecologically sustainable development as set out in section 3A of the EPBC Act, as set out below:

a) decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations;
b) if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation;
c) the principle of inter-generational equity--that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations;
d) the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making; and
e) improved valuation, pricing and incentive mechanisms should be promoted.

2.1.2 Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

The Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) provides for the protection and management of nationally and internationally important flora, fauna, ecological communities, and heritage places. The EPBC Act is the Commonwealth Government's primary environmental legislation and is administered by the Department of the Agriculture, Water and the Environment (DAWE). The EPBC Act provides a legal framework for the protection of the environment in land and waters under control of the Commonwealth and provides that certain actions – in particular, actions that are likely to have a significant impact on matters of national environmental significance (MNES) – are subject to a rigorous assessment and approval process.

The EPBC Act is supported by a range of associated regulations and policies e.g. EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with Cetaceans, which details the caution zones, travel speeds, and maximum approach distances for vessels with regards to cetaceans (whales and dolphins). When a native species or ecological community is listed as 'threatened' under the EPBC Act, conservation advice is developed to assist in its recovery.

Where offshore petroleum activities have the potential to impact on MNES, an assessment of these impacts is required to be presented in the EP. MNES that may be present within the Possum 3D operational area and EMBA are listed in Appendix B and described in Section 4. Potential impacts to MNES due to the proposed activity are assessed in Section 6.

2.1.3 Additional Commonwealth Legislation

Table 2.1 describes additional Commonwealth legislation and its applicability to the activity.

Table 2.1 - Key applicable Australian Commonwealth statutes and regulations

Legislation	Summary	Relevance to the Possum 3D Activity and how they will be met
Aboriginal and Torres Strait Islander Heritage Protection Act 1984	This Act provides for the preservation and protection from injury or desecration areas and objects that are of significance to Aboriginal people, under which the Minister may make a declaration to protect such areas and objects. The Act also requires that the discovery of Aboriginal remains to be reported to the Minister.	Control measures relating to the protection of areas and objects that are of significance to Aboriginal people are included in the OPEP. Any discovery of Aboriginal remains made during the activity, or though oil spill response activities, will be reported to the Minister (via the police).
Australian Heritage Council Act 2003	This Act identifies areas of Australian heritage value listed on the Register of the National Estate and sets up the Australian Heritage Council and its functions.	There are no National Heritage Listed properties or Commonwealth Heritage Listed properties within the Possum 3D operational area. There is one National Heritage Listed place within the EMBA, the Mermaid Reef-Rowley Shoals Listed place.
Australian Maritime Safety Authority Act 1990	This Act specifies that the Australian Maritime Safety Authority's (AMSA) role includes protection of the marine environment from pollution from ships and other environmental damage caused by shipping. AMSA is responsible for administering the Marine Orders in Commonwealth waters.	Relevant to all vessel activity related to the activity. AMSA is also the designated Combat Agency for all vessel-sourced spills within Australian territorial waters.
Biosecurity Act 2015, Amendment (Ballast Water and Other Measures) Act 2017 and Regulations 2016	This Act manages the biosecurity risks associated with goods, people and conveyances entering Australia. The Act aims to reduce harm to animals, plant and human health, the environment, and the economy. In relation to vessels, it regulates the condition of vessels entering Australian waters with regards to ballast water and hull fouling. This Act provides for the *Australian Ballast Water Requirements* and complies with the *International Convention for the Control and Management of Ships' Ballast Water and Sediments 2004* which was entered into force on 8 September 2017.	Relevant to all vessels entering Australian waters. The Department of Agriculture enforces the Australian Ballast Water Management Requirements. Control measures relating to the management of biosecurity risks are included in Section 6.
Fisheries Management Act 1991	The Act aims to implement efficient and cost-effective fisheries management on behalf of the Commonwealth, ensure that the exploitation of fisheries resources and related activities are conducted in a manner consistent with the principles of Ecological Sustainable Development (ESD), maximise the net economic returns to the Australian community from the management of Australian fisheries, ensure accountability to the fishing industry and to the Australian community in Australian Fisheries Management Authority's (AFMA) management of Australian fisheries resources, and achieve government targets in relation to the recovery of the costs of AFMA	Impacts and risks to commercial fisheries that may be affected as part of the proposed activity are discussed in Section 6. Further details on the Act and oil spill response are described in the OPEP.

Legislation	Summary	Relevance to the Possum 3D Activity and how they will be met
Navigation Act 2012	This act regulates navigation and shipping activities, including Safety of Life at Sea (SOLAS). Several Marine Orders enacted under this Act apply directly to offshore petroleum exploration and production activities (including but not limited to): • Marine Order 21 (Safety and emergency arrangements) 2016 • Marine Order 27 (Safety of navigation and radio equipment) 2016 • Marine Order 28 (Operations standards and procedures) 2015 • Marine Order 30 (Prevention of collisions) 2016 • Marine Order 50 (Special purpose vessels) 2012 • Marine Order 91 (Marine pollution prevention—oil) 2014 • Marine Order 93 (Marine pollution prevention—noxious liquid substances) 2014 • Marine Order 94 (Marine pollution prevention—packaged harmful substances) 2014 • Marine Order 95 (Marine pollution prevention—garbage) 2018 • Marine Order 96 (Marine pollution prevention — sewage) 2018 • Marine Order 97 (Marine pollution prevention—air pollution) 2013 • Marine Order 98 (Marine pollution — anti-fouling systems) 2013	Applicable to all vessels used in the activity. Control measures relating to the navigation and prevention of pollution are included in Section 6.
Ozone Protection and Synthetic Greenhouse Gas Management Act 1989	This Act regulates the import, export and manufacture of ozone depleting substances, such as firefighting equipment and refrigerants.	Vessels undertaking this activity will have a register of ozone-depleting substances as appropriate where they are present. Relevant management measures are presented in Section 6.
Protection of the Sea (Harmful Antifouling Systems) Act 2006	This Act relates to the protection of the sea from the effects of harmful anti-fouling systems. It prohibits the use of harmful organotins in anti-fouling paints used on ships.	Australian vessels involved in the activity as described in Section 3 that meet the criteria of the Act will hold a current anti-fouling certificate and cannot use harmful anti-fouling products.
Protection of the Sea (Powers of Intervention) Act 1981 Protection of the Sea (Powers of Intervention) Regulations 1983	The Act authorises the Commonwealth to take measures for the purpose of protecting the sea from pollution by oil and other noxious substances discharged from ships. Also, the Act provides legal immunity for persons acting under an AMSA direction.	This Act may be relevant in the event of an unplanned oil or other noxious substance spill during the activity.

Legislation	Summary	Relevance to the Possum 3D Activity and how they will be met
Protection of the Sea (Prevention of Pollution from Ships) Act 1983 Protection of the Sea (Prevention of Pollution from Ships) (Orders) Regulations 1994	This Act relates to the protection of the sea from pollution by oil and other harmful substances discharged from ships. This Act disallows any harmful discharge of sewage, oil and noxious substances into the sea and sets the requirements for a shipboard waste management plan. This Act implements the requirements of MARPOL 73/78 Annex VI for shipping in Commonwealth waters. Annex VI requires an Australian vessel for more than 400 gross tonnage to have an air pollution prevention certificate. The following Marine Orders relating to marine pollution prevention have been put in place to give effect to relevant regulations of Annexes I, II, III, IV, V and VI of MARPOL 73/78: • Marine Order 91 (Marine pollution prevention—oil) 2014 • Marine Order 93 (Marine pollution prevention—noxious liquid substances) 2014 • Marine Order 94 (Marine pollution prevention—packaged harmful substances) 2014 • Marine Order 95 (Marine pollution prevention—garbage) 2018 • Marine Order 96 (Marine pollution prevention — sewage) 2018 • Marine Order 97 (Marine pollution prevention—air pollution) 2013 ships involved in petroleum activities in Australian waters are required to abide by the requirements under this Act.	Vessels undertaking this activity will adhere to the relevant Marine Orders by having in place and implementing where applicable the required certificates and plans. These, and other management measures related to pollution are detailed in Section 6 and the OPEP.
Underwater Cultural Heritage Act 2018	This Act protects shipwrecks and associated underwater cultural heritage items lying in territorial waters for 75 years or more. It is an offence to interfere with any shipwreck or underwater cultural heritage item covered by the Act. Anyone who finds the remains of an item of underwater cultural heritage, or an article associated with a such needs to notify the relevant authorities as soon as possible and no later than one week to give information about what has been found and its location.	There are no known underwater cultural heritage items within the Possum 3D operational area, however there are known shipwrecks within the wider EMBA as described in Section 4. Any discovery of underwater cultural heritage items will be reported to the WA Museum.

2.2 WESTERN AUSTRALIAN STATUTES AND REGULATIONS

Although the operational area is located within Commonwealth waters off WA, there are shoreline exposure areas of the EMBA that extend to shorelines in WA state waters (e.g. Bedwell and Cunningham Islets of the Rowley Shoals). Activities associated with a response to an unplanned event also have the potential to interact with values and sensitivities that are within the jurisdiction of WA. Table 2.2 provides key applicable Western Australian statutes and regulations to the activity.

Table 2.2 - Key applicable Western Australian statutes and regulations

Legislation	Summary	Relevance to the Possum 3D Activity
Animal Welfare Act 2002 and Animal Welfare (General) Regulations 2003	This Act is established to provide for the welfare, safety, and health of animals, to regulate the use of animals for scientific purposes and related purposes	This Act may be relevant that wildlife rescue and treatment is required following an unplanned hydrocarbon spill.
Aquatic Resources Management Act 2016	This Act is concerned with commercial exploitation and development of state fisheries and marine resources. Under the Act, development projects must be carried out so as to not adversely impact on fisheries or marine resources, including regulating bringing noxious fish into WA.	Impacts and risks to commercial fisheries that may be affected as part of the proposed activity are discussed in Section 6, with control measures presented therein. Further details on the Act and oil spill response are described in the OPEP.
Biodiversity Conservation Act 2016 and Regulations 2018	This Act provides for the conservation and protection of wildlife. Licences to take protected flora and fauna are required under this Act.	This Act may be relevant that wildlife rescue and treatment is required following an unplanned hydrocarbon spill.

Legislation	Summary	Relevance to the Possum 3D Activity
Conservation and Land Management Act 1984	This Act provides for the use, protection and management of certain public lands and waters and the flora and fauna within. It establishes authorities responsible for such protection.	This Act may be relevant following an unplanned hydrocarbon spill threatening state marine parks.
Contaminated Sites Act 2003 and Regulation 2006	This Act provides for the identification, recording, management and remediation of contaminated sites. Under the Act, a 'site' is an area of land or water in WA, including surface water, groundwater and offshore areas out to 3 nm. A site is 'contaminated' if it has a substance in it at above background concentrations, which presents or has the potential to present a risk of harm to human health or the environment.	This Act may be relevant following an unplanned hydrocarbon spill entering state waters.
Emergency Management Act 2005 and Regulations 2006	This Act provides for prompt and coordinated organization of emergency management in the State. Hazards captured under the Act include events that result in destruction of or damage to the environment. It establishes the State Emergency Management Committee, which is the peak management body in responding to emergencies of state significance and establishes obligations to persons to comply and give reasonable help to an officer operating under the Act.	This Act may be relevant following an unplanned hydrocarbon spill entering state waters.
Environmental Protection Act 1986	This is the principal Act relating to environmental protection in WA. It establishes the WA EPA and gives the EPA overall responsibility for the prevention, control and abatement of environmental pollution and for the conservation, preservation, protection, enhancement and management of the environment. Part 5 of the Act states that a person who causes pollution or environmental harms or allows pollution or environmental harm to be caused commits an offence.	This Act may be relevant following an unplanned hydrocarbon spill entering state waters.
Pollution of Waters by Oil and Noxious Substances Act 1987 and Regulations 1993	This Act provides for the protection of the sea and certain waters from pollution by oil and other noxious substances discharged from ships (as defined in the WA Marine Act). This Act prohibits the discharge of oil or noxious substances into state waters and provides for the removal of oil or any mixture containing oil from affected waters.	This Act may be relevant following an unplanned hydrocarbon spill entering state waters.
Western Australian Marine Act 1982 and Regulations 1985	This Act regulates navigation and shipping in WA waters.	All activity vessels traversing WA state waters must abide by the requirements of the Act regarding marine safety requirements. This Act may be relevant following an unplanned hydrocarbon spill entering state waters.

2.3 GUIDELINES, STANDARDS AND CODES OF PRACTICE

In addition to Australian legislation the guidelines, standards, codes of practice presented in Table 2.3 have been taken into account.

Table 2.3 - Key applicable industry guidelines, standards and codes

Guidelines, standards and codes	Summary
2016 Guidelines for the development of a ship energy efficiency management plan (IMO 2016).	Aimed at supporting implementation of the mandatory measures to increase energy efficiency and reduce greenhouse gas emissions from international shipping, paving the way for the regulations on Energy Efficiency Design Index and Ship Energy Efficiency Management Plan to be smoothly implemented by Administrations and industry.
Australian Ballast Water Management Requirements Version 8 (2020) (AWE 2020)	These guidelines state the mandatory ballast water requirements and provide information on ballast pump tests, ballast water reporting and ballast water exchange calculations, enforceable under the Commonwealth *Biosecurity Act 2015*.
Australian National Guidelines for Whale and Dolphin Watching (2017) Commonwealth Department of the Environment and Energy (DoEE)	The intent of these guidelines is to provide a framework that allows people to observe and interact with whales and dolphins in a way that does not cause harm to the animals.

Guidelines, standards and codes	Summary
Australian/New Zealand Standard 14001:2016 Environmental management systems – Requirements with guidance for use (Standards Australia/ Standards New Zealand 2016)	Specifies requirements for an environmental management system to enable an organization to develop and implement a policy and objectives which take into account legal requirements and other requirements to which the organization subscribes, and information about significant environmental aspects. It applies to those environmental aspects that the organization identifies as those which it can control and those which it can influence.
Code of Environmental Practice (2008) Australian Petroleum Production and Exploration Association (APPEA)	This code guides outcomes to be achieved when managing environmental impacts associated with petroleum exploration and production, including seismic surveys. It includes four basic recommendations to APPEA members undertaking activities: • Assess the risks to, and impacts on, the environment as an integral part of the planning process. • Reduce the impact of operations on the environment, public health and safety to ALARP and to an acceptable level by using the best available technology and management practices. • Consult with stakeholders regarding industry activities. • Develop and maintain a corporate culture of environmental awareness and commitment that supports the necessary management practices and technology, and their continuous improvement.
Department of Transport: Oil Spill Contingency Plan 2015 (WA DoT 2015)	Outlines the procedures and arrangements for responding to and recovering from Marine Oil Pollution (MOP) emergencies in State waters in accordance with WestPlan - MOP
Environmental Management in Oil and Gas Exploration and Production (1997) International Association of Oil and Gas Producers (OGP)	Provides an overview of the environmental issues and the technical and management approaches to achieving high environmental performance in oil and gas exploration and production.
Environmental Manual for Worldwide Geophysical Operations (2013) International Association of Geophysical Contractors (IAGC)	This manual provides best practice guidelines for environmental management of geophysical operations undertaken by the industry worldwide, including MSS.
EPBC Act Policy Statement 2.1 - Interaction between offshore seismic activities and whales (2008)	This policy statement provides: practical standards to minimise the risk of acoustic injury to whales; a framework that minimises the risk of biological consequences from acoustic disturbance from seismic sources to whales in biologically important habitat areas or during critical behaviours; and advice to titleholders conducting seismic surveys on their legal responsibilities under the EPBC Act.
*Guidance Note N-04750-GN1488 Oil Pollution Risk Management) (*NOPSEMA 2021)	Provides titleholders with clarification on the regulatory requirements for oil pollution risk assessment as well as the content and level of detail required in an OPEP which in turn supports the development of an acceptable EP submission.
Guidance Note N-04300-GN01660166 ALARP (NOPSEMA 2020a)	This guidance note addresses how the ALARP concept can be addressed.
Guidance Note N04750-GN1344 Environment plan content requirements (Revision 4, April 2019) (NOPSEMA 2020b)	This guidance note interprets the EP content requirements that need to be met and demonstrated under the OPGGS(E)R and provides advice in relation to EP content requirements, the regulatory intent of content requirements, core concepts that are fundamental to each key content requirement and associated EP content considerations.
Guideline GL1721 Environment plan decision making (Revision 6, November 2019) (NOPSEMA 2019c)	Describes how NOPSEMA evaluates the quality of EP submissions and contains detail about of 'factors that influence decisions' and 'considerations in making a decision'. It provides a tool for titleholders and stakeholders to understand regulatory decisions.
Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species (Resolution MEPC.207(62)) International Maritime Organization (IMO)	Sets out the IMO Member States' commitments to minimizing the transfer of invasive aquatic species through ship biofouling and are intended to provide a globally consistent approach to the management of biofouling.
Information Paper IPI765: Acoustic Impact Evaluation and Management (2018) (NOPSEMA)	This publication provides advice to titleholders to assist with preparing EPs for MSS activities, and in particular the components of an EP that relate to detailing, evaluating and managing impacts from acoustic emissions.
International Finance Corporation World Bank Group EHS Guidelines (IFC 2015) Part 1.3 Wastewater and ambient water quality	This guideline applies to projects that have either direct or indirect discharge of process wastewater, wastewater from utility operations or stormwater to the environment. It provides information on common techniques for wastewater management, water conservation, and reuse that can be applied to a wide range of industry sectors.

Guidelines, standards and codes	Summary
International Standards Organization 31000:2018 Risk Management – Guidelines (ISO 2018)	Provides principles, framework and a process for managing risk.
Matters of national environmental significance – Significant impact guidelines 1.1 EPBC Act 1999 Department of the Environment and Energy (DoEE 2013)	Guidelines to assist any person who proposes to take an action to decide whether or not they should submit a referral to the Australian Government Department of Agriculture, Water and the Environment for a decision by the Australian Government Environment Minister on whether assessment and approval is required under the EPBC Act.
National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (2009) Commonwealth Government	This guidance document provides a generic approach to a biofouling risk assessment and practical information on managing biofouling on hulls and niche areas.
National Light Pollution Guidelines for Wildlife – including marine turtles, seabirds, and migratory shorebirds 2020 Department of the Environment and Energy (DoEE) and Department of Biodiversity, Conservation and Attractions WA (DBCA)	The Guidelines outline the process to be followed where there is the potential for artificial lighting to affect wildlife. They apply to new projects, lighting upgrades (retrofitting) and where there is evidence of wildlife being affected by existing artificial light. The aim of the Guidelines is that artificial light will be managed so wildlife is: 1. Not disrupted within, nor displaced from, important habitat; and 2. Able to undertake critical behaviours such as foraging, reproduction and dispersal.
National Plan for Maritime Environmental Emergencies (NATPLAN) (AMSA 2017)	The National Plan sets out national arrangements, policies and principles for responding to maritime emergencies. This is how federal, state and territory response capabilities work together.
Oil & Gas UK Guidance on Risk Related Decision Making (Issue 2, July 2014) (OGUK 2014)	Guidelines to facilitate risk related decision making by providing a common understanding of the bases upon which risk related decisions are made. It provides a structured framework that enables business, technical and societal factors to be considered and used to establish a transparent and justifiable basis for decision making.
Operational and scientific monitoring programs information paper N-04700-IP1349 (Mar 2016) NOPSEMA	Provides general advice and information to assist titleholders to develop fit-for-purpose OSMPs and to demonstrate an appropriate degree of readiness to implement those programs in the event of an oil spill.
Procedure to Be Followed Whilst Offshore Seismic Survey Work Is Undertaken In The Vicinity Of Active Submarine Cable Systems *ICPC Recommendation No. 8* International Cable Protection Committee (ICPC)	Provides procedures for seismic survey operations in the vicinity of active submarine cable systems.
Safe Diving Distance from Seismic Surveying Operations (2019) The Diving Medical Advisory Committee (DMAC)	This publication provides guidance for safe diving distance from seismic survey operations and guidance on the pragmatic means of mitigating impacts to divers from seismic sound.
Seismic Surveys & Marine Mammals (2004) – Joint OGP/IAGC position paper OGP and IAGC	This document provides information associated with the potential effects of seismic surveys on marine mammals.
State Hazard Plan - Maritime Environmental Emergencies (MEE) (WA State Emergency Management Committee 2019)	Contains information relating to the arrangements for managing marine oil pollution and marine transport emergencies.
National Guidelines for Ramsar Wetlands	The Australian National Guidelines for Ramsar Wetlands have been developed to facilitate the improved management of Ramsar sites under then the Ramsar Convention in Australia. The guidelines facilitate maintenance of ecological character in line with Australia's commitments under the Ramsar Convention and responsibilities under the EPBC Act. The guidelines provide a framework for Ramsar Convention implementation in Australia and provide jurisdictions and other interested parties with guidance on the management of Ramsar sites.
The International Convention for the Prevention of Pollution from Ships (MARPOL)	The International Convention for the Prevention of Pollution from Ships (MARPOL) is the main international convention for addressing ship sourced pollution. Australia implements aspects of MARPOL through the Protection of the Sea (Prevention of Pollution from Ships) Act 1983 and the Navigation Act 2012.

Guidelines, standards and codes	Summary
The Oil and Gas Industry: Operating in Sensitive Environments (2003) International Petroleum Industry Environment and Conservation Association (IPIECA)	This publication demonstrates that minimal impact operations are achievable in a diverse range of social and environmental settings, actively encourages exchange of company experience and best practice, provides a basis for discussion with groups outside the industry and summarises a number of case studies.
Aquatic Biosecurity Solution Vessel-Check tool (DHI 2021)	Provides a tool for assessing the biofouling risk of vessels entering coastal waters.
WA Oiled Wildlife Response Plan V1.1 2014 (DBCA, AMOSC)	Provides guidance to Oiled Wildlife Response Agencies, both the DBCA and the Petroleum Industry, as to the approach to an Oiled Wildlife Marine Pollution Incident in WA.

2.4 INTERNATIONAL CONVENTIONS AND AGREEMENTS

Several international convention and agreements have been signed by Australia and are enacted by the legislation, statutes and regulations outlined above. The international conventions in Table 2.4 have been considered in the development of this EP.

Table 2.4 - Key applicable international conventions and agreements

International convention or agreement	Summary
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	An international agreement between governments which aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival.
International Convention for the Safety of Life at Sea (SOLAS), 1974	SOLAS Convention is to specify minimum standards for the construction, equipment and operation of ships, compatible with their safety.
International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978 (STCW)	The STCW sets the standards of competence for seafarers internationally.
International convention on the Control of Harmful Anti-fouling Systems on Ships (AFS Convention) 2001	IMO treaty whereby states agree to prohibit the use of harmful anti-fouling paints and other anti-fouling systems that contain harmful substances.
The Convention on Wetlands of International Importance (Ramsar Convention) and *National Guidelines for Ramsar Wetlands*	The Ramsar Convention's broad aims are to halt the worldwide loss of wetlands and to conserve, through wise use and management, those that remain. Australian National Guidelines for Ramsar Wetlands have been developed. The aim of the guidelines is to facilitate improved management of Ramsar sites and maintenance of ecological character, in line with Australia's commitments under the Ramsar Convention and responsibilities under the EPBC Act. The guidelines provide a framework for Ramsar Convention implementation in Australia and provide jurisdictions and other interested parties with guidance on the management of Ramsar sites.
The International Convention for the Prevention of Pollution from Ships (MARPOL)	MARPOL includes regulations aimed at preventing both accidental pollution and pollution from routine vessel operations. Australia implements MARPOL through the Protection of the Sea (Prevention of Pollution from Ships) Act 1983 and the Navigation Act 2012.
The Republic of Korea–Australia Migratory Bird Agreement (ROKAMBA)	Part of international efforts to conserve migratory birds of the East Asian – Australasian Flyway, along with bilateral migratory bird agreements between Australia and Japan (JAMBA, formed in 1974) and Australia and China (CAMBA, signed in 1986).

3 DESCRIPTION OF THE ACTIVITY

3.1 LOCATION OF THE ACTIVITY

The Possum 3D MSS operational area lies entirely in Commonwealth waters within the NWMR (Figure 1.1). The operational area is approximately 13,477 km^2 within which activities such as streamer deployment and retrieval, maintenance, recovery, and vessel manoeuvring (line turns) and some individual source array element testing during which corrective or preventative equipment maintenance may occur.

Full-fold seismic data will be acquired for a maximum area covering 5,400 km^2. The final full-fold acquisition area is yet to be defined but will be within a 8,584 km^2 broader active source area (hereafter called "acquisition area" within this EP, unless specifically indicated) (Figure 1.1) in water depths of 118 – 566 m. This is the area within which the seismic source will be active, including for soft start procedures and line run-outs. There will be no seismic source operation outside of the acquisition area, however individual source arrays may be tested within the operational area as outlined above. Boundary co-ordinates for the operational area are listed in Table 3.1 and for the acquisition area in Table 3.2. Passive magnetic and gravity field measurements may also be recorded simultaneously with the seismic data within the operational area (see Section 3.4).

Table 3.1 - Possum 3D MSS operational area coordinates

Longitude (E)	Latitude (S)
119° 14' 09.5135" E	17° 35' 48.6890" S
119° 24' 12.3661" E	17° 35' 35.4192" S
119° 45' 31.0716" E	17° 16' 38.5284" S
119° 45' 29.2682" E	16° 52' 53.6267" S
119° 45' 28.8612" E	16° 47' 33.0647" S
119° 53' 00.2830" E	16° 39' 58.8815" S
120° 01' 10.3513" E	16° 40' 01.7724" S
120° 01' 07.7448" E	16° 31' 42.8341" S
120° 14' 08.1238" E	16° 31' 34.4639" S
120° 14' 32.7660" E	18° 00' 46.2925" S
120° 08' 21.7465" E	18° 04' 45.2458" S
119° 53' 12.5126" E	18° 07' 36.1525" S
119° 00' 59.1120" E	18° 08' 06.6299" S
119° 01' 08.5223" E	17° 48' 54.9755" S
119° 05' 05.7300" E	17° 44' 56.1624" S
119° 10' 04.6884" E	17° 39' 55.1734" S
119° 14' 09.5135" E	17° 35' 48.6890" S

Datum: GCS_WGS84

Table 3.2 – Possum 3D MSS acquisition area coordinates

Longitude (E)	Latitude (S)
120° 09' 48.3452" E	16° 36' 29.8442" S
120° 10' 19.9223" E	18° 01' 15.5369" S
119° 59' 31.5658" E	18° 04' 37.3728" S
119° 13' 22.0184" E	18° 04' 36.5951" S
119° 13' 24.0593" E	17° 40' 44.8715" S
119° 47' 04.8498" E	17° 40' 42.5592" S
119° 47' 05.4248" E	17° 22' 09.5827" S
119° 47' 00.8030" E	16° 52' 59.3371" S
119° 55' 08.0532" E	16° 44' 51.3906" S
120° 06' 14.4232" E	16° 44' 54.3980" S
120° 06' 14.4233" E	16° 36' 32.2451" S
120° 09' 48.3452" E	16° 36' 29.8442" S

Datum: GCS_WGS84

At the closest point, the operational area is located approximately 210 km west of Broome on the mainland coast. The southeast corner is located more than 190 km northwest of Eighty Mile Beach and more than 320 km south of Scott Reef. The operational area is in close proximity to the Mermaid Reef Marine Park (Mermaid Reef MP) boundary (~4 km). Located in WA State waters, the boundary of Rowley Shoals Marine Park at Imperieuse Reef is approximately 12 km to the west of the operational area.

3.2 TIMING OF THE ACTIVITY

The activity window for this EP is between January 2022 and end of July 2023. The actual commencement date for the proposed Possum 3D MSS is yet to be finalised, as it is dependent on peak periods of environmental sensitivity (see Section 4), temporal constraints related to potential commercial fishing activities, survey vessel availability, client data requirements, fair sea state conditions and approvals from government regulatory agencies. The most appropriate acquisition window for the activity has been determined to be from December to end of July. The duration of the activity will not be longer than 70 days, including contingencies for weather and emergencies. COVID-19 restrictions on travel may potentially also impact on the timing of the survey.

3.3 SEISMIC PROGRAMME

3.3.1 Survey Parameters

In terms of technical methods and procedures, the activity is a typical 3D survey similar to most others conducted in Australian marine waters. No unique or unusual equipment or operations are proposed. The proposed surveys will be conducted using a purpose-built or converted seismic survey vessel. During the proposed activities, the survey vessel will traverse a series of pre-determined sail lines within the operational area at a speed of approximately 4 -6 knots (approximately 7-11 km/h). A racetrack configuration will be adopted to avoid excessive delays due to line turns and will consider the safe navigation of the survey vessel during turns whilst towing seismic equipment. With the exception of emergency conditions, no vessels or seismic equipment shall enter the Mermaid Reef Marine Park or Rowley Shoals Marine Park.

As the vessel travels along the survey lines, the acoustic source will produce a series of sound pulses every 5–8 seconds from sources spaced approximately 8.3-12.5 m along the sail line. These pulses will be directed downward through the water column and seabed. The transmitted sound is attenuated and reflected at geological boundaries. The reflected signals are detected using sensitive microphones arranged along a number of hydrophone cables (i.e. streamers) that are towed behind the survey vessel. The reflected sound is then processed to provide accurate information about the structure and composition of geological formations below the seabed and to identify hydrocarbon reservoirs.

The seismic streamer array will comprise eight to twelve solid streamers, each 7-9km in length. Streamer spacing will be 100-112.5 m apart, and sail line spacing will be 562-675 m apart (Table 3.3). The streamer depth will be 12-18m. The total size of the towed array is 1,012.5-1237.5 m wide and 8.2-9.5 km long. The triple source array (i.e. acoustic source) tow depth will be 6-8 m (±1 m). The operating pressure for the acoustic source array will be 2,000 psi. The acoustic source array will consist of a maximum volume of ~2380-2,820 in^3. Data will be acquired over 24-hour operations.

Table 3.3 – Possum 3D MSS Acquisition Parameters

Parameter	Possum 3D MSS
No. of streamers	8-12
Streamer length	7-9 km
Streamer line spacing	562 – 675 m
Survey spacing	100-112.5 m
Array width	1,012.5 – 1,237.5 m
Array length	8.2 – 9.5km
Size of air gun array (acoustic source)	2,380 – 2,820 in^3
Operating pressure	2,000 psi
Source interval	8.3-12.5 m
Source depth	6-8 m (±1 m)
Streamers' Depth	12-18m
Frequency range	2-250 Hz
Peak Source Levels (Broadside)	248.8 (LS,pk) (dB re 1 µPa m)
Peak Source Levels (Vertical)	254.9 (LS,pk) (dB re 1 µPa m)

3.3.2 Acoustic Source Justification

During the proposed activities, the seismic vessel will traverse a series of pre-determined sail lines at a speed of approximately 4 to 6 knots, emitting a series of acoustic pulses that will be directed down through the water column and seabed. The total volume of the planned seismic energy source is 2,380-2,820 in^3 with an operating pressure of approximately 2000 psi. The volume of the acoustic source was selected following a technical review of seismic surveys in similar geophysical and geological environments. The source volume selected is assessed to be the minimum volume possible to provide a strong signal (i.e. peak amplitude), better signal to sound output, deeper penetration and hence improved data quality so as to achieve the survey objectives.

Acoustic seismic pulses are of high energy and low frequency. Most of the sound energy produced by a seismic source is in the range 10-300 Hz, with highest levels at frequencies less than 100 Hz (McCauley 1994).

It is noted that actual source sound levels are less than the theoretical maximum because the theoretical sound pressure levels are computed on the basis of the seismic array being a point source, whereas it is not possible to be 1 m from all compressed air elements in a source array simultaneously. Thus, actual measured sound levels near the source will be lower, by a significant amount, than the theoretical levels quoted for the source.

The rate of signal attenuation from the seismic source will be dependent on local sound propagation characteristics. In a vertical sense this will be related to basin architecture and the nature of the overburden, and hence no general rule of thumb is applicable.

Lagrange-1 and Bedout-1 wells were drilled approximately 30km to the south if the Survey and the Searcher 2014 reprocessed Roebuck 2D (JN87) seismic data provides a tie of these wells into the Survey area. The wells total depth were 3,250mSS at approximately 2.2 seconds TWT and the zones of interest in the wells deepens significantly into the Survey area. To fully image the Triassic and Palaeozoic targets, along with the basin architecture, requires a source array ideally optimised to image down to 5 seconds TWT, estimated to be to approximately 8km in depth.

The nearby Capreolus MC3D survey was analysed for amplitude attenuation characteristics of the basin. This survey used a 3480 in^3 source (larger than that proposed for Possum 3D MSS), and so it was possible to use this survey to determine how much the source size could be reduced for the Possum 3D MSS. This suggests that acquisition with a maximum acoustic source of 2,820 in^3 will be sufficient seismic energy to illuminate the geological objective of the survey, whilst minimising environmental disturbance.

3.4 MAGNETIC AND GRAVITY DATA ACQUISITION

Passive magnetic and gravity field measurements may also be recorded simultaneously with the seismic measurements. The gravity system is installed within the seismic survey vessel (often in the instrument room) and comprises an integrated gravity meter and recording system. It passively records the strength and relative change in the earth's gravity field, which reflects changes in the underlying geology.

The strength of the local magnetic field is measured via a marine magnetometer sensor. The sensor is towed at a depth of 10 – 20 m by a high strength marine tow cable extending 120 – 140 m directly behind the survey vessel well within the 7-8 km length of the seismic array streamers (Table 3.3). A monitoring and recording device for the magnetometer is generally mounted in the instrument room on the seismic vessel.

3.5 VESSELS

3.5.1 Seismic Survey Vessel

The Possum 3D MSS will be acquired by a specialist geophysical company using a purpose-built or specifically-converted seismic survey vessel using methods and equipment typical for surveys conducted in Australian waters. No unique or unusual equipment or operations are proposed. With the exception of emergency conditions, the survey vessel will not anchor at sea and where possible the Mermaid and other reefs will be avoided. The specific seismic survey vessel for this survey is yet to be determined but will be similar to the vessel specifications provided in Table 3.4. It is anticipated that the seismic vessel will utilise either the port of Broome, Dampier or Port Hedland WA as the home port for the duration of the survey.

Table 3.4 – Possum 3D Seismic survey vessel specifications

Parameter	Possum 3D
Class	DNV 1A1
Length	~90-110 m
Beam	~19-25 m at the waterline
Draft	~6-8 m
Gross tonnage	~6,000-8,000 t
Total fuel capacity	~1,500-2,000 m^3
Largest single fuel tank capacity	≤ 325 m^3
Fuel type	MGO
Acquisition capability	12 x 10 km streamer
Complement (POB)	~50-70

3.5.2 Support Vessels

Up to two support vessels will be contracted to provide logistical and safety support throughout the proposed MSS. For example, the support vessel will maintain a safe distance between the acoustic array and other vessels, assisting with managing interactions and maintain communications with shipping and fishing activities as required, assist in the recovery of lost streamers and warning the survey vessel of in-water hazards 24/7. One support vessel will be capable of taking survey vessel under tow with all equipment deployed to keep survey vessel under control if required. Except for emergency conditions, the support vessels will not anchor at sea and where possible the Mermaid and other reefs will be avoided. The specific support/supply vessels for this survey are yet to be determined but will be similar to the vessel specifications provided in Table 3.5.

Table 3.5 – Possum 3D Seismic support/ supply vessel specifications

Parameter	Support vessel	Supply vessel
Length	50-60 m	25-30 m
Beam	10-15 m	8-10 m
Draft	<7 m	<7 m
Gross tonnage	1,000-1,200 t	~1,000 t
Fuel type	MGO/ MDO	MGO/ MDO
Complement (POB)	~50	~14

3.6 VESSEL REFUELLING

Refuelling and resupply at sea by a supply vessel is expected to occur approximately every 2 – 4 weeks during the survey (depending on the specific vessel and contractor) within or immediately adjacent to the operational area. In accordance with the contract vessel's procedures, refuelling will only take place during daylight hours and within strict weather limit guidelines and will not occur within a distance of 25 km from any emergent land or shallow water features (i.e. 30 m water depth).

4 DESCRIPTION OF THE ENVIRONMENT

This section addresses Regulation 13(2) of the OPGGS(E)R, which requires an EP to describe the existing EMBA of the activity, and detail relevant values and sensitivities of that environment, including its social, economic and cultural features. The below description of the existing environment includes the values and sensitivities within the operational area (as defined in Section 3) and the larger area that may be affected by the worst-case unplanned event. These values and sensitivities have been used for the risk assessment (Section 6).

4.1 EMBA DEFINITION

The outer extent of the EMBA was determined by the spatial extent of:

- The oil spill EMBA (Modelled): an unplanned hydrocarbon spill of 321 m^3 of marine diesel oil (MDO) as an instantaneous surface release due to vessel collision (the worst-case unplanned event). Stochastic modelling (RPS 2020) was used to determine the marine and shoreline environments that could be exposed to hydrocarbon concentrations which exceed thresholds (Section 6). The area covers an area significantly larger than the area that is likely to be affected by a single spill event as it encompasses the area predicted to be affected over 100 replicate spills per season for three seasons.
- The oil spill EMBA (Indicative): The extent of the oil spill EMBA (Modelled) of an instantaneous surface release was conducted from one location in the operational area judged by subject matter experts to be of the highest sensitivity (east of Mermaid Reef within the operational area). To indicate the full extent of an unplanned hydrocarbon spill within the operational area a simple shift of the modelling location to the extreme south-east of the operational area was conducted. Although the underlying forcing conditions would be different from this location (e.g. wind angle shift, currents steered by the bathymetry), the simple shift provides an indication of the extent of an unplanned oil spill if it were to occur in the south-eastern corner of the operational area to provide a worst-case predictive tool when combined with the modelled oil spill EMBA above.
- The underwater sound EMBA: Acoustic modelling was conducted by JASCO Applied Sciences (JASCO) to provide evidence for assessing marine fauna sound exposures (Appendix C). The largest extent of modelled impact was the maximum (Rmax) horizontal distances (km) from the 2820 in^3 array to modelled maximum-over-depth peak pressure level (PK) thresholds based on the NOAA Technical Guidance (NOAA 2018) for marine mammals, which was modelled as 62.9 km at a 168 dB re 1 µPa2.s (SEL_{24h}) sound exposure threshold for temporary threshold shift (TTS) in low frequency cetaceans (Appendix C). Thus, a conservative 63 km buffer from the acquisition area was set as the largest spatial extent of underwater sound impacts due to emissions from the seismic sound array.

The EMBA has been defined by overlaying the outer extent of the above exposure thresholds. Note that the low threshold may not produce ecologically significant impacts but has been used as a 'worst-case' predictive tool to set the outer limit of the EMBA (as per guidance provided in NOPSEMA Bulletin #1, 2019).

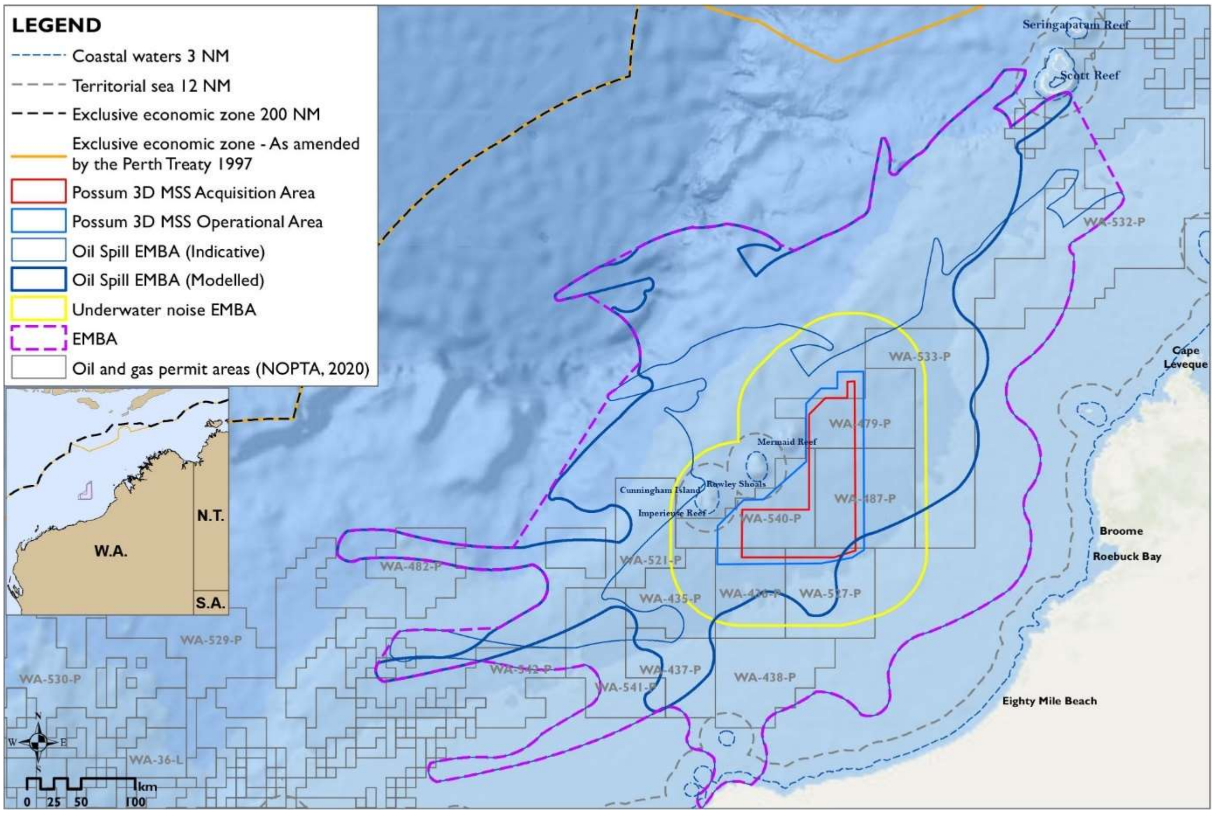


Figure 4.1 – Operational area and EMBA of the Possum 3D MSS

4.2 OPERATIONAL AREA SUMMARY

The operational area is located in deep waters that slope down from the western extent of the ancient coastline at 118 m to approximately 566 m depth. A featureless, sandy-mud seabed with sparse sessile organisms is likely to be the dominant substrate within the operational area. There are no emergent or outstanding oceanographic features within the operational area. The operational area overlaps the Multiple Use Zone of the Argo-Rowley Terrace Marine Park (Section 4.4.1.1), the Mermaid Reef and Commonwealth waters surrounding Rowley Shoals Key Ecological Feature (KEF; Section 4.4.2.1). The Mermaid Reef Marine Park (Section 4.4.1.1) and Rowley Shoals Marine Park (Section 4.4.1.2) are immediately adjacent to the operational area.

According to a search of the PMST database (Appendix B), 96 protected marine species may occur or are likely to occur within the operational area including:

- 25 cetaceans;
- five marine turtles;
- 12 sea snakes;
- 10 shark and rays;
- 31 fishes; and
- 13 seabird species.

There are Biologically Important Areas (BIA) for three species that overlap the operational area – the pygmy blue whale migration and distribution BIAs (Section 4.6.4.2), the white-tailed tropicbird breeding BIA and the little tern resting BIA (Section 4.6.4.6). There are no Native Title Determination Areas, Registered Aboriginal Sites, Commonwealth Heritage Listed places or World Heritage properties overlapping the operational area.

Fourteen commercial fisheries (Commonwealth and State) are permitted to fish within the operational area, however historical fishing effort is only recorded for two fisheries in the operational area (Section 4.7.1). One commercial shipping fairway traverses the operational area (Section 4.7.1.3) and there is one long-term research buoy within the operational area (Section 4.7.6).

Indicative timings for key environmental sensitivities including proposed petroleum exploration and production activities, climate considerations, and marine fauna potentially occurring within the operational area is provided in Table 4.1.

Table 4.1 - Indicative timings for key environmental sensitivities within the operational area

Aspect		2021												2022												2023						
	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J
Cyclone season																																
Coral spawning																																
Whale shark (migration)																																
Pygmy blue whales (migration)																																
White-tailed tropicbird (breeding at Rowley Shoals)																																
Little tern (resting BIA at Rowley Shoals)																																
SCUBA divers at Rowley Shoals																																
Spanish mackerel (spawning)																																
Scampi (spawning)																																
Kerauden Extension 3D MSS																																
Sauropod 3D MSS																																
Inpex 2D MSS																																

4.3 REGIONAL OVERVIEW

The Possum 3D MSS operational area lies within Commonwealth marine waters of the NWMR, which extends from offshore Kalbarri, WA, to the Northern Territory (NT) border and includes all waters 3 nm from the territorial baseline to the 200 nm EEZ boundary (Figure 4.1). The NWMR comprises approximately 1.07 million km^2 of sub-tropical and tropical waters in the Indian Ocean and Timor Sea (DEWHA 2008) and is distinguished by its predominantly wide continental shelf, very high tidal regimes (especially in the north), very high cyclone incidence, unique current systems and warm, low-nutrient surface waters. The region supports high species-richness of tropical Indo-west Pacific biota, but low levels of endemism (DSEWPaC 2012a).

Overall, the NWMR is relatively shallow, with water depths of less than 200 m over more than 40 % of its area. More than 50 % of the region has a depth less than 500 m, reflecting the region's large areas of continental shelf and slope (Baker *et al.* 2008). Extensive carbonate banks and coral reefs are important focal points for biodiversity in the region. A string of submerged carbonate banks and carbonate reefs on the outer North West Shelf includes Scott Reef, Seringapatam Reef and the Rowley Shoals.

4.4 PROTECTED AREAS

Values and sensitivities that occur within the operational area and EMBA were identified through online database search tools, including the Protected Matters Search Tool (PSMT) and Aboriginal Heritage Inquiry System (AHIS). Reports from these searches are provided in Appendix B. Species identified through the searches that, upon review, were identified as not occurring within the relevant area due to terrestrial based life cycles were removed from this assessment and are not discussed further.

Values and sensitivities (including those matters protected under Part 3 of the EPBC Act) that may be present within the operational area and EMBA are identified in Table 4.2. The International Union for Conservation of Nature (IUCN) reserve management principles used in the management of marine parks are described in Appendix D.

Table 4.2 - Protected Areas within the Possum 3D MSS Operational Area (OA) and EMBA

Conservation Value or Sensitivity	Presence	
	OA	EMBA
Australian Marine Parks (Section 4.4.1.1)	1	4

WA State Marine Parks (Section 4.4.1.2)	✗	1
Key Ecological Feature (Section 4.4.2)	1	5
Nationally Important Wetlands (Section 4.4.3)	✗	1
Protected Marine Species (Section 4.4.3) (including listed Threatened Species and Listed Migratory Species)	96	155
Listed Threatened Ecological Communities	✗	✘
World Heritage Property	✗	✗
Commonwealth Heritage List (Section 4.4.1.2)	✗	1
Ramsar Wetland	✗	✗

The operational area and EMBA overlaps the Territorial Sea Commonwealth marine area. The nearest World Heritage Property is the Ningaloo Coast, which is located more than 650 km from the operational area. The nearest Ramsar Wetlands are Roebuck Bay and Eighty Mile Beach, which are more than 220 km and 180 km from the operational area respectively and not within the EMBA.

4.4.1 Marine Parks and Reserves

The operational area overlaps the Argo-Rowley Terrace Marine Park (MP) (Commonwealth). The EMBA overlaps an additional three Commonwealth MP and one WA State MP (Table 4.3, Figure 4.2).

Table 4.3 – Marine Parks and Reserves within the Possum 3D MSS Operational Area (OA) and EMBA

Marine Park	OA	EMBA
Argo-Rowley Terrace MP (Commonwealth)	✓	✓
Eighty Mile Beach MP (Commonwealth)	✗	✓
Mermaid Reef MP (Commonwealth)	✗	✓
Kimberley MP (Commonwealth)	✗	✓
Rowley Shoals MP (WA State)	✗	✓

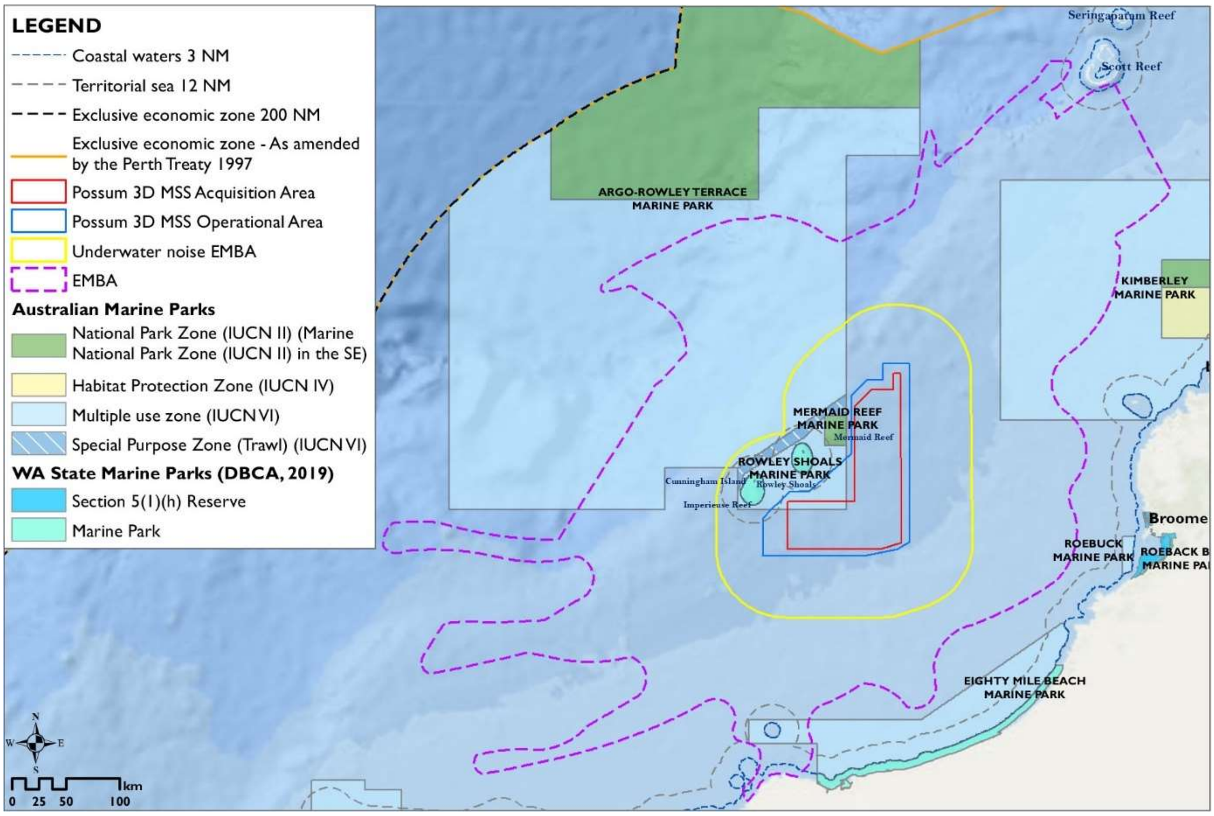


Figure 4.2 - Australian Marine Parks and WA State Marine Parks in the vicinity of the Possum 3D MSS

4.4.1.1 Australian Marine Parks

Argo-Rowley Terrace Marine Park

The Argo-Rowley Terrace MP is the largest marine reserve in the NWMR, with a total area of 146,003 km^2 (DoEE 2015c) and is divided into three zones (Figure 4.2):

- Multiple Use Zone – IUCN category VI (108,812 km^2)
- Special Purpose Zone (Trawl) – IUCN category VI (1,141 km^2)
- National Park Zone – IUCN category II (36,050 km^2).

Neither the operational area nor the EMBA overlap the National Park Zone and this is not discussed further.

The operational area overlaps the Multiple Use Zone of the Argo-Rowley Terrace MP - IUCN category VI (Figure 4.2). Water depths in this zone are more than 230 m. This zone is managed for the ecologically sustainable use of natural ecosystems while ensuring long-term protection of the biological diversity and natural values. Several activity types are permitted within this multiple use zone, including mining and seismic exploration. Conservation values of this zone include:

- the Mermaid Reef and the Commonwealth waters surrounding Rowley Shoals (an area of high biodiversity with enhanced productivity and feeding and breeding aggregations);
- connectivity between the existing Mermaid Reef Marine National Nature Reserve and reefs of the WA Rowley Shoals Marine Park and the deeper waters of the region;
- seafloor features including aprons and fans, canyons, continental rise, knolls/abyssal hills and the terrace and continental slope;
- Important area for sharks, which are found in abundance around the Rowley Shoals relative to other areas in the region; and
- important foraging areas for migratory seabirds and the endangered loggerhead turtle.

The EMBA overlaps the Special Purpose (Trawl) Zone – IUCN category VI of the Argo-Rowley Terrace MP. This zone is managed for the sustainability of the fisheries and research and monitoring within the areas. Several activity types are permitted within this zone however authorisation is required. Conservation values of this zone include:

- the Mermaid Reef and the Commonwealth waters surrounding Rowley Shoals (an area of high biodiversity with enhanced productivity and feeding and breeding aggregations);
- connectivity between the existing Mermaid Reef Marine National Nature Reserve and reefs of the WA Rowley Shoals Marine Park and the deeper waters of the region; and
- seafloor features including aprons and fans, canyons, continental rise, knolls/abyssal hills and the terrace and continental slope.

Eighty Mile Beach Marine Park

The Eighty Mile Beach MP is between Port Hedland and Broome, encompassing waters from the 3 nm mark in approximately 15 m water depth to 70 m, covering 10,785 km^2. The entire Eighty Mile Beach MP is zoned as Multiple Use Zone (IUCN VI). The MP is marginally overlapped by the EMBA.

Eighty Mile Beach MP contains only the marine area associated with Eighty Mile Beach- the adjacent WA Eighty Mile Beach MP includes the shoreline areas. The significance of the marine area is due to the habitats associated with three species of endangered sawfishes contained within the park, (Section 4.6.4.4) ecosystems that support the adjacent Ramsar site and marine turtle rookeries (Section 4.6.4.3) and the BIAs contained within the MP including that of avifauna (Section 4.6.4.6), marine turtles, sawfishes and humpback whales (Section 4.6.4.2) (DoEE 2018).

Cultural values of the MP include those of the sea country for the Nyangumarta, Karajarri and Ngarla people (Section 4.4.1.1). Other values of the MP include:

- being adjacent to the Eighty Mile Bach Ramsar site, recognised as one of the most important areas for migratory shorebirds in Australia;
- examples of ecosystems representative of the Northwest Shelf Province;
- diverse benthic and pelagic fish communities; and
- ancient coastline, thought to be an important migratory pathway for humpback whales.

The IUCN category VI 'Multiple Use' zone is managed for the ecologically sustainable use of natural ecosystems while ensuring long-term protection of the biological diversity and natural values. Several activity types are permitted within this multiple use zone, including mining and seismic exploration.

Kimberley Marine Park

The Kimberley MP comprises a total area of 74,469 km^2 that lies at the eastern extent of the EMBA. The park is divided into three zones:

- Multiple Use Zone – IUCN category VI
- Habitat Protection Zone – IUCN category IV
- Marine National Park Zone – ICUN category II.

The EMBA does not overlap the Habitat Protection Zone or the Marine National Park Zone and these are not discussed further.

The IUCN category VI 'Multiple Use' zone is managed for the ecologically sustainable use of natural ecosystems while ensuring long-term protection of the biological diversity and natural values. Several activity types are permitted within this multiple use zone, including mining and seismic exploration. Values of the zone that occur within the EMBA include:

- protection for the communities and habitats of waters offshore of the Kimberley coastline ranging in depth from less than 15 m down to 800 m;
- continental shelf, slope, plateau, pinnacle, terrace, banks and shoals and deep hole/valley seafloor features; and
- two KEFs: the ancient coastline (an area of enhanced productivity attracting baitfish which, in turn, supplies food for migrating species) and the continental slope demersal fish communities (the second richest area for demersal fish species in Australia).

Mermaid Reef Marine Park

The Mermaid Reef MP surrounds the most north-easterly atoll of the Rowley Shoals. The MP is within the Argo-Rowley Terrace MP (described above) and is adjacent to the Rowley Shoals MP (Section 4.4.1.2; Figure 4.2). The entire Mermaid Reef MP is zoned as IUCN II (National Park Zone) (DoEE 2018). The entire MP falls within the EMBA.

Mermaid Reef is one of three atolls forming the Rowley Shoals. Mermaid Reef is 14.5 km long and 7.6 km wide. The total area is approximately 539 km^2, and the average depth of its lagoon is 20 m (DNP 2013). The major marine habitats of Mermaid Reef are classified as sand cay, lagoon, submerged sand, deep reef flat and emergent areas. A biological description of Mermaid Reef and the Rowley Shoals is provided in Section 4.6.2.3.

The national and international significance of the Mermaid Reef MP is based on its pristine character, coral formations, geomorphic features, and diverse marine life. The environmental values are its biodiversity, the marine ecosystems on which this biodiversity depends and the high-water quality (DNP 2013). The coral communities of Mermaid Reef are one of the values of the Mermaid Reef MP and can exist over a great range of depth due to the clear waters (see Section 4.6.2.3). Other values of the MP include:

- best geological example of shelf atolls;
- water quality;
- rich and diverse marine communities/habitats (biodiversity);
- pristine, undisturbed marine communities and habitats, e.g. corals;
- high abundance of marine fauna, e.g. fishes;
- wilderness character; and
- cultural heritage (shipwreck *Lively,* Section 4.4.1).

The IUCN category II 'National Park' applies to areas that protect large-scale ecological processes and provide a foundation for environmentally compatible opportunities including spiritual, recreational and scientific visitation. Given its remote location, the primary influences on water quality are oceanographic currents, cyclones and the impacts of human visitation. Mermaid Reef MP is visited by divers, fishers and scientists, all of whom must arrive by vessels which produce sound and emissions and utilise moorings. The strategic objectives for managing Mermaid Reef are aligned to manage and protect the area for scientific research and environmental monitoring. The management plan lists higher water temperatures, increased frequency and severity of cyclones, changes to oceanic currents and increased ocean acidification as possible threats to Mermaid Reef.

4.4.1.2 WA State Marine Parks

Rowley Shoals Marine Park

The Rowley Shoals MP falls within the EMBA. The MP (gazetted as a Class A Marine Reserve in 1990) falls under State jurisdiction due to the presence of emergent land (Bedwell Islet at Clerke Reef and Cunningham Islet at Imperieuse Reef). The extent of the MP runs to the limit of WA coastal waters of the emergent land (3 nm). The operational area does not overlap the Rowley Shoals MP; however the whole MP is within the EMBA.

The Rowley Shoals MP is characterised by intertidal and subtidal coral reefs, diverse marine fauna and high-water quality. These attributes and the low level of use contribute to the Park's unique wilderness qualities, which are a significant attraction for visitors. The remoteness of Rowley Shoals and low use ensured that the marine environment is in a near natural state, particularly relative to other reefs in the Indo-West Pacific region which are subject to intense, human pressures and destructive fishing practices. For a biological description of the Rowley Shoals see Section 4.6.2.3.

The Rowley Shoals are recorded to contain numerous fish, echinoderm and coral species new to WA (Gilmour *et al.* 2007 as cited in DEWHA 2008) reflecting the significant differences between the offshore Indo-Pacific fauna and inshore WA coastal fauna. Therefore, the faunal assemblages of the Rowley Shoals Marine Park are regionally significant, as they contain large numbers of species not found in the more turbid coastal environments of tropical WA (DEC 2007).

DBCA is responsible for the management of marine conservation reserves under provisions of the Conservation and Land Management Act 1984 (DEC 2007). Management objectives and strategies promote conservation, science and education, public participation and recreational and commercial uses within and external to the park. As such, management actions conserve the ecological and social values of the marine park, and designated zones maintain the environmental values and compatible activities and purposes of the park, including sanctuary, recreation, special purpose and general use zones (Figure 4.3). It should be noted that seismic activities could occur within all areas of the park, including sanctuary zones, if assessed accordingly under the *Environment Protection Act 1986*, however as the Possum 3D MSS does not overlap the park this assessment is not required.

A strategic objective of the Rowley Shoals Marine Park Management Plan 2007-2017 (DEC 2007) is to maintain the marine biodiversity of the Marine Park and to maintain its ecological integrity and social values. To help achieve this, the Park has been zoned based on:

- the value of the Shoals as an international coral reef reference site; and
- recognition that a key value of the Shoals is wilderness and it relies on the area having a high degree of naturalness (e.g. presence of large fish).

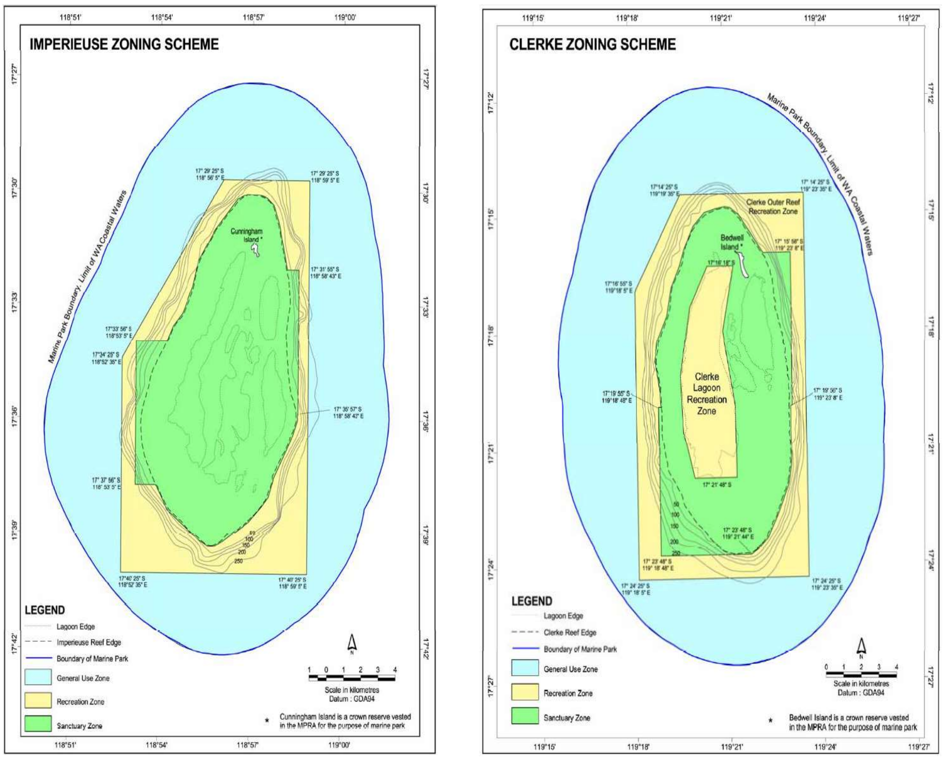


Figure 4.3 –Zoning Schemes of Imperieuse Reef (left) and Clerke Reef (right) in the Rowley Shoals Marine Park (DEC 2007)

Table 4.4 – Relevant Values and Management Objectives of the Rowley Shoals Marine Park (DEC 2007)

Value	Management Objective	Target
Geology and Geomorphology	To ensure the structural complexity of the Park's geomorphology is not significantly affected by human activities.	No change of seabed structural complexity as a result of human activity in the Park.
Water Quality	To ensure that the water quality of the Marine Park is not significantly impacted by sewage discharge from boats.	No change in water quality of all Park waters from background levels as a result of human activity in the Park.
Intertidal coral reef communities	To ensure species diversity and abundance of marine flora and fauna on the intertidal coral reef communities of the Park are not significantly impacted by reef-walking and collecting activities.	No loss of intertidal coral reef community diversity as a result of human activity in the Park. No loss of living intertidal coral reef community abundance* as a result of human activity in the Park.
Subtidal coral reef communities	To reduce damage to coral communities caused by mooring and anchoring activities.	No loss of subtidal coral reef community diversity as a result of human activity in the Park. No loss of living subtidal coral community abundance* as a result of human activity in the Park.
Invertebrates (excluding corals)	To ensure that invertebrate diversity and abundance are not significantly impacted by recreational fishing and from illegal fishing activities in the Park.	No loss of invertebrate species diversity as a result of human activity in the Park. No loss of protected invertebrate species abundance* as a result of human activity in the Park. Abundance and size composition of invertebrate species in sanctuary zones to be at natural** levels. Management targets for abundance of targeted invertebrate species in all other areas to be determined in consultation with the Department of Primary Industries and Regional Development (DPIRD) and peak bodies.
Finfish	To develop an understanding of the finfish diversity and abundance in the Park.	No loss of finfish species diversity as a result of human activity in the Park. No loss of protected finfish species abundance* as a result of human activity in the Park. Abundance and size composition of finfish species in sanctuary zones to be at natural** levels Management targets for abundance of targeted finfish species in all other areas to be determined in consultation with DPRID and peak bodies.
Turtles	To gain an increased understanding of the importance of habitats within the Park for turtles.	No loss of turtle diversity as a result of human activity in the Park. No loss in turtle abundance* as a result of human activity in the Park.
Seabirds	To ensure that breeding red–tailed tropicbirds on Bedwell Islet are not significantly disturbed by human activity.	No loss of seabird diversity as a result of human activity in the Park. No loss of seabird abundance* as a result of human activity in the Park.
Cetaceans	To gain an increased understanding of the use of the Park by cetaceans.	No loss of cetacean diversity as a result of human activity in Park. No loss of cetacean abundance* as a result of human activity in the Park.

*In this context a loss or change in "abundance" or "biomass" excludes losses of a minor, transient or accidental nature. This qualification does not apply to seabirds, turtles and cetaceans where minor or transient losses would be unacceptable (but does not apply to losses due to accidents)

**"Natural" in this case refers to the abundance that would occur in areas that are undisturbed and/or unexploited by human activities.

4.4.2 Key Ecological Features

One KEF is marginally overlapped by the operational area: The Mermaid Reef and Commonwealth waters surrounding Rowley Shoals KEF. Four other KEF's fall within the wider EMBA (Table 4.5; Figure 4.4).

Table 4.5 – KEFs within the Possum 3D MSS Operational Area and EMBA (DAWE 2020)

KEF	Values	Operational Area	EMBA
Mermaid Reef and Commonwealth waters surrounding Rowley Shoals	High productivity and aggregations of marine life.	✓	✓
Ancient Coastline at 125 m depth contour	Unique seafloor feature with ecological properties of regional significance.	✗	✓
Continental slope demersal fish communities	High levels of endemism.	✗	✓

KEF	Values	Operational Area	EMBA
Glomar Shoals	Important area for a number of commercial and recreational fish species such as rankin cod, brown striped snapper, red emperor, crimson snapper, bream and yellow-spotted triggerfish.	✗	✓
Seringapatam Reef and Commonwealth Waters in the Scott Reef Complex	Regionally important in supporting diverse aggregations of marine life, high levels of primary productivity and species richness.	✗	✓

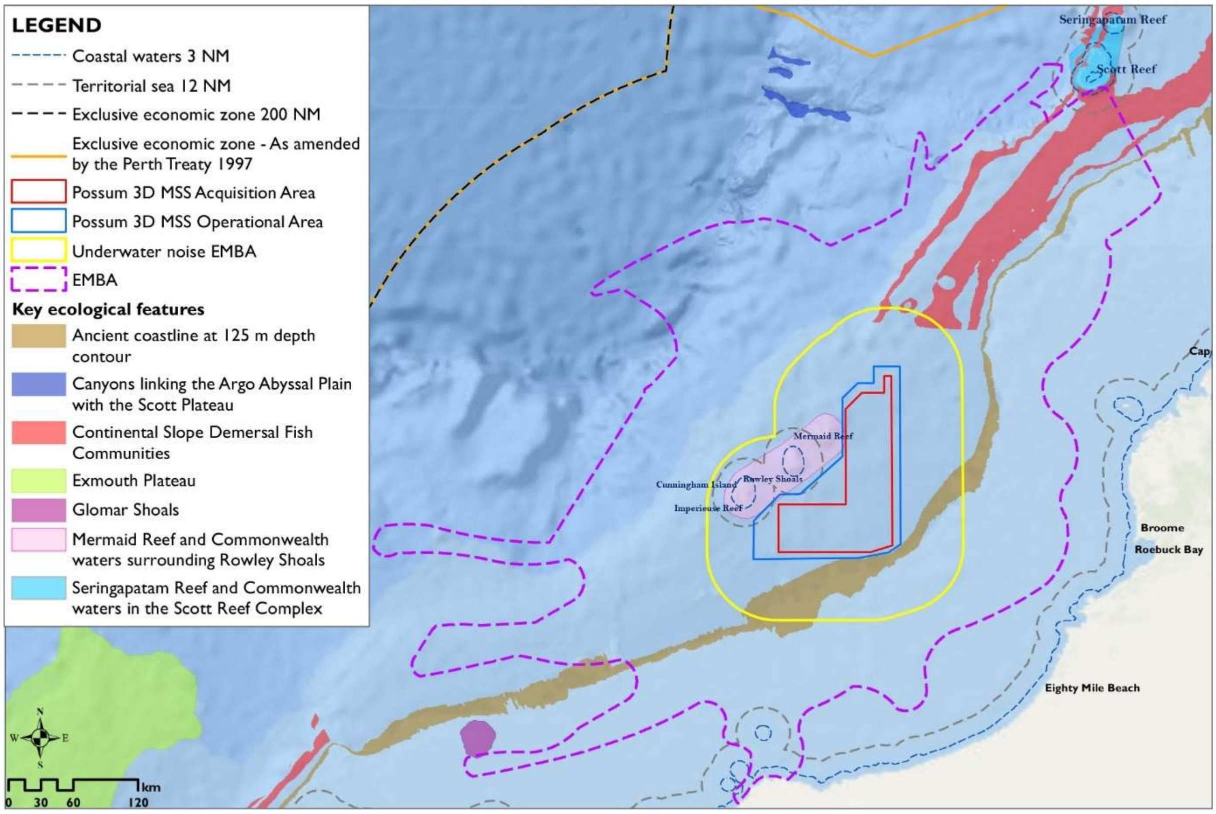


Figure 4.4 - Possum 3D MSS Operational Area, EMBA and KEFs

4.4.2.1 Mermaid Reef and Commonwealth Waters Surrounding the Rowley Shoals

The KEF's total area is more than 4,740 km^2, and of this, the operational area overlaps the KEF by less than 1%. The acquisition area does not overlap this KEF but is approximately 670 m from the KEF boundary. The main features of the system (i.e. reef lagoon at 40 m contour) are associated with the coral reef communities and are approximately 8 km away from the boundary of the operational area.

The Mermaid Reef and Commonwealth waters surrounding the Rowley Shoals KEF includes all existing State and Australian Marine Parks plus adjacent apron/fan features, within a 6 nm buffer of the reef features. The Rowley Shoals are a collection of three atoll reefs: Clerke, Imperieuse and Mermaid Reefs. Together, Imperieuse and Clerke Reefs constitute the Rowley Shoals Marine Park, (Section 4.4.1.2) and Mermaid Reef is within the Mermaid Reef MP (see Section 4.4.1.1). The value of the KEF is described as the 'enhanced productivity and high species richness, that apply to both the benthic and pelagic habitats within the feature' (DAWE 2020). The regional importance of the atolls is based on high species diversity, enhanced productivity, and aggregations of marine life. For a biological description of Mermaid Reef and the Rowley Shoals see Section 4.6.2.3.

The management plan for the NWMR does not identify potential pressures on this KEF as being "*of concern*". However, there are several potential pressures on this KEF identified as being "*of potential concern*", such as sea level rise, changes in sea temperatures, ocean acidification, physical habitat modification, oil pollution and invasive species. The potential pressure of sound pollution on this KEF is "*not of concern*" (DSEWPaC 2012a).

4.4.2.2 Ancient Coastline at 125 m isobath

The operational area does not overlap the Ancient Coastline KEF, however the EMBA does. The closest point of this KEF is 500 m from the operational area and 4.4 km from the acquisition area.

The Ancient Coastline KEF is recognised for its biodiversity values in both benthic and pelagic habitats (DSEWPaC 2012a). The NWMR shelf contains terraces and steps that reflect sea level changes that occurred over the last 100,000 years, the most prominent being an escarpment along the North-West Shelf (NWS) and Sahul Shelf at a depth of 125 m. The ancient submerged coastline provides areas of hard substrate contributing to higher diversity and enhanced species richness than soft sediment habitats. Hard substrate fauna in the bioregion includes sponges, corals, crinoids, molluscs, echinoderms and other benthic invertebrates. The escarpment may also facilitate increased availability of nutrients off the Pilbara coast by interacting with internal waves or regional mixing associated with seasonal changes in currents and winds, thereby creating small, localised upwellings and enhancing vertical mixing of water layers. The enhanced productivity attracts larger marine fauna, such as whale sharks and large pelagic fish (DEWHA 2007), and humpback whales migrate along the ancient coastline (DNP 2013).

The Marine Bioregional Plan (MBP) for the NWMR does not identify potential pressures on this KEF as being "*of concern*". However, there are several potential pressures on this KEF identified as being "*of potential concern*", such as ocean acidification, extraction of living resources, oil pollution and invasive species. The potential pressure of sound pollution on this KEF is "*of less concern*" (DSEWPaC 2012a).

4.4.2.3 Continental Slope Demersal Fish Communities

The operational area does not overlap the Continental Slope Demersal Fish Communities KEF, however the EMBA does overlap the southern end of the KEF. The Continental Slope Demersal Fish Communities are a rich assemblage of ~500 fish species, of which 76 are endemic to the bioregion (DSEWPaC 2012a). The demersal fish species occupy two distinct demersal community types (biomes): the upper slope in water depths of 225–500 m, and the mid–slope in water depths of 750–1,000 m. Although the reasons for the high levels of endemism are not fully understood, the presence of fish diversity and high numbers of endemic species suggest that important interactions occur between the physical processes and trophic structures (DNP 2013).

The MBP for the NWMR does not identify potential pressures on this KEF as being "*of concern*". However, there are several potential pressures on this KEF identified as being "*of potential concern*", such as changes in sea temperatures, ocean acidification, physical habitat modification and bycatch. The potential pressure of sound pollution on this KEF is "*not of concern*" (DAWE 2020).

4.4.2.4 Glomar Shoals

The operational area does not overlap the Glomar Shoals KEF, however the indicative EMBA overlaps it marginally (Figure 4.4). The Glomar Shoals KEF is important regionally as it is an area indicated to be of high productivity and importance for several commercial and recreational fish species including rankin cod, red emperor, crimson snapper, bream and yellow-spotted triggerfish (DAWE 2020). The shoals rise to 33-77 m and have a high concentration of coarse marine sediment consisting of coralline algae and shells.

No pressures are identified as "*of concern*" to the shoals, however of "*potential concern*" is changes in sea temperature, ocean acidification, extraction of living resources and invasive species (DAWE 2020).

4.4.2.5 Seringapatam Reef and Commonwealth Waters in the Scott Reef Complex

The operational area does not overlap the Seringapatam Reef and Commonwealth Waters in the Scott Reef Complex KEF however, EMBA overlaps it marginally (Figure 4.4). The Seringapatam Reef and Commonwealth Waters in the Scott Reef Complex KEF is regionally important in supporting diverse marine life. The reefs rise from 300-700 m in a series of submerged platforms that total 2,148 km^2. Seringapatam Reef and Scott Reef are areas of high primary productivity that attracts seasonal aggregations of whale sharks, humpback whales and sea snakes. Two species of marine turtle have rookeries on Sandy Islet, part of the Scott Reef South complex (DAWE 2020).

The MBP for the NWMR identifies the extraction of living resources by traditional Indonesian fishermen as being *"of concern"*. Pressures of "*potential concern*" include sea level rise, sea surface temperature changes, ocean acidification as a result of climate change, marine debris, physical habitat modification, oil pollution and invasive species (DAWE 2020).

4.4.3 Nationally Important Wetlands

Mermaid Reef Marine Park (Section 4.4.1.1) is considered a Nationally Important Wetland (NIW) in Australia. NIW are determined by a set of criteria developed by the ANZECC Wetlands Network. Mermaid Reef is considered a class A NIW

(Marine and coastal zone wetland). Management and conservation of the NIW falls under the NWMR Marine Park Management Plan (DoEE 2018a), the values of which are described in Section 4.4.1.1.

4.4.4 Heritage

4.4.4.1 Cultural Heritage

A search using the AHIS indicated there are no Native Title Determination Areas or Registered Aboriginal Sites overlapping the operational area (Appendix B).

There is no registered Aboriginal Site listed within the EMBA (APPENDIX B). There is one registered other Heritage Place marginally overlapping the wider EMBA, ID 20621 Bedout Island of type Mythological, Natural Feature (APPENDIX B) withinthe Native Title Determination Area Ngarla and Ngarla #2 (Determination Area A). The determination area covers the land and waters in the Pilbara region near Port Hedland, extending north of Bedout Island held in trust by the body corporate Wanparta Aboriginal Corporation (FCA 2007).

Under the *Historic Shipwrecks Act 1976* (Commonwealth), all historic wrecks and associated relics older than 75 years are protected if located in waters from the Low Water Mark (LWM) out to the continental shelf edge (DoE 2015e). A search of the National Shipwrecks Database (DoE 2015e) indicated that there is one shipwreck located in the vicinity of the operational area. The *Lively* is a 240 t sailing vessel that wrecked near Mermaid Reef in 1810. It is located approximately 17 km from the western boundary of the operational area (DoEE 2015e).

4.4.4.2 Commonwealth Heritage List

There are no Commonwealth Heritage Listed areas within the operational area. Mermaid Reef is the only place listed on the Commonwealth Heritage List that is in close proximity to the operational area: Mermaid Reef - Rowley Shoals, approximately 4 km away, Listed Place (22/06/2004) Place ID 105255, Place File No 5/09/210/0033.

4.5 PHYSICAL ENVIRONMENT

4.5.1 Climate

Two seasons characterise the NWMR: winter (May–August) and summer (September–April) with a transitional period between. Winter seasons are characterised by clear skies, fine weather and predominantly strong east to southeast winds and infrequent rain. There is a seasonal reversal in wind direction, with summer winds more variable, but predominantly coming from a west to southwest direction. Weather is largely controlled by seasonal oscillation of an anti-cyclonic belt. The region exhibits monsoonal climatic patterns characterised by a pronounced (summer) cyclone season between December and March (DEWHA 2008).

The Kimberley region is subject to episodic offshore cyclonic activity, where cyclones generate offshore but move south, rarely crossing the coastline until the Pilbara region (DEWHA 2007). On average, two to three tropical cyclones occur during each tropical cyclone season, primarily from December–April, although cyclones have been recorded as late as June (BoM 2016a). Tropical cyclones are unpredictable in occurrence, intensity and behaviour, but can generate extreme seas and swells, and localised wind gusts over 150 km/hr.

4.5.2 Oceanography

Overall, the NWMR is relatively shallow, with more than 50% of the region at depths less than 500 m. Within the operational area the depth ranges from 118 m (just beyond the Ancient Coastline to the south of the operational area, see Section 4.4.2.2) to approximately 566 m in the north of the operational area (Figure 4.5).

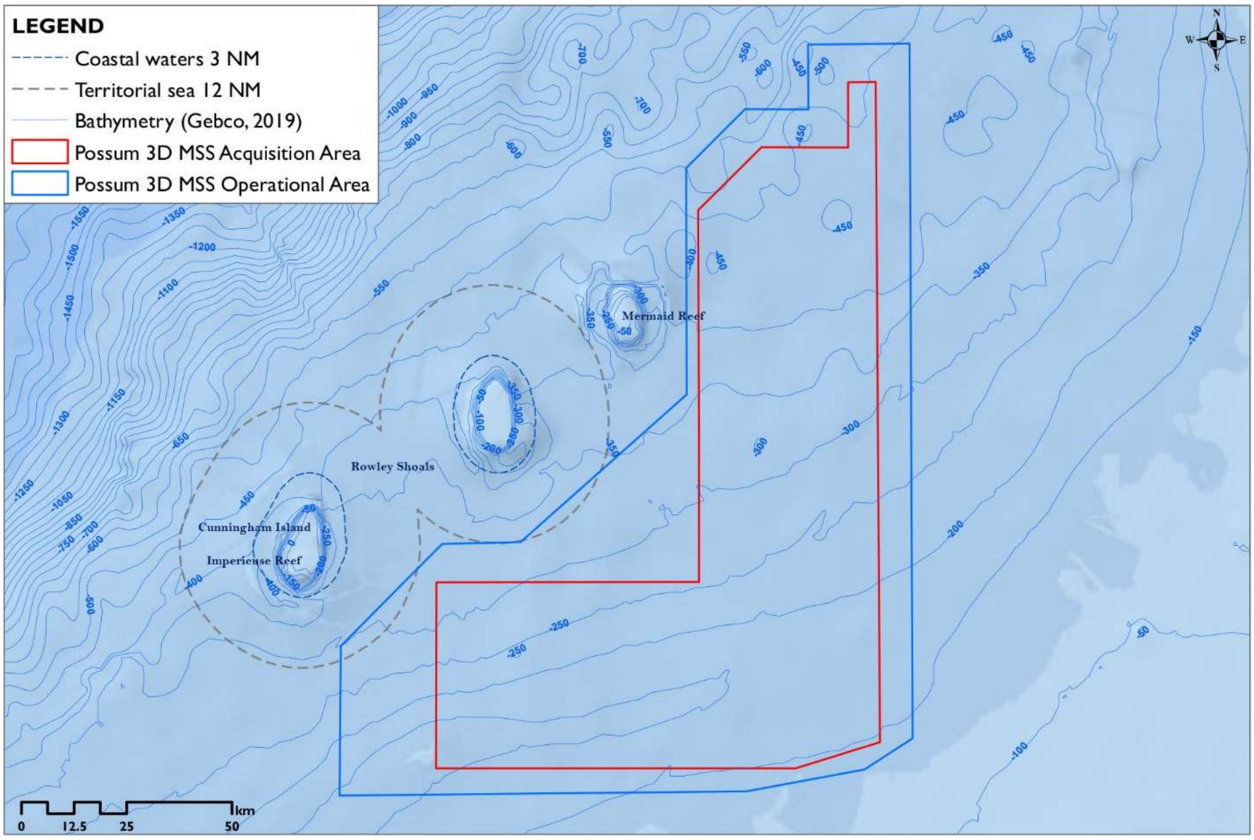


Figure 4.5 - Bathymetry of the Possum 3D MSS operational area

Ocean currents, temperature, salinity and other water column properties are major drivers of marine ecosystems. Depth is the primary driver in the differences between inshore and offshore waters. As the NWMR is relatively shallow, surface currents exert a strong influence over the region's biophysical and ecological processes (Figure 4.6; DEWHA 2008). Oceanographic processes are also a key driver in the composition of marine environments, including its physical and chemical composition and temperature and provides the link between oceanic systems.

The Kimberley region is a tropical marine realm, with warm temperatures between 26–28°C, and slightly lowered salinity levels characteristic of waters proximal to the Indonesian Throughflow Current. Offshore areas have clear waters due to low nutrient levels and no continental sediment input. The waters from the Eastern Indian Ocean combined with the input of waters derived from the Indonesian Throughflow Current result in sea levels in the tropics being ~0.5 m higher than along the southern coast of Australia (Pearce & Griffiths 1991, as cited in Collins & Testa 2010). The significant difference in steric height between the Pacific and Indian Oceans drives Pacific waters through the Indonesian archipelago via the Indonesian Throughflow and into the Indian Ocean. A portion of these waters eventually travel poleward via a strong alongshore pressure gradient. This pressure gradient is not present along the eastern edge of other major oceans and makes the WA system unique globally (DEWHA 2007).

The South Equatorial Current and Eastern Gyral Current intensify from July–September (DEWHA 2007). Similarly, the Leeuwin Current is strongest in autumn, and diminishes during the North-west Monsoon in summer (December–March). This complex system of ocean currents changes between seasons and between years, generally resulting in the surface waters being warm, nutrient poor and of low salinity (DEWHA 2008). During the south-east trade winds (April–September), the predominant direction of the ocean current is west-southwest. In the monsoon season (December–March), winds come from the northwest or west, and the direction of the ocean current reverses, becoming east-northeast. The mean rate of ocean currents throughout the year is usually less than 0.5 knots (Skewes *et al.* 1999).

The NWMR experiences highly-variable tides with heights increasing from south to north and corresponding with the increase in shelf width. Tides can be broadly categorised as semi-diurnal with a spring/neap cycle. In the Kimberley region, the daily tidal range is up to 10 m during spring tides and less than 3 m during some neap tides. Tides and winds strongly influence water flow in the coastal zone and over the inner to mid-shelf, whereas the large-scale regional circulation influences flow over the outer-shelf, slope, rise and deeper waters. The Kimberley region's tidal range is associated with the generation of internal waves, which are likely to impact nutrient mixing in the region along with stability in sediments (DEWHA 2008).

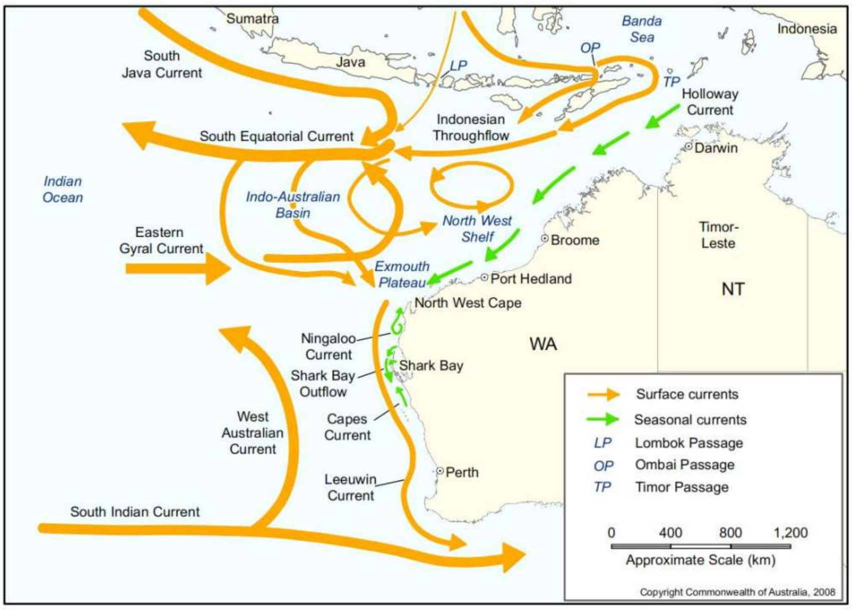


Figure 4.6 – Regional Oceanography and Surface Currents of the NWMR (modified from DEWHA 2007).

4.5.3 Geology and Sedimentology

The NWMR is composed primarily of continental slope and continental shelf. Other features (such as canyons, plateaux, terraces, ridges, reefs, banks and shoals) occupy less space in the region but have relatively high importance for productivity and biodiversity (DEWHA 2008). Over half of the total area of banks and shoals across Australia's marine jurisdiction occur within the NWMR.

The NWMR sediment is dominated by marine carbonates (on average 60%) with the highest carbonate content occurring on the shelf, including areas associated with reefs and algal banks/shoals. These shallow sediments contain authigenic phosphate and glauconite, indicating upwelling (Collins 2011; Figure 4.7). The deep areas of the abyssal plain/deep ocean are muddy, and any potential particulate carbonate content would have been removed through dissolution as it sank beneath the carbonate compensation depth (DEWHA 2007). A plume of lagoon sediment from Mermaid Reef was detected at 400 m (Collins 2002). Sediment transport on the shelf is largely influenced by tidal currents, while on the slope and abyssal plains, it is mostly influenced by large ocean currents and slope processes (Baker *et al.* 2008).

The outer parts of the shelf are characterized by the widespread occurrence of coarse, carbonate sediments and generally not buried by the fine-grained terrigenous sediments restricted to the coastal/inner shelf depositional environments (Harris *et al.* 2005). Sediments in coastal waters, particularly in areas of strong currents, are higher in gravel content, whereas shelf and other shallow areas contain high percentages of sand (DEWHA 2007). Sediments within the Timor Transition are mainly calcium carbonate rich, although sediment type varies from sandy substrate, to soft muddy sediments and hard rocky substrate.

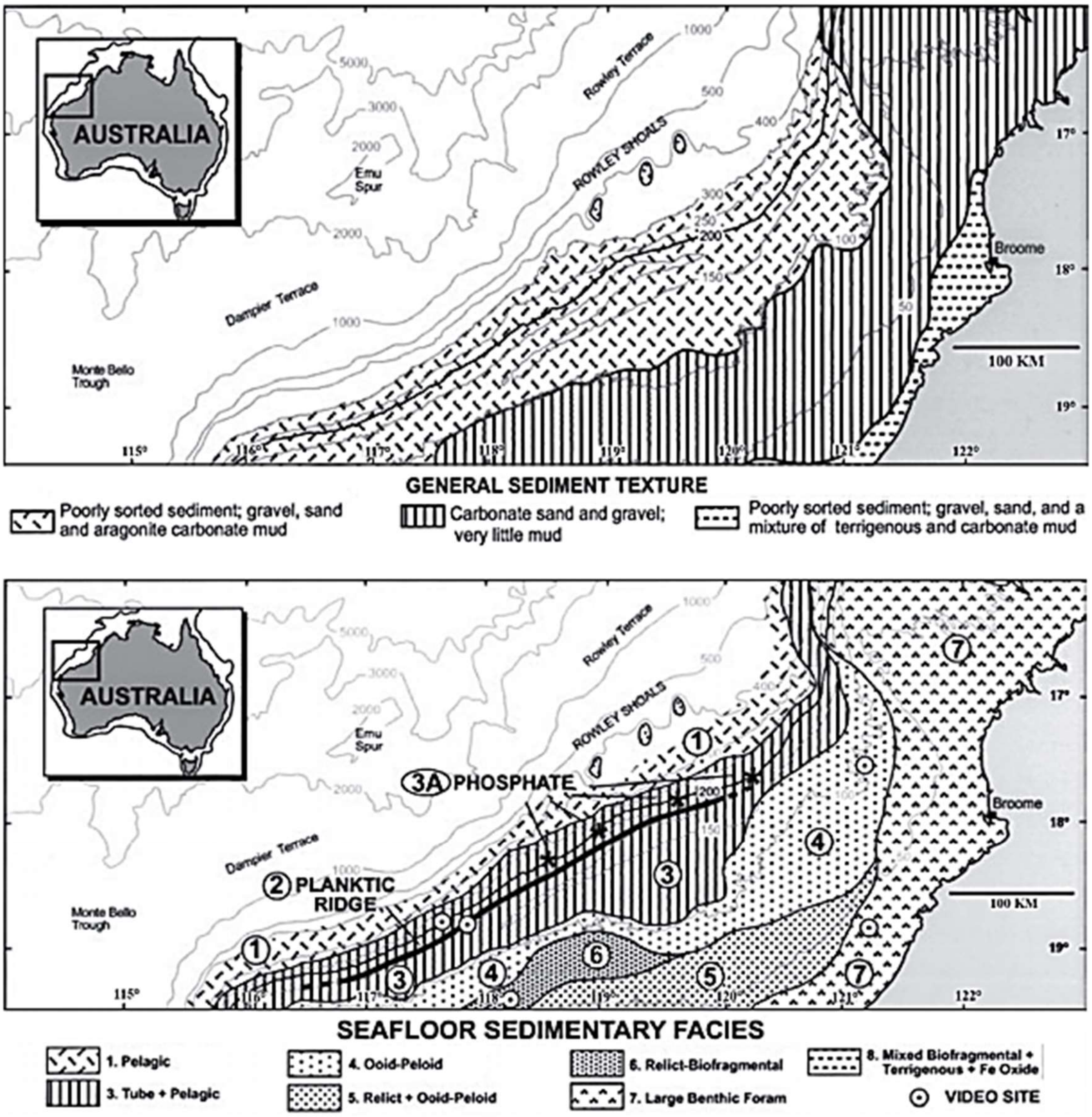


Figure 4.7 - Seafloor sedimentary facies of the North West Shelf (Collins 2011)

4.6 BIOLOGICAL ENVIRONMENT

Most of the species found within the NWMR are tropical and found in other parts of the Indian and western Pacific oceans. The NWMR has high species diversity, but with fewer endemic species than cooler and more temperate waters. The region contains more coastal and shelf fish species than anywhere else on the WA coast, particularly in the Kimberley and the NWS, and is home to globally-significant populations of internationally threatened species. The region's high species richness partially reflects its strong biogeographic links with Indonesia and the west Pacific through the Indonesian Throughflow Current (DAWE 2020).

The high species richness of the NWMR is said to be associated with the diversity of habitats available. These include hard seafloor areas (e.g. limestone pavements on the NWS), submerged cliffs and coral reefs of the Kimberley, and atolls and reefs on the edge of the NWS. These habitats support a high diversity of benthic filter feeders and producers. Fish spawning in summer/autumn in the Kimberley is thought to correspond with peaks in production and current movements. There is a strong delineation in demersal slope fish communities in the Kimberley in comparison to systems further south.

The NWMR supports internationally-important breeding and feeding grounds for a number of Threatened and Migratory marine species that transit through the bioregion, including humpback whales, which mate and give birth in the waters off the Kimberley coast (Section 4.6.4). Significant turtle rookeries are found on coastal beaches and offshore islands and the surrounding waters provide important resting and internesting (i.e. in between egg laying periods) habitats (Section 4.6.4.3) (DEWHA 2007, 2008). A full list of the Protected Marine Species that may occur within the operational area and EMBA is provided in Appendix B.

4.6.1 Plankton Communities

Seasonal changes in the region's oceanography are the primary drivers of biological productivity in the NWMR. These include weakening of the Indonesian Throughflow and Leeuwin Currents; the seasonal reversal in wind direction, which supports the development of currents such as the Ningaloo Current; conditions more favourable for upwelling on the NWS; and episodic events such as cyclones. As a result of the periodic nature of these changes, biological productivity follows sporadic and significant cycles that are geographically dispersed (DEWHA 2007).

The offshore water of the NWMR are oligotrophic. Planktonic abundances are likely to be low and are characterised by high species diversity but relatively low endemicity. Bentho-pelagic fish (those that occur in water depths of approximately 200–1,000 m) are a vital link in the trophic systems of the region (Brewer *et al.* 2007). As they migrate vertically between the pelagic and benthic (seafloor) systems, they consume nutrients and aid in the transfer of the nutrients between the two systems. Other processes also transfer nutrients from pelagic systems to benthic systems, for example deep-water benthic communities that are attached to the seafloor or have limited ranges are heavily reliant upon nutrients in the form of detritus falling into the benthic environment (DEWHA 2008).

Most of the NWMR species are tropical and are found in other parts of the Indian and western Pacific oceans. The NWMR contains more fish species than anywhere else off the WA coast, particularly in the Kimberley and the NWS. The sandstone and tidal creeks of the Kimberley coastline helps drive biological productivity through episodic injections of nutrients from storm runoff, as does re-suspension of sediments from large tides (DEWHA 2008). A unique combination of bathymetry and oceanography enhances the biological productivity south of the Dampier Peninsula, particularly around Quondong and James Price Point. Here, unique waters attract an abundance of baitfish, which in turn attracts aggregations of seabirds, large predatory fish, cetaceans, turtles and dugongs (DEWHA 2008). The bathymetry and available data suggest that the productivity and plankton communities within the operational area are likely to be comparable to those found in the wider region.

The primary productivity of Scott and Seringapatam Reef to the extreme north of the EMBA are valued for their high primary productivity levels (Section 4.4.2.4). Upwelling, tides and the mesoscale eddies that occur within this reef complex transports cooler, nutrient rich water to the reef to support its high species richness and seasonal aggregations of cetaceans (Green *et al.* 2019).

4.6.2 Benthic Communities

4.6.2.1 Soft Bottom Benthos and Filter Feeders

Much of the NWMR's outer mid-shelf is covered by relatively featureless, sandy-mud seabed with sparse sessile organisms that is likely to be the dominant substrate within the operational area. Throughout the region the seabed is dominated by filter-feeding heterotrophs such as gorgonians, sponges, soft corals, and detritus-feeding crabs and echinoderms. This is especially true of the non-trawled areas in the deeper water, and the soft-bottomed rises (Heyward *et al.* 1997). To the immediate south and east of the operational area are many limestone banks which form part of the Ancient Coastline KEF (Section 4.4.2). They have a harder substrate and are likely to support a more diverse range of sessile benthos such as hard and soft corals, gorgonians, encrusting sponges and macroalgae; and consequently, a more reef-associated fish fauna. Although these waters may be relatively oligotrophic for part of the year, these communities probably rely on primary productivity from phytoplankton and commensal zooxanthellae within hard corals (Brewer *et al.* 2007). The benthos and associated filter feeders within the operational area are expected to comparable to those found in the wider region.

4.6.2.2 Algae and Seagrass

Algae are dominant on shallow sandbars, platforms, reefs and ridges and are thought to be the major primary producer in the NWMR, followed by mangroves and corals in isolated areas (DEWHA 2007). The Indo-Pacific algal flora is very diverse and covers a large area. Over 120 species of macroalgae and seagrasses are reported to occur on the Rowley Shoals, Scott Reef and Seringapatam Reef. However, compared to the northwest coast of the mainland, the diversity is markedly lower (Huisman *et al.* 2009). Due to the depth of the operational area, it is not expected that seagrasses will be present.

The seagrass *Thalassia hemprichii* is known to occur in patches within the lagoon on Mermaid Reef to the west of the operational area and within the EMBA. This strappy seagrass is found down to 5 m and is commonly considered to be the climax seagrass of this ecosystem type, predated upon by sea urchins (Lawrence & Agastuma 2013).

4.6.2.3 Coral Reefs and Shoals

The reefs of the NWMR generally fall into two categories: algal-dominated reefs occurring north of Camden Sound and influenced by the warm waters of the Indonesian Throughflow Current and coral dominated reefs to the south of Camden Sound. Coral reef communities are naturally highly dynamic ecosystems with especially high species diversity. Coral communities, including patch or fringing reefs occur in shallow water, sub tidal environments of the NWMR, as well as around intertidal areas adjacent to islands and other emergent features (DEWHA 2007).

Multispecies, synchronous spawning (i.e. mass spawning) of scleractinian corals occur in the Dampier Archipelago (in State waters adjacent to the NWMR), at Ningaloo Reef and at other reefs in the NWMR including the Rowley Shoals (Gilmour *et al.* 2009). Mass spawning occurs around the third quarter of the moon (i.e. seven to nine nights after the full moon) on neap, nocturnal ebb tides in March and April each year. This coincides with the annual intensification of the Leeuwin Current and the Indonesian Throughflow Current (DEWHA 2008).

There are no known coral reefs present within the operational area as the depth of the area (approximately 125 m-approximately 450 m) is too deep to support these habitats, however the Rowley Shoals are immediately adjacent to the operational area and within the wider EMBA. Whilst the Seringapatam Reef and Commonwealth Waters in the Scott Reef Complex KEF (Section 4.4.2.4) is intersected by the EMBA, none of the coral reef systems within it are predicted to come into contact with hydrocarbons and are therefore not further discussed here.

Rowley Shoals

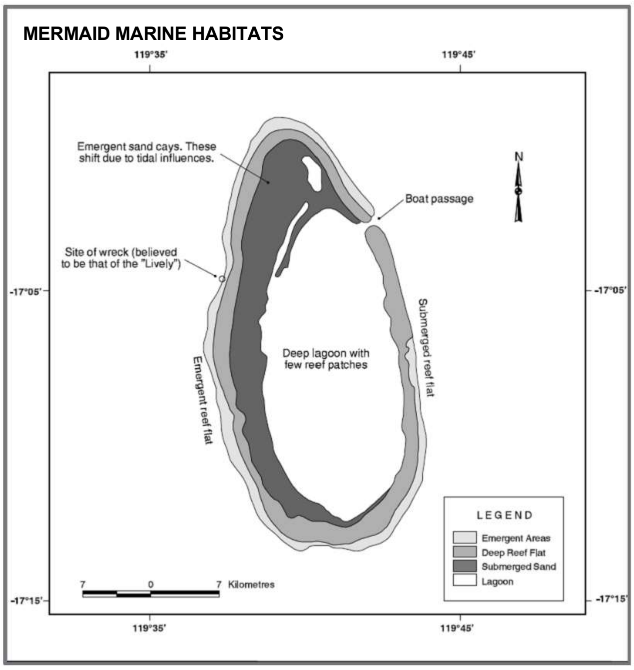
The Rowley Shoals are a hotspot for biodiversity in the NWMR and contain intertidal and sub-tidal carbonate coral reefs, rising from depths of 440 m (Baker *et al.* 2008). The shoals comprise of three atolls – the Clerke, Mermaid and Imperieuse Reefs.

All three atolls are similar in shape, size, orientation and distance from each other (Figure 4.3; Figure 4.8). Each atoll has a large lagoon area containing small sand cays or islands, narrow lagoon entrance channels on the eastern side and an outer reef edge dropping-off relatively steeply into oceanic waters between 500 and 700 m deep. The atolls are oval in shape and have a southwest to northeast alignment along the edge of the continental shelf. They are approximately 30–40 km apart (DNP 2013). The three atolls are separated from one another by deep water and rise from considerable depths (Clerke Reef from approximately 390 m and Imperieuse Reef from approximately 230 m). Both Clerke and Imperieuse Reefs contain emergent sand cays located at their northern ends. The reef flats are nearly continuous, varying from 500–600 m in width and encircling a central lagoon with depths ranging from 10 m at Clerke Reef to 20 m at Mermaid Reef (DEC 2007).

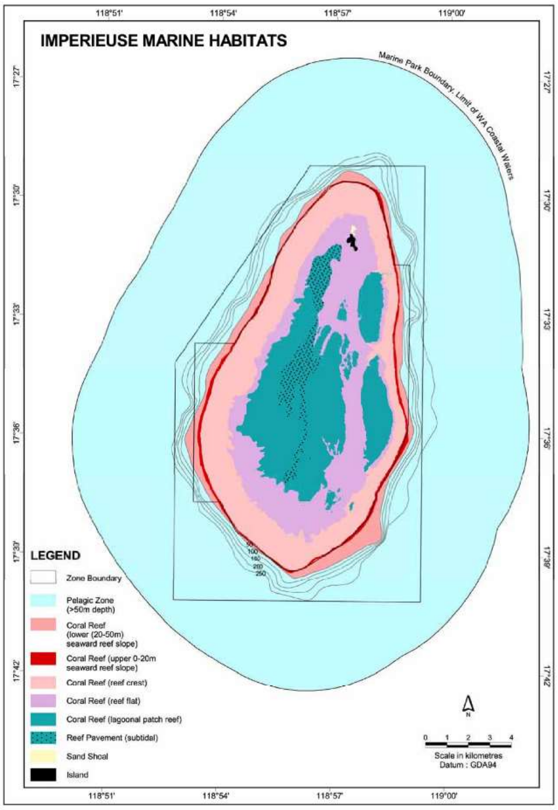
Imperieuse Reef is approximately 16 km by approximately 8 km and rises steeply from the surrounding ocean floor, which is 230 m deep. On the south-eastern edge of the reef, coral boulders rise approximately 3 m above the water mark. Large areas of the reef dry out at low tide, and there are two lagoons that contain coral patches. Cunningham Islet is a small sand cay 3.7 m high and devoid of vegetation. It is located close within the northern extremity of the reef and is surrounded by a small lagoon 93 m wide (Figure 4.8).

Clerke Reef lies 23 km north-west of Imperieuse Reef and is approximately 15 km x approximately 6 km. It rises steeply from the sea floor at 390 m (Figure 4.8). Near the northern end of the reef lies Bedwell Islet, a supra-tidal, unvegetated, elongated cay about 1.3 km long composed of coarse sand. On the eastern and western sides of the reef are numerous boulders which fall dry at low tides. A narrow passage leads to a lagoon with many detached coral patches within the reef.

Mermaid Reef is the most northerly of the reefs and is characterised by unusual environmental conditions for shelf edge reefs, including clear, deep oceanic water and large tidal ranges. Mermaid Reef consists of a reef flat 500–800 m wide that delves into shallow back-reefs that are rich in coral diversity and has a large lagoon up to 20 m deep (Figure 4.8). Mermaid Reef does not contain emergent land.



Source: Environment Australia 2000



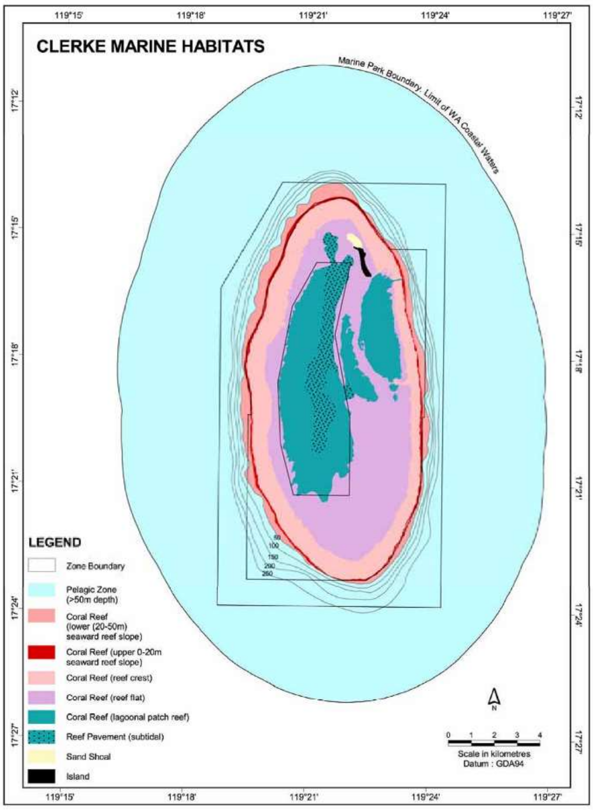


Figure 4.8 – Rowley Shoal Marine Habitats

The atolls support a diverse marine fauna typical of oceanic coral reef communities of the Indo-west Pacific and are important stepping-stones in the maintenance of gene flow among the northwest Australian coral reefs. The coral communities of Mermaid Reef are one of the special values of Mermaid Reef MP and can exist over a great range of depth due to the clear waters. The large depth range of the shoals also supports a diverse marine invertebrate community, including a number of endemic species. Invertebrate species (excluding corals) at the Rowley Shoals include sponges, cnidarians (e.g. jellyfish, anemones), worms, bryozoans (e.g. sea mosses), crustaceans (e.g. crabs, lobsters, etc.), molluscs (e.g. cuttlefish, baler shells, giant clams, etc.), echinoderms (e.g. starfish, sea urchins) and sea squirts (DEC 2007). The most common macroinvertebrate recorded in recent biological surveys at the Rowley Shoals was at least six times more abundant in this shoal system than any other in the NWMR (the Trinidad clam *Tridacna crocea*) and cryptic fish occurrence was twice more likely on Mermaid and Clerke Reef than at Imperieuse Reef (Edgar et al 2017). Surveys have also identified 389 species of finfish at the reefs (DEWHA 2008). Mermaid and Clerke Reefs, along with Scott Reef, had the highest biomass of large (more than 20 cm) reef fishes in comparison to other recently surveyed reefs of the NWMR network (Edgar *et al.* 2017). The steep changes in slope around the reefs attract a range of migratory pelagic species including cetaceans, tunas, billfish and sharks (DNP 2013). The Rowley Shoals also exhibit a greater proportion of living corals and crustose coralline algae than others within the NWMR network (70% total live cover, 70% live hard coral cover, 5% turf algae cover, 20% crustose coralline algae cover and less than 1% macroalgae cover) (Edgar *et al.* 2017).

The Rowley Shoals have experienced few local pressures due to their isolation and distance from the mainland. Only minor bleaching events have been recorded (Parsons *et al.* 2019).

4.6.3 Shoreline Habitats

There is no emergent land within the operational area. The only emergent land within the EMBA is Clerke and Imperieuse Reef of the Rowley Shoals to the west of the operational area. These two reefs have emergent sandy islets with some rocky calcareous structures surrounding them. These sandy beaches provide habitat to a variety of burrowing invertebrates and foraging grounds for shorebirds (DNP 2013).

Bedwell Islet of Clerke Reef is a bare sand islet, home to one of only two colonies of red-tailed tropicbirds in WA (see Section 4.6.4.6). It is also an important nesting area to a number of other seabirds including wedge-tailed shearwaters, white-bellied sea eagles, ruddy turnstones, various terns, eastern reef-egrets and white-tailed tropicbirds. These sand cays are also important resting and feeding sites for migratory shorebirds (DAWE 2020).

Cunningham Islet of Imperieuse Reef is the other bare sand cay in the Rowley Shoals complex. Cunningham Islet experiences more sand movement than Bedwell Islet and as such does not support breeding birds (DAWE 2020).

4.6.4 Marine Fauna

A review of protected marine fauna within the operational area and the EMBA was undertaken in August 2021 using the EPBC Act PMST. A summary of the results of the Protected Matters Report are provided in Table 4.6 and the full reports are provided in Appendix B.

Ninety six (96) protected marine species may occur or are likely to occur within the operational area including a total of 25 cetaceans, five marine turtles, 12 sea snakes, 10 sharks and rays, 31 fishes and 13 seabird species. Of the 96 species, 18 are Listed Threatened Species (LTS) and 33 are Listed Migratory Species (LMS). A further 59 protected marine species were identified that may occur within the EMBA. LTS and LMS occurring within the operational area and EMBA are described in the remainder of this section.

4.6.4.1 Biologically Important Areas

BIAs are "spatially defined areas where aggregations of individuals of a regionally significant species are known to display biologically important behaviours such as breeding, foraging, resting or migration" (DoEE 2020). Species that are identified as having a BIA within the operational area and EMBA are identified in Table 4.6.

Table 4.6 – Species protected under the EPBC Act that may occur in the Possum 3D MSS operational area and EMBA.

Species	Common name	OA	EMBA	Protection status	Threatened status	Migratory status	Recovery Plan/ Conservation Advice
Cetaceans							
Balaenoptera borealis	Sei whale	Likely to occur	Known to occur (foraging, feeding or related behaviour)	Listed	Vulnerable	MS	Blue, Fin and Sei Whale Recovery Plan 2005-2010*. Conservation Advice *Balaenoptera borealis* sei whale 2015.
Balaenoptera musculus	Blue whale	Known to occur (migration route)	Known to occur (migration route)	Listed	Endangered	MS	Conservation Management Plan for the Blue Whale (2015) - A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999.
Balaenoptera physalus	Fin whale	Likely to occur	Known to occur (foraging, feeding or related behaviour)	Listed	Vulnerable	MS	Blue, Fin and Sei Whale Recovery Plan 2005-2010*. Conservation Advice *Balaenoptera physalus* fin whale 2015.
Megaptera novaeangliae	Humpback whale	Known to occur	Known to occur (breeding)	Listed	Vulnerable	MS	Humpback Whale recovery Plan 2005-2010*. Conservation Advice *Megaptera novaeangliae* humpback whale 2015.
Balaenoptera edeni	Bryde's whale	Likely to occur	Likely to occur	Listed	-	MS	-
Orcinus orca	Killer whale	May occur	May occur	Listed	-	MS	-
Physeter macrocephalus	Sperm whale	May occur	May occur	Listed	-	MS	-
Tursiops aduncus	Spotted bottlenose dolphin (Arafura / Timor Sea populations)	May occur	Likely to occur	Listed	-	MS	-
Delphinus delphis	Common dolphin	May occur	May occur	Cetacean	-	-	-
Feresa attenuata	Pygmy killer whale	May occur	May occur	Cetacean	-	-	-
Globicephala macrorhynchus	Short-finned pilot whale	May occur	May occur	Cetacean	-	-	-
Grampus griseus	Risso's dolphin	May occur	May occur	Cetacean	-	-	-
Kogia breviceps	Pygmy sperm whale	May occur	May occur	Cetacean	-	-	-
Kogia simus	Dwarf sperm whale	May occur	May occur	Cetacean	-	-	-
Lagenodelphis hosei	Fraser's dolphin	May occur	May occur	Cetacean	-	-	-
Mesoplodon densirostris	Blainville's beaked whale	May occur	May occur	Cetacean	-	-	-
Peponocephala electra	Melon-headed whale	May occur	May occur	Cetacean	-	-	-
Pseudorca crassidens	False killer whale	Likely to occur	Likely to occur	Cetacean	-	-	-
Stenella attenuata	Spotted dolphin	May occur	May occur	Cetacean	-	-	-
Stenella coeruleoalba	Striped dolphin	May occur	May occur	Cetacean	-	-	-
Stenella longirostris	Long-snouted spinner dolphin	May occur	May occur	Cetacean	-	-	-

Species	Common name	OA	EMBA	Protection status	Threatened status	Migratory status	Recovery Plan/ Conservation Advice
Steno bredanensis	Rough-toothed dolphin	May occur	May occur	Cetacean	-	-	-
Tursiops aduncus	Indian ocean bottlenose dolphin	May occur	Likely to occur	Cetacean	-	-	-
Tursiops truncatus s. str.	Bottlenose dolphin	May occur	Likely to occur	Cetacean	-	-	-
Ziphius cavirostris	Cuvier's beaked whale	May occur	May occur	Cetacean	-	-	-
Dugong dugon	Dugong	-	Know to occur	Listed	-	MS	-
Sousa chinensis	Indo-Pacific humpback dolphin	-	Likely to occur	Listed	-	MS	-
Balaenoptera actorostrata	Minke whale	-	May occur	Cetacean	-	-	-
Indopacetus pacificus	Longman's beaked whale	-	May occur	Cetacean	-	-	-
Mesoplodon ginkgodens	Gingko-toothed beaked whale	-	May occur	Cetacean	-	-	-
Marine Reptiles							
Caretta caretta	Loggerhead turtle	Likely to occur	Known to occur (foraging, feeding or related behaviour)	Listed	Endangered	MS	Recovery Plan for Marine Turtles in Australia 2017.
Chelonia mydas	Green turtle	Known to occur	Know to occur (breeding)	Listed	Vulnerable	MS	Recovery Plan for Marine Turtles in Australia 2017.
Dermochelys coriacea	Leatherback turtle	Likely to occur	Know to occur (breeding)	Listed	Endangered	MS	Recovery Plan for Marine Turtles in Australia 2017. Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle) 2008.
Eretmochelys imbricata	Hawksbill turtle	Likely to occur	Know to occur (breeding)	Listed	Vulnerable	MS	Recovery Plan for Marine Turtles in Australia 2017.
Natator depressus	Flatback turtle	Likely to occur	Know to occur (breeding)	Listed	Vulnerable	MS	Recovery Plan for Marine Turtles in Australia 2017.
Acalyptophis peronii	Horned sea snake	May occur	May occur	Listed	-	-	-
Aipysurus duboisii	Dubois' sea snake	May occur	May occur	Listed	-	-	-
Aipysurus eydouxii	Spine-tailed sea snake	May occur	May occur	Listed	-	-	-
Aipysurus laevis	Olive sea snake	May occur	May occur	Listed	-	-	-
Astrotia stokesii	Stokes' sea snake	May occur	May occur	Listed	-	-	-
Disteira kingii	Spectacled sea snake	May occur	May occur	Listed	-	-	-
Disteira major	Olive-headed sea snake	May occur	May occur	Listed	-	-	-
Ephalophis greyi	North-western mangrove sea snake	May occur	May occur	Listed	-	-	-
Hydrophis elegans	Elegant sea snake	May occur	May occur	Listed	-	-	-
Hydrophis mcdowelli	Small-headed sea snake	May occur	May occur	Listed	-	-	-
Hydrophis ornatus	Spotted sea snake	May occur	May occur	Listed	-	-	-
Pelamis platurus	Yellow-bellied sea snake	May occur	May occur	Listed	-	-	-

Species	Common name	OA	EMBA	Protection status	Threatened status	Migratory status	Recovery Plan/ Conservation Advice
Aipysurus apraefrontalis	Short-nosed sea snake	-	Likely to occur	Listed	Critically Endangered	-	Approved Conservation Advice for *Aipysurus apraefrontalis* (Short-nosed Sea Snake) 2011.
Aipysurus foliosquama	Leaf-scaled Sea snake	-	Known to occur	Listed	Critically Endangered	-	Approved Conservation Advice for *Aipysurus foliosquama* (Leaf-scaled Sea snake) 2011.
Lepidochelys olivacea	Olive ridley turtle	-	Likely to occur	Listed	Endangered	MS	Recovery Plan for Marine Turtles in Australia 2017.
Crocodylus porosus	Salt-water crocodile	-	Likely to occur	Listed	-	MS	-
Aipsurus tenuis	Brown-lined sea snake	-	May occur	Listed	-	-	-
Hydrophis dawriniensis	Black-ringed sea snake	-	May occur	Listed	-	-	-
Hydrophis coggeri	Slender-necked sea snake	-	May occur	Listed	-	-	-
Hydrophis czeblukovi	Fine-spined sea snake	-	May occur	Listed	-	-	-
Lapemis hardwickii	Spine-bellied sea snake	-	May occur	Listed	-	-	-
Sharks and rays							
Carcharodon carcharias	White Shark	May occur	May occur	Listed	Vulnerable	MS	Recovery Plan for the White Shark (*Carcharodon carcharias*) 2002*.
Rhincodon typus	Whale shark	Known to occur (foraging, feeding or related behaviour) F	Known to occur (foraging, feeding or related behaviour)	Listed	Vulnerable	MS	Whale Shark (*Rhincodon typus*) Recovery Plan 2005-2010*. Conservation Advice *Rhincodon typus* whale shark 2015.
Pristis pristis	Largetooth sawfish	Known to occur	Known to occur	Listed	Vulnerable	-	Sawfish and River Sharks Multispecies Recovery Plan 2015. Approved Conservation Advice for *Pristis pristis* (largetooth sawfish) 2014.
Pristis zijsron	Green sawfish	Known to occur	Known to occur	Listed	Vulnerable	-	Sawfish and River Sharks Multispecies Recovery Plan 2015. Approved Conservation Advice for Green Sawfish 2008.
Anoxypristis cuspidata	Narrow sawfish	May occur	Know to occur	Listed	-	MS	Sawfish and River Sharks Multispecies Recovery Plan 2015.
Carcharhinus longimanus	Oceanic Whitetip Shark	May occur	Likely to occur	Listed	-	MS	-
Isurus oxyrinchus	Shortfin mako	Likely to occur	Likely to occur	Listed	-	MS	-
Isurus paucus	Longfin mako	Likely to occur	Likely to occur	Listed	-	MS	-
Manta alfredi	Reef manta ray	Know to occur	Known to occur	Listed	-	MS	-
Manta birostris	Giant manta ray	May occur	Likely to occur	Listed	-	MS	-
Charcharias taurus	Grey nurse shark	-	May occur	Listed	Vulnerable	-	Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) 2014.
Glyphis garricki	Northern river shark	-	May occur	Listed	Endangered	-	Sawfish and River Sharks Multispecies Recovery Plan 2015. Approved Conservation Advice for *Glyphis garricki* (northern river shark) 2014.

Species	Common name	OA	EMBA	Protection status	Threatened status	Migratory status	Recovery Plan/ Conservation Advice
Pristis clavate	Dwarf sawfish	-	Known to occur	Listed	Vulnerable	-	Sawfish and River Sharks Multispecies Recovery Plan 2015. Approved Conservation Advice for *Pristis clavata* (Dwarf Sawfish) 2009.
Fishes							
Bhanotia fasciolata	Corrugated pipefish	May occur	May occur	Listed	-	-	-
Campichthys tricarinatus	Three-keel pipefish	May occur	May occur	Listed	-	-	-
Choeroichthys brachysoma	Pacific short-bodied pipefish	May occur	May occur	Listed	-	-	-
Choeroichthys suillus	Pig-snouted pipefish	May occur	May occur	Listed	-	-	-
Corythoichthys amplexus	Fijian banded pipefish	May occur	May occur	Listed	-	-	-
Corythoichthys flavofasciatus	Reticulate pipefish	May occur	May occur	Listed	-	-	-
Corythoichthys intestinalis	Australian messmate pipefish	May occur	May occur	Listed	-	-	-
Corythoichthys schultzi	Schultz's pipefish	May occur	May occur	Listed	-	-	-
Cosmocampus banneri	Roughridge pipefish	May occur	May occur	Listed	-	-	-
Doryrhamphus dactyliophorus	Banded pipefish	May occur	May occur	Listed	-	-	-
Doryrhamphus excisus	Bluestripe pipefish	May occur	May occur	Listed	-	-	-
Doryrhamphus janssi	Cleaner pipefish	May occur	May occur	Listed	-	-	-
Filicampus tigris	Tiger pipefish	May occur	May occur	Listed	-	-	-
Halicampus brocki	Brock's pipefish	May occur	May occur	Listed	-	-	-
Halicampus dunckeri	Red-hair pipefish	May occur	May occur	Listed	-	-	-
Halicampus grayi	Mud pipefish	May occur	May occur	Listed	-	-	-
Halicampus spinirostris	Spiny-snout pipefish	May occur	May occur	Listed	-	-	-
Haliichthys taeniophorus	Ribboned seadragon	May occur	May occur	Listed	-	-	-
Hippichthys penicillus	Beady pipefish	May occur	May occur	Listed	-	-	-
Hippocampus angustus	Western spiny seahorse	May occur	May occur	Listed	-	-	-
Hippocampus histrix	Spiny seahorse	May occur	May occur	Listed	-	-	-
Hippocampus kuda	Spotted seahorse	May occur	May occur	Listed	-	-	-
Hippocampus planifrons	Flat-face seahorse	May occur	May occur	Listed	-	-	-
Hippocampus spinosissimus	Hedgehog seahorse	May occur	May occur	Listed	-	-	-
Micrognathus micronotopterus	Tidepool pipefish	May occur	May occur	Listed	-	-	-
Solegnathus hardwickii	Pallid pipehorse	May occur	May occur	Listed	-	-	-
Solegnathus lettiensis	Gunther’s pipefish	May occur	May occur	Listed	-	-	-
Solenostomus cyanopterus	Robust ghost pipefish	May occur	May occur	Listed	-	-	-
Syngnathoides biaculeatus	Double-end pipehorse	May occur	May occur	Listed	-	-	-
Trachyrhamphus bicoarctatus	Bentstick pipefish	May occur	May occur	Listed	-	-	-

Species	Common name	OA	EMBA	Protection status	Threatened status	Migratory status	Recovery Plan/ Conservation Advice
Trachyrhamphus longirostris	Straightstick pipefish	May occur	May occur	Listed	-	-	-
Acentronura larsonae	Helen's pygmy pipehorse	-	May occur	Listed	-	-	-
Bulbonaricus brauni	Braun's pughead pipefish	-	May occur	Listed	-	-	-
Choeroichthyes latispinosus	Murion Island pipefish	-	May occur	Listed	-	-	-
Doryrhamphus miltiannulatus	Many-banded pipefish	-	May occur	Listed	-	-	-
Doryhamphus negrosensis	Flagtail pipefish	-	May occur	Listed	-	-	-
Festucalex scalaris	Ladder pipefish	-	May occur	Listed	-	-	-
Halicampus nitidus	Glittering pipefish	-	May occur	Listed	-	-	-
Hippocampus trimaculatus	Three-spot seahorse	-	May occur	Listed	-	-	-
Phoxocampus belcheri	Black rock pipefish	-	May occur	Listed	-	-	-
Avifauna							
Numenius madagascariensis	Far eastern curlew	May occur	Known to occur	Listed	Critically Endangered	MWS	Conservation Advice *Numenius madagascariensis* eastern curlew 2015.
Calidris canutuus	Red knot	May occur	Known to occur	Listed	Endangered	MWS	Conservation Advice *Calidris canutus* Red knot 2016.
Papasula abbotti	Abbott's booby	May occur	May occur	Listed	Endangered	-	Conservation Advice *Papasula abbotti* Abbott's booby 2015.
Charadrius leschenaultii	Greater Sand Plover, Large Sand Plover	Known to occur	Known to occur	Listed	Vulnerable	MWS	Conservation Advice *Charadrius leschenaultii* Greater sand plover.
Actitis hypoleucos	Common sandpiper	May occur	Known to occur	Listed	-	MWS	-
Calidris acuminata	Sharp-tailed sandpiper	May occur	Likely to occur	Listed	-	MWS	-
Calidris melanotos	Pectoral sandpiper	May occur	Likely to occur	Listed	-	MWS	-
Anous stolidus	Common noddy	May occur	Likely to occur	Listed	-	MS	-
Calonectris leucomelas	Streaked shearwater	Likely to occur	Known to occur	Listed	-	MS	-
Fregata ariel	Lesser frigratebird	Likely to occur	Known to occur (breeding)	Listed	-	MS	-
Fregata minor	Great frigratebird	May occur	Likely to occur	Listed	-	MS	-
Phaethon lepturus	White-tailed tropicbird	Known to occur (foraging, feeding or related behaviour) F	Known to occur (breeding)	Listed	-	MS	-
Sterna albifrons	Little tern	Known to occur (Congregation or aggregation) R	Known to occur (Congregation or aggregation)	Listed	-	MS	-

Species	Common name	OA	EMBA	Protection status	Threatened status	Migratory status	Recovery Plan/ Conservation Advice
Calidris ferruginea	Curlew sandpiper	-	Known to occur	Listed	Critically Endangered	MWS	Conservation Advice *Calidris ferruginea* curlew sandpiper 2015.
Limosa lapponica menzbieri	Northern Siberian Bar-tailed Godwit	-	Known to occur	Listed	Critically Endangered	-	Conservation Advice *Limosa lapponica menzbieri* Bar-tailed godwit (northern Siberian)
Macronectes giganteus	Southern giant petrel	-	May occur	Listed	Endangered	MS	Commonwealth Listing Advice on *Macronectes giganteus* 2001. National recovery plan for threatened albatrosses and giant petrels 2011-2016.
Pezoporus occidentalis	Night Parrot	-	May occur	Listed	Endangered	-	Conservation Advice *Pezoporus occidentalis* night parrot
Rostratula australis	Australian painted snipe	-	May occur	Listed	Endangered	-	Approved Conservation Advice for *Rostratula australis* (Australian painted snipe) 2013.
Rostratula benghalensis (sensu lato)	Painted Snipe	-	May occur	Listed	Endangered	-	Approved Conservation Advice for *Rostratula australis* (Australian painted snipe) 2013 Commonwealth Listing Advice on *Rostratula australis* (Australian Painted Snipe)
Anous tenuirostris melanops	Australian Lesser Noddy	-	Known to occur (foraging, feeding or related behaviour)	Listed	Vulnerable	MS	Conservation Advice *Anous tenuirostris melanops* Australian lesser noddy National Recovery Plan for Ten Species of Seabirds 2005-2010*
Sternula nereis nereis	Australian fairy tern	-	Known to occur (foraging, feeding or related behaviour)	Listed	Vulnerable	-	Approved Conservation Advice for *Sternula nereis nereis* (Fairy Tern) 2011.
Falco hypoleucos	Grey Falcon	-	Likely to occur	Listed	Vulnerable	-	Conservation Advice *Falco hypoleucos* Grey Falcon
Charadrius veredus	Oriental plover	-	May occur	Listed	-	MWS	-
Glareola maldivarum	Oriental pratincole	-	May occur	Listed	-	MWS	-
Limnodromus semipalmatus	Asian Dowitcher	-	Likely to occur	Listed	-	MWS	-
Limosa lapponica	Bar-tailed godwit	-	Known to occur	Listed	-	MWS	-
Pandion haliaetus	Osprey	-	May occur	Listed	-	MWS	-
Thalasseus bergii	Greater Crested tern	-	Known to occur (breeding)	Listed	-	MWS	-
Tringa nebularia	Greenshank	-	Likely to occur	Listed	-	MWS	-
Apus pacificus	Fork tailed swift	-	Likely to occur	Listed	-	MS	-
Phaethon rubricauda	Red-tailed tropicbird	-	Known to occur (breeding)	Listed	-	MS	-

Species	Common name	OA	EMBA	Protection status	Threatened status	Migratory status	Recovery Plan/ Conservation Advice
Sterna dougallii	Roseate tern	-	Known to occur (breeding)	Listed	-	MS	-
Sula dactylatra	Masked booby	-	Known to occur (breeding)	Listed	-	MS	-
Sula leucogaster	Brown booby	-	Known to occur (breeding)	Listed	-	MS	-
Sula sula	Red-footed booby	-	Known to occur (breeding)	Listed	-	MS	-
Ardea ibis	Cattle egret	-	May occur	Listed	-	-	-
Chrysococcyx osculans	Black-eared Cuckoo	-	May occur	Listed	-	-	-
Cuculus optatus	Oriental Cuckoo	-	May occur	Listed	-	-	-
Haliaeetus leucogaster	White-bellied sea-eagle	-	Known to occur	Listed	-	-	-
Hirundo rustica	Barn swallow	-	Likely to occur	Listed	-	-	-
Larus novahollandiae	Silver gull	-	Known to occur (breeding)	Listed	-	-	-
Merops ornatus	Rainbow Bee-eater	-	May occur	Listed	-	-	-
Motacilla cinerea	Grey Wagtail	-	May occur	Listed	-	-	-
Motacilla flava	Yellow Wagtail	-	Likely to occur	Listed	-	-	-
Sterna bengalensis	Lesser crested tern	-	Known to occur (breeding)	Listed	-	-	-
Sterna bergii	Crested tern	-	Known to occur (breeding)	Listed	-	-	-

Source: PMST, accessed August 2021. *Recovery Plan has ceased to be in effect., Migratory Status – MS = Migratory, MWS = Migratory Wetland Species

4.6.4.2 Cetaceans

Four cetacean LTS may occur within the operational area (Table 4.6) as identified by a Protected Matters Search report (Appendix B): the blue whale (Endangered) and the humpback, sei and fin whale (Vulnerable). A further four LMS may occur within the operational area: the Bryde's whale, killer whale, sperm whale and spotted bottlenose dolphin (Arafura/ Timor Sea population). The likelihood of these species' occurrence within the operational area is described below.

A further two LMS are likely to occur within the EMBA: the dugong and Indo-Pacific humpback dolphin.

Blue Whales

Of the four recognised subspecies of blue whales worldwide, two are known to occur in the Southern Hemisphere: the Antarctic blue whale (*Balaenoptera musculus intermedia*) and the pygmy blue whale (B. *musculus brevicauda*). Both are listed as Endangered under the World Conservation Union Red List (IUCN) of Threatened Species and the blue whale species is listed as Endangered in Australian waters. The blue whale has a current recovery plan in Australia - the Conservation Management Plan for the Blue Whale (DoE 2015a). Threats identified within the plan are:

- whaling;
- climate variability and change;
- overharvesting of prey;
- noise interference;
- habitat modification;
- vessel disturbance and collision.

The threats relevant to the proposed activity are noise interference, vessel disturbance and collision.

The blue whale is recorded offshore in all states of Australia excluding the NT (DoEE 2015a). Blue whales have an international distribution, and their migration paths are widespread and do not clearly follow coastlines nor international borders. Antarctic blue whales are usually found in waters south of 60°S and as such it is likely that all blue whales occurring within the operational area will be pygmy blue whales. In the NWMR, pygmy blue whales migrate along the 500–1,000 m depth contour on the edge of the slope (DoEE 2015a, DEWHA 2007).

Based on limited knowledge of distribution and abundance, critical habitats are not defined for pygmy blue whales in Australia (DoEE 2015b). Pygmy blue whales are believed to calve in tropical waters in winter, with births occurring from May–June each year. As confirmed by sightings and remote telemetry data, the pygmy blue whale breeding areas are likely to be in Indonesia, particularly within the Banda Sea and Molucca Sea (DoEE 2015a, Double et al. 2014). However, the exact breeding grounds for this subspecies are unknown and may potentially include other unidentified areas (DoEE 2015a, Bannister et al. 1996).

A study recorded passive acoustic information during the pygmy blue whales' annual transit past the WA coastline from 2000-2006 (McCauley & Jenner 2010). The results of the acoustic detections collected at the Montebello Islands (Figure 4.9) identified:

- a northerly pulse of animals (extended pulse in comparison to the southerly migrating animals) transiting through the Montebello Islands from late March–early August, with the highest densities of detections, and with peak migration period occurring during the months of June and July; and
- a pulse of southerly-transiting pygmy blue whales passing through the Montebello Islands from early October–December, with the highest densities of detections, and a peak migration period occurring from November–December.

The passive acoustic detections of the pygmy blue whales were converted to instantaneous counts of the number of individual whales calling. Between 662 and 1,559 pygmy blue whales passed by the sound logger site during the 2004 pygmy blue whale southern migration along the WA coast. Based on acoustic records collected since 2000, researchers determined a regular and predictable seasonal migratory pattern along the WA coast.

Another publication presents satellite telemetry recordings of 11 pygmy blue whales that were tagged off the WA coast over a two year period from 2009–2011 (Double et al. 2014; Figure 4.10). The results supported conclusions from the acoustic recordings (McCauley & Jenner 2010), confirming the pygmy blue whale migratory periods and routes along the WA coastline. During their northern migration, the tagged pygmy blue whales travelled approximately 100 km from the WA coastline until reaching the North West Cape, where most of the whales travelled further offshore (approximately 240 km) and arrived in Indonesia by June, with one individual that departed Indonesian waters on their southern migration to Australia in September (Double et al. 2014).

The operational area overlaps the distribution BIA for pygmy blue whales (Figure 4.11). The operational area also overlaps the migration BIA for pygmy blue whales (Figure 4.11). The operational area overlaps less than half of the primary migratory pathway at a point where the migration route is more than 250 km wide. Northbound animals are thought to be heading to calving areas in the Banda Sea. Therefore, once animals have rounded the Northwest Cape, the shortest route is via Scott Reef and remaining on the 500 m depth contour to the north of the operational area (Figure 4.12). Near the Montebello Islands, individual whales have been recorded travelling at speeds of 50–75 km per day (Double et al. 2014). Anecdotal sightings of pygmy blue whales have been documented at Mermaid Reef in June 2008 (Jenner et al. 2009). Given the timing and progression of migration and based on annual acoustic detections at Scott Reef (more than 190 km to the north; DoEE 2015a), migrating pygmy blue whales are expected to travel through the northern part of the operational area on their southbound migration from September–December and between April – July in deeper waters during the northern migration.

A foraging BIA is within the northern extent of the EMBA (Figure 4.11). Foraging BIAs for pygmy blue whales are considered important for the species' survival, as they contain highly productive resources for the species (DoEE 2015a). Recognised foraging areas for the pygmy blue whale in WA are located in the Perth Canyon and in Geographe Bay, and further foraging areas were identified off Exmouth and Scott Reef, which are more than 700 km and 70 km away, respectively.

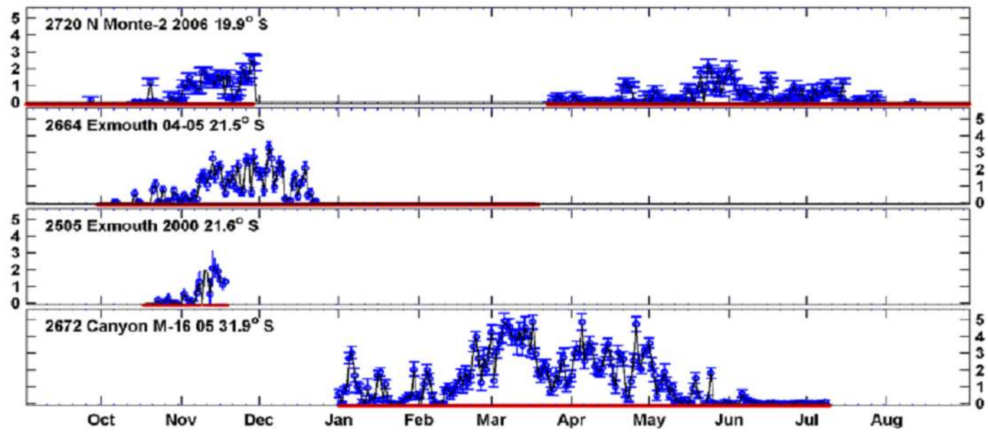


Figure 4.9 – 24hr averaged counts of pygmy blue whales off North West Cape, Montebello Islands and Perth Canyon, WA (McCauley and Jenner 2010).

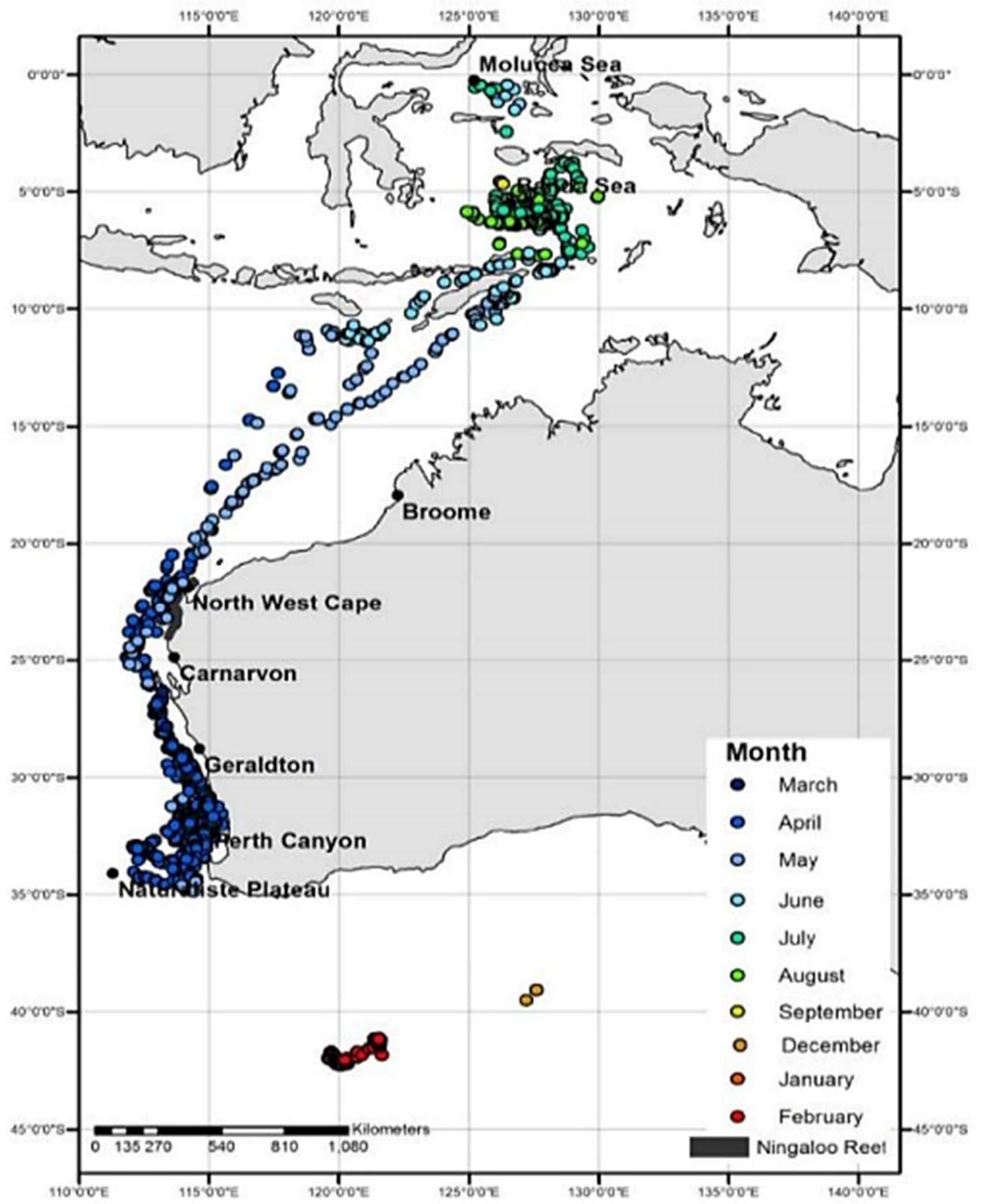


Figure 4.10 – Telemetry data of pygmy blue whales along the WA coast (Double et al. 2014).

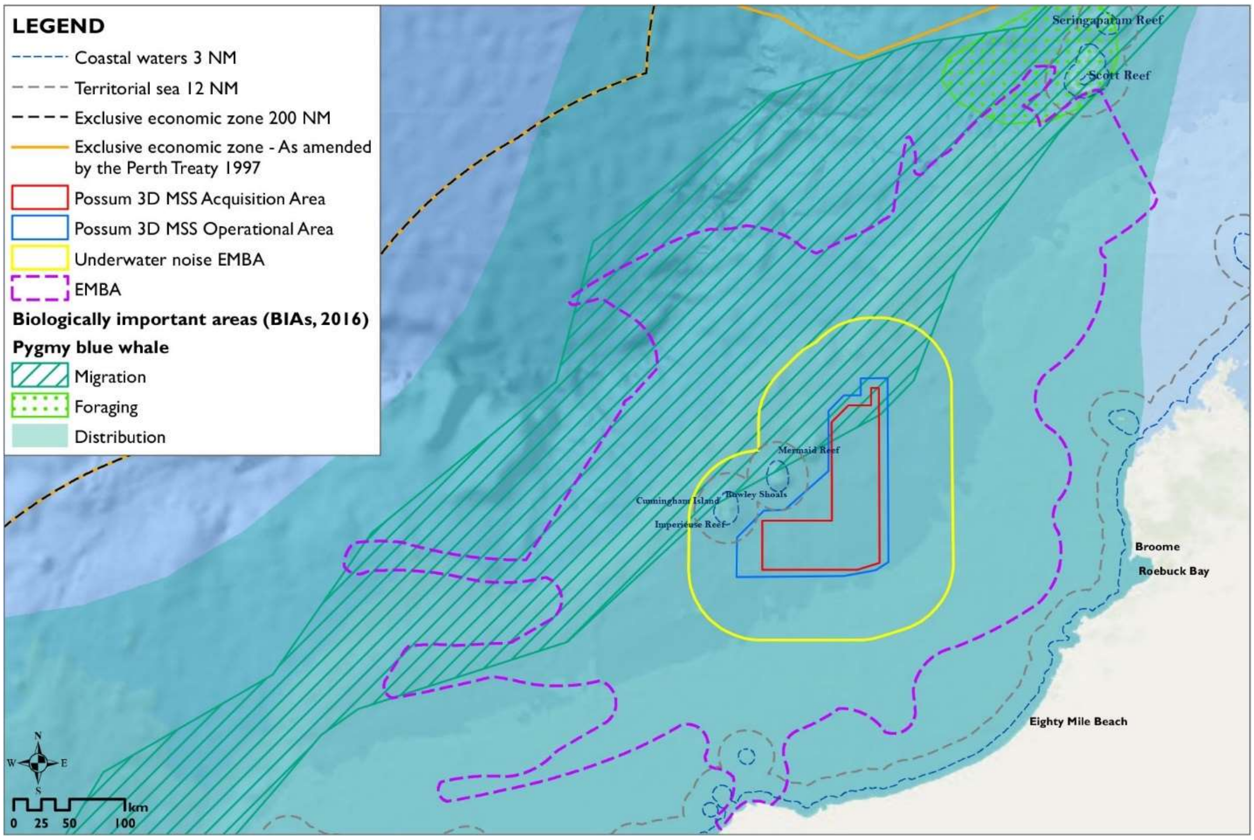


Figure 4.11 – Pygmy blue whale BIAs within the Possum 3D MSS EMBA

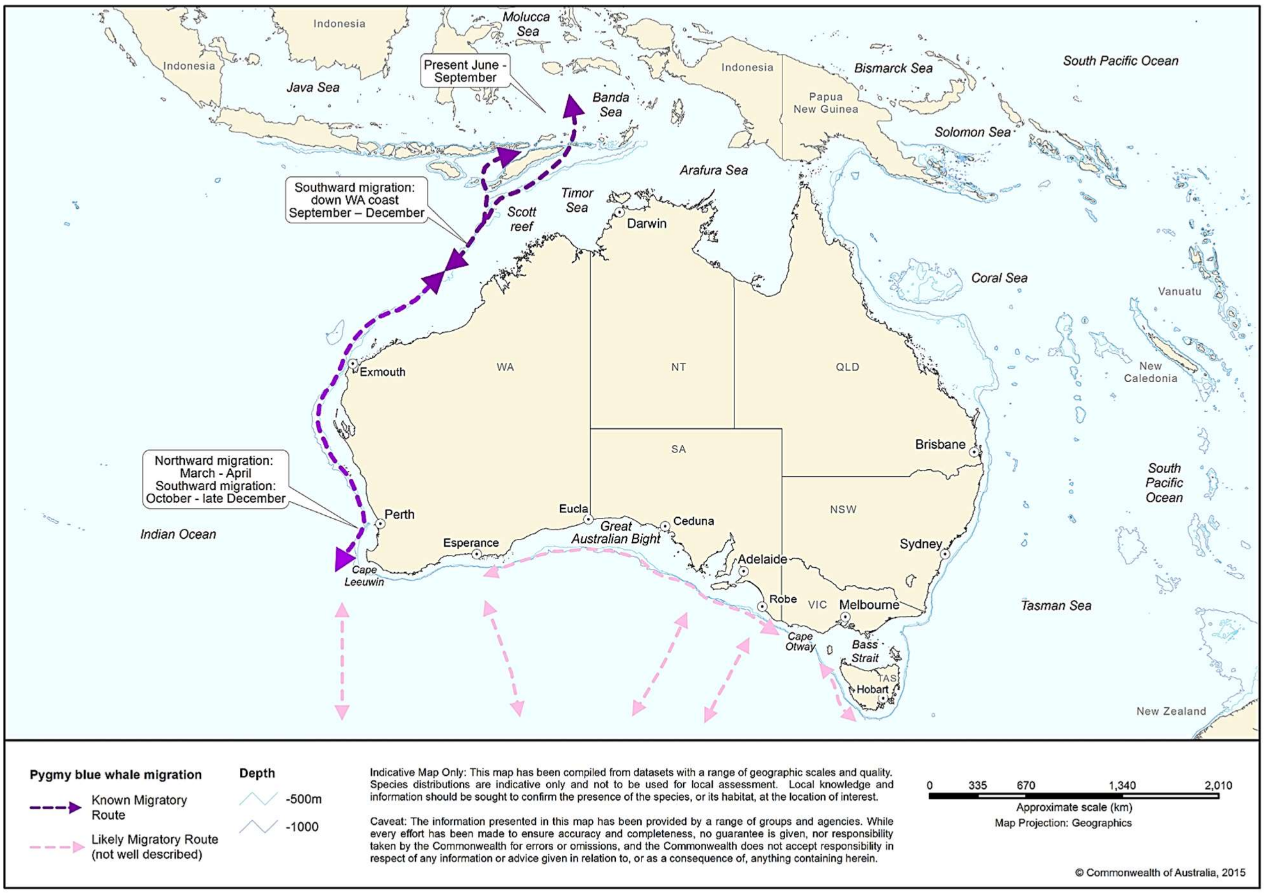


Figure 4.12 – Pygmy blue whale migration route along WA coast (DoEE 2015a).

Humpback whales

The humpback whale (*Megaptera novaeangliae*) is listed as Vulnerable and Migratory under the EPBC Act and are protected under the WA Biodiversity Conservation Act 2016. They are the most commonly-sighted whale in northern WA and one of the largest baleen whales in Australian waters. There is a current conservation advice for the humpback whale – the *Conservation Advice Megaptera novaeangliae humpback whale 2015*. Threats identified within the advice are:

- whaling;
- climate and oceanographic variability and change;
- overharvesting of prey;
- noise interference;
- habitat degradation including coastal development and port expansion;
- entanglement; and
- vessel disturbance and strike.

The threats relevant to the proposed activity are noise interference, entanglement, vessel disturbance and strike.

The species conducts annual migrations between Antarctic and northern Australian waters. After feeding in Antarctic waters during the summer months (Bannister & Hedley 2001, Chittleborough 1965), the species migrates north to the Camden Sound in the west Kimberley (Jenner et al. 2001; Figure 4.13) on or within the 200 m depth contour. The northern migration route for humpback whales is generally further offshore than the southern migration route (Paterson et al. 1994).

South-migrating whales have been observed in waters off Pender Bay, north of Broome (Double *et al.* 2010). Various data indicates that the southern migration route of mothers and calves is narrow and follows shallow waters (Double et al. 2010, Jenner et al. 2010, 2001).

The humpback whale migration BIA (Figure 4.14) includes the southern border of the NWMR and extends north to the breeding and calving areas in the northern Kimberley region, all outside the EMBA. This BIA represents both the northern and southern migration pathway for humpback whales in the northwest WA and spreads to approximately 100 km offshore, despite some individual outliers observed travelling in deeper waters.

Whale sightings have been recorded inshore from vessels transiting between Broome and the Rowley Shoals, although scattered sightings of humpback whales occur up to 270 km offshore (Jenner et al. 2001). However, based on the operational area's substantial distance offshore (more than 150 km to the coast) and in deep water (up to 450 m), it is unlikely that significant numbers of humpback whales will be encountered during survey activities.

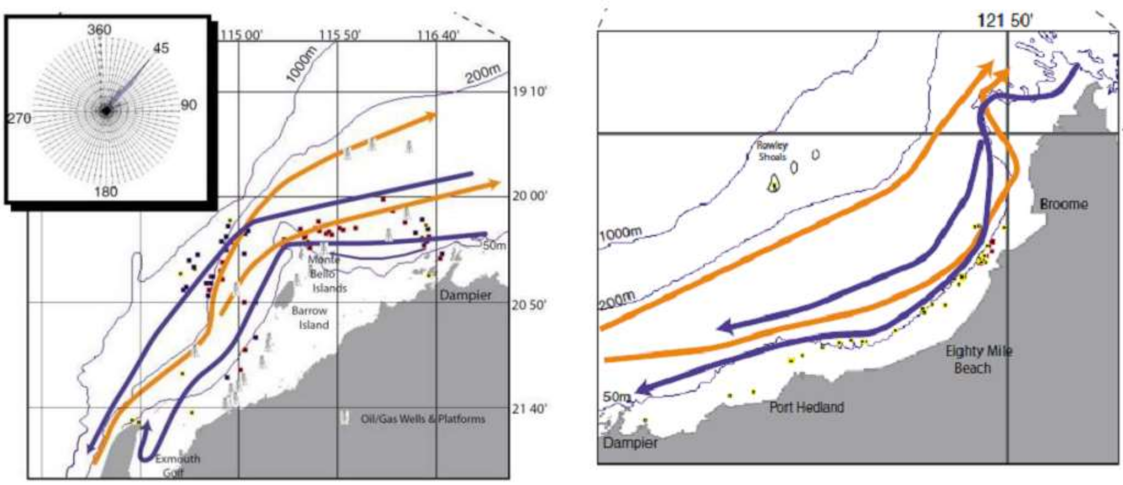


Figure 4.13 – Estimated humpback whale migratory pathways and actual observation points (yellow = northbound) along the WA coast (Jenner et al. 2001).

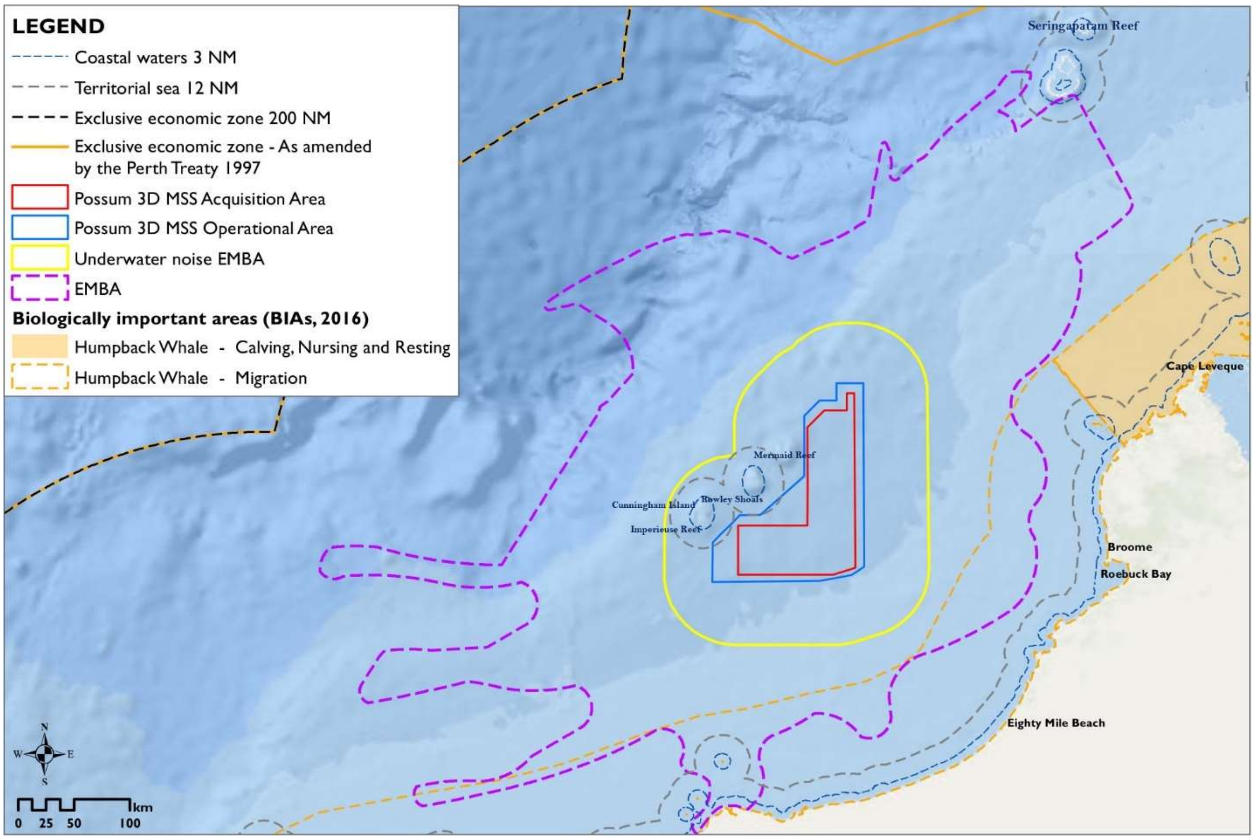


Figure 4.14 – Humpback whale BIAs in the Possum 3D MSS EMBA

Sei Whale

The sei whale (*Balaenoptera borealis*) is a cosmopolitan species, ranging from polar waters to the tropics and frequently in deeper, offshore waters (Bannister *et al.* 1996). The species is not commonly recorded in Australian waters, and the available distribution information may overlap with the taxonomically similar Bryde's whale (Department of Environment and Energy 2016b). The species is migratory, moving between Australian waters and Antarctic feeding areas. The available information suggests that sei whales are found in deeper water and have the same general pattern of migration as most other baleen whales including blue and fin whales, although the timing is generally later (TSSC 2015d). Additionally, there are no known mating or calving areas in Australian waters (Bannister *et al.* 1996). The recovery plan for the sei whale is not in force, (Blue, Fin and Sei Whale Recovery Plan 2005-2010) however there is a current *Conservation Advice Balaenoptera borealis sei whale* (TSSC 2015d). Threats identified within the conservation advice are:

- climate and oceanographic variability and change
- anthropogenic sound and acoustic disturbance
- pollution (persistent toxic pollutants)
- prey depletion due to fisheries (potential threat)
- resumption of commercial whaling (potential threat)
- habitat degradation including coastal development and port expansion
- vessel strike

The threats relevant to the proposed activity are anthropogenic sound and acoustic disturbance, vessel strike. Sei whales may be present in the deep, offshore waters of the operational area. However, it is unlikely that they will be present in significant numbers.

Fin Whale

The fin whale (*Balaenoptera physalus*) is the second largest species of whale, with a distribution known primarily from a small number of stranding events and whaling records and occurring along the west coast of Australia to NSW (TSSC 2015b, Bannister *et al.* 1996). Australian Antarctic waters are important feeding grounds for the species, and regular sightings of fin whales were documented throughout the Antarctic (TSSC 2015b). Recent observations of fin whales included opportunistic feeding in South Australia (TSSC 2015b). The migration routes and location of winter breeding grounds are uncertain, but their presence in Victorian and southern WA waters is detected in summer and autumn months (Department of Environment and Energy 2016b). These whales are rarely found inshore, and no known mating or calving areas are documented in

Australian waters. Within the *Blue, Fin and Sei Whale Recovery Plan 2005-2010* (not in effect) and the current *Conservation Advice Balaenoptera physalus fin whale 2015*. Threats identified within the conservation advice are:

- climate and oceanographic variability and change
- anthropogenic sound and acoustic disturbance
- pollution (persistent toxic pollutants)
- prey depletion due to fisheries (potential threat)
- resumption of commercial whaling (potential threat)
- habitat degradation including coastal development and port expansion
- vessel strike

Anthropogenic sound was identified as a minor threat to the species' conservation and recovery, and further assessment of acoustic impacts will require more information on spatial and temporal distribution (TSSC 2015b). Thus, while fin whales may be present in the operational area, it is unlikely that they will be present in significant numbers.

Listed Migratory Cetacean Species

LMS baleen whales whose distributions overlap with the operational area and EMBA include species that are observed infrequently and restricted to cool or deep waters (e.g. Bryde's whales). Three toothed whale species are also protected with a Migratory status: the killer whale, sperm whale and spotted bottlenose dolphin (Arafura/Timor Sea populations). As such, the likelihood of occurrence for these species within the operational area and EMBA is described below.

Bryde's whale (*Balaenoptera brydei*) sightings were recorded from all states of Australia except the NT and do not have known foraging or breeding grounds (DoEE 2016b, Bannister *et al.* 1996). However, based on the lack of accurate abundance and sighting data, important habitats or areas for either Bryde's whales are unknown (DoEE 2016b). This species may be encountered in deeper waters within the operational area and EMBA.

Killer whales (*Orcinus orca*) are the largest member of the dolphin family and recognisable by their distinctive black, white and grey colour pattern (DoEE 2016b, Reeves *et al.* 2002). The killer whale is probably the most cosmopolitan of all cetaceans and may be seen in any marine region, throughout all oceans and contiguous seas, from equatorial regions to the polar pack-ice zones, and river systems. Their habitats include oceanic, pelagic and neritic (relatively shallow waters over the continental shelf) regions, in both warm and cold waters (Reeves *et al.* 2002). They may be more common in cold, deep waters, but off Australia, killer whales are most often seen along the continental slope and on the shelf, particularly near seal colonies (DoEE 2016b).

In Australia, killer whales were recorded from all states, with concentrations reported around Tasmania, South Australia, the Antarctic territory (south of 60°S) and Heard and Macquarie Islands. Some individuals remain in the Antarctic over winter (Thiele & Gill 1999), and it is probable that most killer whales move latitudinally with changing ice conditions. Recently, the first acoustical analysis of killer whale vocalisations in Australian waters were recorded in Bremer Canyon, southern WA (more than 2,200 km away from the operational area), which described the species' acoustic characteristics and confirmed their occurrence in this area (Wellard *et al.* 2015). Also, the first satellite-tagged killer whale in Australian waters was observed preying on humpback whale calves and spinner dolphins off the Ningaloo Coast (Pitman *et al.* 2015), more than 700 km southwest of the operational area. These results confirmed the increasing occurrence of killer whales in WA, in addition to their growing predation rates on other cetaceans, particularly in response to the thriving humpback whale abundance. However, no distribution, migration or abundance information is available for Australian populations of killer whales. No BIA for killer whales exists within or adjacent to the operational area. Therefore, while this species is known to occur in the region with increasing presence, observations of killer whales within the operational area are likely to be rare and infrequent. There is no BIA for this species within the EMBA.

Sperm whales (*Physeter macrocephalus*) are found worldwide in deep waters (more than 200 m) off continental shelves and shelf edges (Bannister *et al.* 1996). Sperm whale sightings have been recorded from all Australian states, occurring around upwelling and deep canyon areas on the continental shelf (DSEWPaC 2012b). Pods of female and juvenile sperm whales reside all year throughout the region, and in contrast, male sperm whales migrate regularly to forage in the southern Antarctic waters. While specific areas for sperm whales have not been identified in the NWMR, this species is likely to occur offshore as confirmed by historical whaling records (DSEWPaC 2012b). However, key WA localities for sperm whales are between Cape Leeuwin and Esperance (Bannister *et al.* 1996), which is more than 2,500 km from the operational area. Therefore, the operational area and surrounding waters do not overlap with important habitats for this species, and only very low numbers of individual sperm whales may be present on an infrequent basis. There is no BIA for this species within the EMBA.

Spotted bottlenose dolphins of the Arafura/ Timor Sea population (*Tursiops aduncus*) inhabit warmer coastal areas, in waters less than 10 m deep (Bannister *et al.* 1996). The Arafura/Timor Sea population has a distribution that extends as far south as Exmouth, as well as the shallow waters surrounding Barrow Island and also between Barrow Island and the mainland coast. Among the Australian populations, the Arafura/Timor Sea population is the only migratory population and primarily occurring in open coastal and continental shelf waters less than 200 m deep (DSEWPaC 2012b). However, the operational area does not overlap with known BIA for this species, the closest of which is a breeding BIA at Roebuck Bay more than 200 km away and in shallow waters. There is no BIA for this species within the EMBA. Therefore, based on the operational area's distance from shore and deep-water depths, the likelihood of encountering spotted bottlenose dolphins of the Arafura/ Timor Sea population is rare and infrequent.

The dugong (*Dugong dungon)* has a large, but fragmented, Indo-West Pacific distribution and is found in Australian waters from Shark Bay, WA to Moreton Bay, Qld. The Australian populations represent approximately 19% of the global population, with a significant portion of that occurring in WA. Dugongs are mostly found near tidal and subtidal seagrass meadows as they are seagrass specialists, for example in the shallows of Eighty Mile Beach, Shark Bay and Roebuck Bay (Tol *et al.* 2016). The maximum depth range of dugongs varies with the occurrence with seagrasses, however with the limit of the photic zone being around 60 m this is often the species' distribution limit (DAWE 2020). Dugongs are not expected to occur near the vicinity of the operational area due to the lack of habitat, however they may occur along the nearshore margin of the EMBA near Eighty Mile Beach.

The Indo-pacific humpback dolphin (*Sousa chinensis*) has a worldwide distribution, and in Australia along tropical coasts down to 22°S in WA in shallow, nearshore waters. Water depth is known to affect the distribution of the species worldwide, with maximum depth preference of 25 m being common ((Jefferson et al. 2001). Indo-pacific humpback dolphins feed on estuarine and reef fishes, and occasionally crustaceans (Jefferson *et al.* 2001). Due to the lack of suitable habitat the species is not expected to occur within the vicinity of the operational area, however it is expected to occur on the nearshore margins of the wider EMBA.

4.6.4.3 Marine Reptiles

Marine Turtles

Five marine turtle species may occur within or in the waters surrounding the operational area: green, hawksbill and flatback turtles (Vulnerable and Migratory); and loggerhead and leatherback turtles (Endangered and Migratory). The Olive Ridley turtle is Endangered and identified as species or species habitat that may occur within the EMBA, however it has no identified BIA's within the EMBA.

Few marine turtles are expected to be encountered during the proposed survey activities, as there are no breeding, nesting or foraging sites for marine turtles overlapping the operational area as identified by the National Conservation Values Atlas (DoEE 2015b). The closest marine turtle BIA is located more than 100 km from the southern boundary of the operational area, this being the 80km internesting buffer for flatback turtles at Eighty Mile Beach (Figure 4.15). While some marine turtles occur within the Rowley Shoals Marine Park (DEC 2007) and in and around Mermaid Reef (DNP 2013), these reefs are not considered critical habitats for marine turtles, and there are no known significant breeding sites for marine turtles within the Rowley Shoals Marine Park (Environment Australia 2003). The *Recovery Plan for Marine Turtles in Australia 2017-2027* identifies "habitat critical of the survival of a species" ('habitat critical'), several of which occurs within the EMBA. Note that this is not "Critical Habitat" as defined under Section 207A of the EPBC Act.

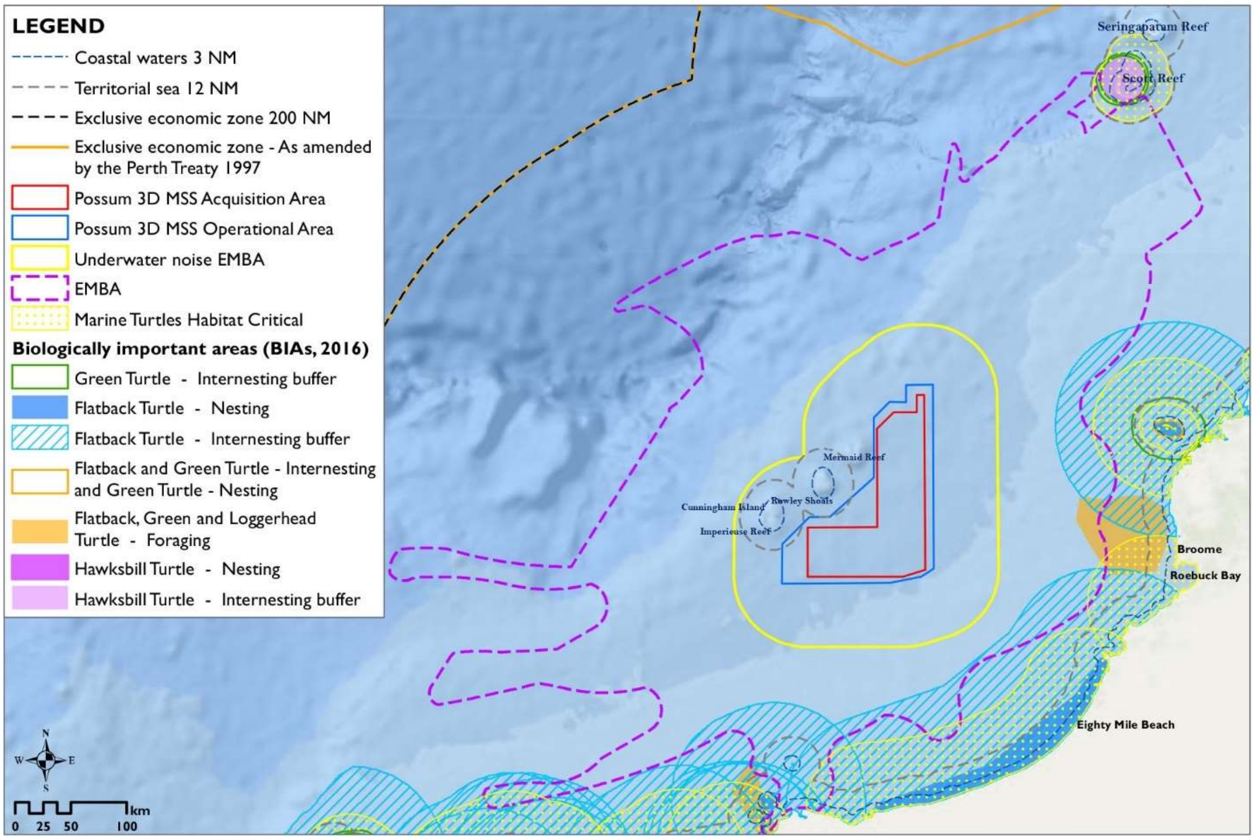


Figure 4.15 – BIA's and habitat critical for marine turtles within the Possum 3D MSS operational area and EMBA

The six species of marine turtles that may occur within the operational area or EMBA are all identified within the *Recovery Plan for Marine Turtles in Australia 2017-2027* (DoEE 2017; the Recovery Plan). The leatherback turtle is also subject to the Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle) 2008.

Threats identified within the Recovery Plan are:

- climate change and variability
- marine debris
- chemical and terrestrial discharge
- International & Indigenous take
- Terrestrial predation
- Fisheries bycatch
- Light pollution
- Habitat modification
- Vessel disturbance
- Noise Interference
- Recreational activities
- Diseases and Pathogens

The threats relevant to the proposed activity are Light pollution, Vessel disturbance and Noise interference. The Recovery Plan identifies acute sound interference from anthropogenic sound sources, such as seismic surveys, as a threat to the stocks of green, flatback and loggerhead turtles in the North West Shelf and Pilbara region.

Table 4.7 – Summary of marine turtle ecology within the NWMR (DoEE 2017)

Species	Leatherback Turtle	Flatback Turtle		Green Turtle		Hawksbill Turtle	Loggerhead Turtle	Olive Ridley Turtle
Genetic Stock	Australia	South-West Kimberley	Pilbara	North West Shelf	Scott – Browse	WA	WA	Australia (unknown)
Nesting Season	Dec – Jan	Oct – Mar (peak Dec/Jan)	Oct – Mar	Nov – Mar	Nov – Mar	Oct – Feb	Nov – May	May – Jul

Species	**Leatherback Turtle**	**Flatback Turtle**		**Green Turtle**		**Hawksbill Turtle**	**Loggerhead Turtle**	**Olive Ridley Turtle**
Internesting Buffer	20 km radius	60 km radius	60 km radius	20 km radius	20 km radius	20 km radius	20 km buffer	20 km buffer
Hatching Season	Feb – Mar	Dec – May (peak Feb/Mar)	Dec – May	Jan – May	Jan – May	Dec – May	Jan – May	Jul – Sept

Most species of marine turtles migrate large distances between foraging and nesting areas. Between their nesting and foraging grounds, olive ridley turtles and green turtles migrate up to 1,130 km and 2,600 km, respectively (Whiting *et al.* 2005; DSEWPaC 2012d). Thus, it is reasonable to conclude that low numbers of marine turtles may transit through the operational area, such as flatback turtles that nest at Eighty Mile Beach or along the Pilbara Coast (both of which are more than 180 km from the operational area) and migrate along the continental shelf toward their Kimberley foraging habitats. However, based on the remote distance offshore and the absence of critical habitats or BIAs within the operational area, it is highly unlikely that significant numbers of the marine turtles will occur within the operational area, and their occurrence is expected to be rare and infrequent.

Sea Snakes

Twenty-two species of sea snakes are likely to occur in WA (Storr *et al.* 1986). However, the distribution of individual species, population sizes and ecology remain mostly unknown (DEWHA 2008). Sea snakes are widespread throughout the offshore and near-shore habitats of the NWMR. Some species are highly mobile and travel large distances, while others are restricted to relatively shallow waters. Most sea snakes have shallow, benthic feeding patterns and are rarely found in water depths exceeding 30 m (Cogger 1975).

Twelve species of sea snakes protected under the EPBC Act as marine species may occur within or adjacent to the operational area. However, given the operational area's deep water depths (118-566 m) substantial distance from shore, and the noticeable absence of sea snakes from the adjacent Rowley Shoals (Edgar et al 2017), it is unlikely that large numbers of sea snakes will be encountered within the operational area, and any occurrence will likely be rare and infrequent.

An additional eight species of sea snake are expected to occur within the EMBA, including the Critically Endangered short-nosed sea snake and the Leaf-scaled sea snake. The short-nosed sea snake is managed under the Approved Conservation Advice for *Aipysurus apraefrontalis* (Short nosed Sea Snake) (TSSC 2010a). The Leaf-scaled Sea snake is managed under the Approved Conservation Advice for Aipysurus foliosquama (Leaf-scaled Sea Snake) (TSSC 2010b). Both species have been recently recorded in field surveys with the short-nosed sea snake in Exmouth Gulf and Ningaloo Reef and the Leaf-scaled Sea snake in Shark Bay (D'Anastasi *et al.* 2016). Historical sightings (CALM surveys in 2002) at Ashmore Reef have not been reproduced in more recent, intensive survey effort (D'Anastasi *et al.* 2016). Both species typically occur in shallow water (less than 10 m) in the protected parts of the reef flat (TSSC 2010a/b) and any occurrence will likely be rare and infrequent. There are no LMS of sea snake expected to occur within the operational area or EMBA.

Crocodiles

The salt-water crocodile (*Crocodylus porosus*) is a globally-distributed crocodilian species, occurring in the northern tropics of Australia (Kay 2004). The preferred habitat of the species is saltwater environments such as estuaries and tidal flats over a large range of salinities and are known to undertake long-haul ocean voyages over hundreds of kilometres (Kay 2004). In the absence of tracking data, mark-recapture studies suggest that males have significantly large home ranges and will lead a nomadic lifestyle whereas females have a tendency to occupy a smaller home range along riverbanks (Kay 2004). The salt-water crocodile is not expected to occur within the operational area, however, may occur along coastal fringes in the wider EMBA.

4.6.4.4 Sharks and Rays

The NWMR supports large populations of cartilaginous fish such as sharks and rays, which are typically higher-order predators and perform an important ecological role of prey species regulation. Shark species abundance is considerable on the Rowley Shoals. Surveys around Mermaid Reef confirmed a diverse shark fauna, including important areas for the grey reef shark (*Carcharhinus amblyrhynchos*), the whitetip reef shark (*Triaenodon obesus*) and the silvertip whaler (*C. albimarginatus*). A survey conducted over the Rowley Shoals and the North-West Commonwealth Marine Reserves Network in 2013 (Edgar *et al.* 2017) found the highest biomass of sharks to be at Mermaid Reef, and the lowest at Clerke Reef.

Ten species of sharks and rays were identified by a PMST search (Appendix B), that may occur within the operational area. Of these, four species have a Threatened status of "Vulnerable": the great white shark, largetooth sawfish, green sawfish and whale shark and may occur within the operational area. A further three species may occur within the EMBA: the Endangered northern river shark, Vulnerable dwarf sawfish and grey nurse shark.

White Shark

The white shark (great white shark; *Carcharodon carcharias*) is listed as Vulnerable and Migratory under the EPBC Act and is protected under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). They inhabit temperate waters close inshore or on the continental shelf in water less than 100 m deep. Although their range extends into the NWMR, great white sharks are not commonly found north of Northwest Cape (DSEWPaC 2012c, Bruce *et al.* 2006). Telemetry data from satellite-tagged great white sharks confirm their migrations across deep ocean basins, as a great white shark tagged in South Africa had the fastest transoceanic return migration to Exmouth Gulf, WA, within nine months and over 20,000 km (Bonfil *et al.* 2005). However, there are no known aggregation sites for great white sharks in the NWMR, and this species is most likely to be found south of North West Cape, probably in low densities (Environment Australia 2002b). The principal threat to the white shark in WA relates to bycatch and illegal fishing. Seismic activities or vessel strikes are not considered a threat (DSEWPaC 2013). Of the ten objectives outlined within the *White Shark Recovery Plan* (DSEWPAC 2013), none related to actions associated with seismic sound or vessel movements. However, Objective 3 states 'Quantify and minimise the impact of recreational fishing on the white shark through incidental (illegal and/or accidental) take, throughout its range in Australian waters'.

No critical habitats in the NWMR have been identified for the great white shark, which only resides in areas temporarily without any known territorial defence (DSEWPaC 2013). Furthermore, identified recovery threats to the Australian populations do not include exposure to underwater sound (DSEWPaC 2013). Great white sharks are not expected to be encountered within the operational area.

Whale Shark

The whale shark (*Rhincodon typus*) is listed as Vulnerable and Migratory under the EPBC Act and classified as Vulnerable on the World Conservation Union's Red List of Threatened Species (IUCN 2015). In WA, whale sharks are protected under the *Biodiversity Conservation Act 2016,* the *Conservation and Land Management Act 1984* and the *Fish Resources Management Act 1994*. Management practices and measures contained within the *Whale Shark Recovery Plan 2005-2010* (DEH 2005) are implemented through State legislation, Marine Protected Area Management Plans, and the Whale Shark Management Plan program no. 57 (DpaW 2013). The whale shark is also WA's marine animal emblem. Critical habitats identified in the Whale Shark Recovery Plan 2005-2010 (DEH 2005) are the known seasonal aggregation sites (Ningaloo Reef in WA), which are believed to be linked to local seasonal food availability where shallow bathymetry in close proximity to deeper water is known to induce upwelling events (Copping *et al.* 2018).

The Approved Conservation Advice for the whale shark (2015) does not identify underwater sound as a threat to the species, however habitat disruption and boat strike are identified as threats to the recovery of whale sharks in Australian waters. The WA *'Whale Shark Management with particular reference to Ningaloo Reef' Wildlife Management Program No. 57*. (DpaW 2013) identifies sound from commercial vessels as populational disturbances to the whale shark. Whale sharks have been observed to dive in response to nearby boat motors (pers. Comm. Referenced in DpaW 2013).

This species is normally oceanic and cosmopolitan in their distribution, occurring in both tropical and temperate waters (Meekan & Radford 2010). Whale sharks are commonly encountered close to or on the surface of the water, although they are known to be deep divers and absent for long periods of time. They are strong but slow swimmers, typically travelling ~24 km/day (Eckert *et al.* 2002).

There is a general lack of knowledge on many aspects of whale shark biology, including definitive migration patterns. In WA, they are known to aggregate in Ningaloo Reef from March–July, and travel northward of the Ningaloo Marine Park along the 200 m contour from July–November each year (TSSC 2015c, Colman 1997, Wilson *et al*. 2006; Figure 4.16). However, the migratory timing is variable, and individual whale sharks have been recorded at other times of the year (Wilson *et al.* 2001). In the waters adjacent to Ningaloo Reef, whale shark presence coincides with the coral mass spawning period, during which time there is an abundance of prey resources (i.e. krill, planktonic larvae and schools of bait fish). Population abundance estimates of whale sharks in the Ningaloo aggregation area are between 300 and 500 individuals (Meekan *et al.* 2006).

Preliminary research on the migration patterns of whale sharks showed that after departing Ningaloo Reef in July, they migrate north through the NWMR, with some individuals passing Scott and Ashmore Reefs (Wilson *et al.* 2006). McKinnon *et al.* (2002) tracked two whale sharks: one travelling along the shelf break towards Timor in Indonesia and the other tracked travelling northwest to Christmas Island. Another tagged whale shark spent 115 days travelling northeast along the 200 m contour passing by Scott Reef, towards Timor Leste (Meekan & Radford 2010). Short-term tags recorded whale sharks moving northwest into the Indian Ocean and directly north towards Sumatra and Java. Novel satellite tracking undertaken by ECOCEAN over 2015-2016 tracked 12 individuals from Exmouth on their northern migration for up to 155 days (Reynolds *et al.* 2016; Figure 4.16).

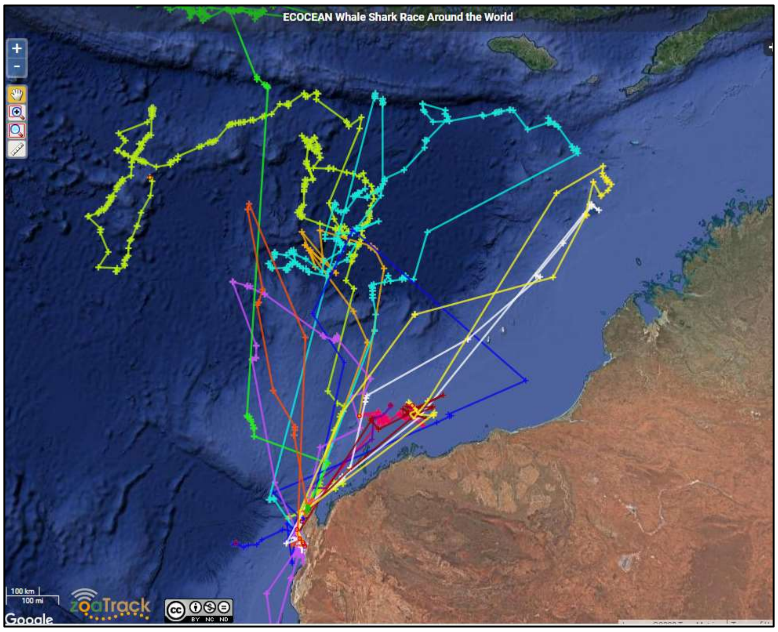


Figure 4.16 – Telemetry data of migrating whale sharks off Exmouth (Reynolds *et al.* 2016)

A foraging BIA for whale sharks slightly overlaps the southern edges of the operational area (Figure 4.17). The potential migration period (i.e. sensitive period) for whale sharks through the operational area is from July–November and along the 200 m isobath (TSSC 2015c). Thus, it is possible that whale sharks may be encountered if the proposed survey activities extend into July. However, due to low population abundance estimates as well as unknown and irregular movements, it is not expected that whale sharks will be encountered in significant numbers, and any observation of solitary individual whale sharks are likely to be rare and infrequent.

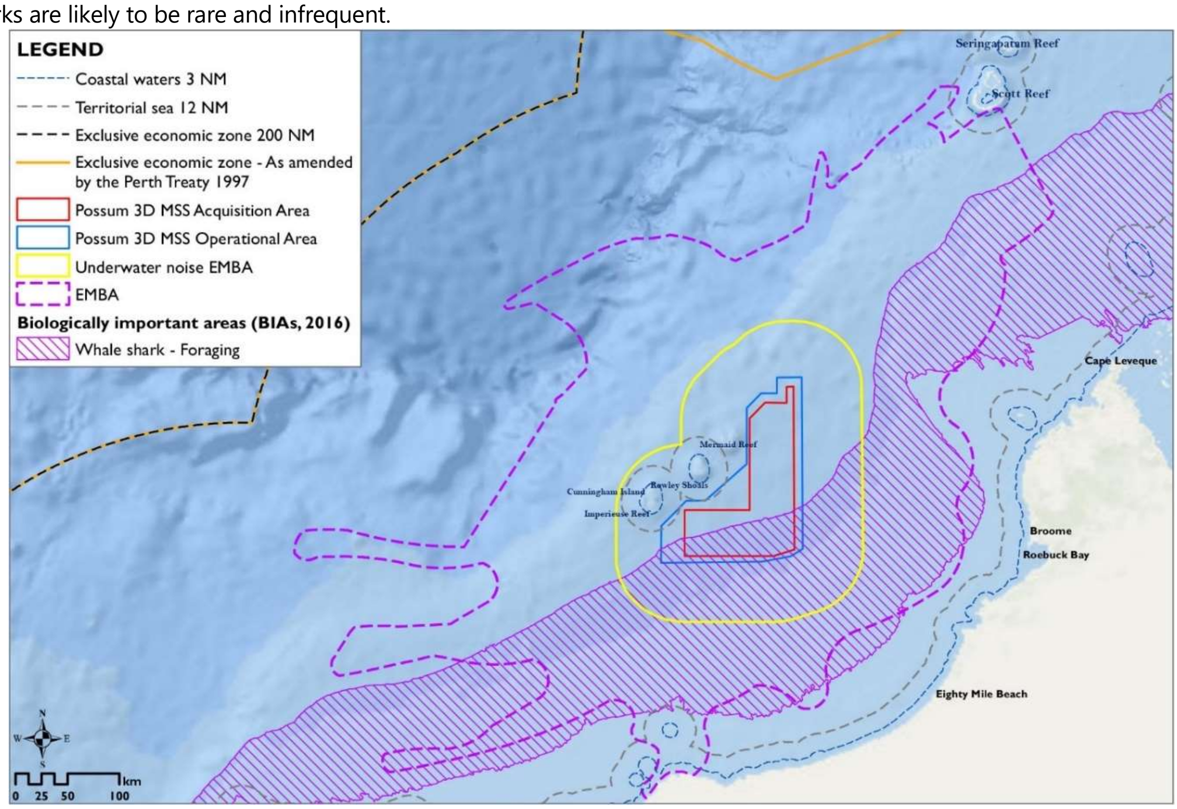


Figure 4.17 – Whale shark BIA within the Possum 3D MSS operational area and EMBA

Sawfish

The largetooth sawfish (*Pristis pristis*; previously known as the freshwater sawfish) is listed as a Vulnerable species under the EPBC Act (DSEWPaC 2012c, DEWHA 2008). They are found over a wide range of salinities from freshwater to the oceans, giving rise to the fish being categorised as a 'euryhaline' species. Northern and north-western Australia comprise the remaining significant population for this species of fish, which is confined to freshwater drainages and the upper reaches of estuaries, occasionally being found at sea. The largetooth sawfish BIA sits in the shallow waters of Roebuck Bay, which is more than 230 km from the operational area.

Also listed as Vulnerable under the EPBC Act, the green sawfish (*Pristis zijsron*) is a species of shark recorded across northern Australia and generally in coastal waters (DoEE 2016b, DEWHA 2008). As with other sawfish species, the green sawfish mainly inhabits shallow, soft sediment coastal and estuarine environments, but has also been recorded in tropical and sub-tropical water up to 70 m deep (DSEWPaC 2012c). A BIA for green sawfish is designated at Eighty Mile Beach, which is more than 190 km from the operational area. The Sawfish and River Sharks Multispecies Recovery Plan 2015 does not identify underwater sound as a threat to either the largetooth or green sawfish.

Based on their habitat preference of shallow, inshore waters of rivers and estuaries of northern Australia, it is unlikely that either the largetooth or green sawfish will be encountered in the offshore waters of the operational area, however they may occur within the EMBA.

The dwarf sawfish (*Pristis clavate*) is listed as a Vulnerable species under the EPBC Act and is managed under the Sawfish and River Sharks Multispecies Recovery Plan 2015 and Approved Conservation Advice for *Pristis clavate* (Dwarf Sawfish) 2009. The species is distributed in shallow coastal and estuarine waters (2-3 m) from Exmouth, WA to the western side of Cape Tribulation. There are no records of the dwarf swordfish outside of Australian waters. As the habitat of the species is considered to be inshore this species is not expected occur within the EMBA or OA.

Northern River Shark

The northern river shark (*Glyphis garricki*) species is listed as Endangered under the EPBC Act and is managed under the Sawfish and River Sharks Multispecies Recovery Plan (Commonwealth of Australia 2015). The northern river shark can move between freshwater and seawater environments, with the species utilising rivers, tidal sections of large tropical estuarine systems, microtidal embayment's, inshore and offshore marine habitats (DoEE 2014). Neonates, juveniles and subadults have been recorded in freshwater, estuarine and marine environments, whereas adults have only been recorded in the marine environment (DoEE 2014). The presence of animals well offshore suggests northern river sharks undertake movements away from rivers and estuaries and therefore likely to move between river systems, however, the extent to which this occurs, and the distances moved is unknown (DoEE 2014). Northern river sharks are believed to be endemic to Australia and southern New Guinea, and outside of Australia, the species is known from only a few specimens from the Fly River in Papua New Guinea (DoEE 2014). The global population size of northern river sharks is unknown and the relationship between the Australian and global populations is poorly understood (DoEE 2014). The northern river shark (*Glyphis garricki*) is not expected to occur within the operational area, however may occur within the EMBA

Grey nurse shark

The grey nurse shark (*Charcharias taurus*) is listed as Critically Endangered in Australian waters. The eastern Australian population is considered to be the most threatened population globally (Stow *et al.* 2006). The grey nurse shark has a widespread global distribution in shallow nearshore waters. Grey nurse sharks have a low population replenishment rate due to the process of more developed young consuming the less developed whilst in the womb, severely reducing the pupping rate and increasing the species' susceptibility to external pressures. Grey nurse sharks are not expected to occur within the operational area, however may occur in the shallow coastal waters of the wider EMBA.

Listed Migratory Shark and Ray Species

The narrow sawfish (*Anoxypristis cuspidata*) is listed as Migratory under the EPBC Act. This species is managed under the Sawfish and River Sharks Multispecies Recovery Plan 2015 and may occur within the operational area and EMBA. The species is benthopelagic and can be found in marine and coastal waters down to 40 m (Chen *et al.* 2016), however most often occur in estuarine habitats and river deltas and most commonly occur in waters off Queensland (D'Anastasi *et al.* 2013).

The oceanic whitetip shark (*Carcharhinus longimanus*) is listed as Migratory under the EPBC Act. The oceanic whitetip shark is found in pelagic waters throughout the tropics and sub-tropics, preferring waters above 20^{o}C and reaching depths > 180m. Stretching from Cape Leeuwin they are found through parts of the Northern Territory, down the east coast of Queensland and New South Wales to Sydney, however has not been recorded within the Gulf of Carpentaria or the Arafura Sea. (Dulvy *et al.* 2019). Given the range and preferred habitats it is likely that the oceanic whitetip shark will be encountered infrequently within the operational area.

The shortfin mako and longfin mako sharks (*Isurus oxyrinchus, Isurus paucus*) are listed as Migratory under the EPBC Act. The longfin mako is a widely-distributed, but rarely-encountered, oceanic shark that ranges from Geraldton, WA, and around the north coast to at least Port Stephens, New South Wales (DSEWPaC 2012c). The shortfin mako is an oceanic and pelagic species and occurs in all Australian waters except the Arafura Sea, Gulf of Carpentaria and Torres Strait (TSSC 2014). The range and preferred habitats of the shortfin mako are not considered restricted or limited, and they are found throughout temperate seas in waters between 10 and 24ºC (Rogers *et al.* 2009). Based on telemetry data, shortfin mako sharks were primarily recorded (80% data) in water 320–600 m in the Great Australian Bight (Rogers *et al.* 2009). Therefore, based on their oceanic, deep water preferences, it is likely that shortfin or longfin mako sharks will be encountered infrequently within the operational area.

In 2009, the giant manta ray (*Manta birostris*) was reclassified into two distinct species: the giant and the reef manta rays. The giant manta rays are oceanic and migratory species found in cool temperate to subtropical waters north of 26°S (Armstrong *et al.* 2020). The reef manta ray behaviours range from strong site fidelity (i.e. re-sighted in the same area over several years) to large scale migrations over 700 km (Courturier *et al.* 2015, 2014). Both species have been recorded as being sympatric in some locations and allopatric in others (Kashiwagi *et al.* 2011 as cited in DSEWPaC 2012a). The giant manta ray is commonly sighted inshore, around coral reefs and rocky reefs in coastal areas along the WA and NT coasts. They have been recorded at Clerke Reef, Scott Reef, Ningaloo Reef, Canyons linking the Cuvier Abyssal Plain with the Cape Range Peninsula and internal waters off the Kimberley coast (Edgar et. Al. 2017; DSEWPaC 2012a)., It is possible that giant manta rays may be encountered within the operational area, however observations of giant manta rays offshore are likely to be rare and infrequent.

4.6.4.5 Fishes

Thirty-one (31) species of syngnathids were identified as 'may occur' in the operational area with a further nine that may occur within the wider EMBA (Appendix B) however none of are identified as Threatened or Migratory under the EPBC Act. Species within this family typically are site-attached and associated with shallow reef habitats 0-60 m depth. Species in the Halicampus genus (of which four appear in the PMST report for the operational area and additional one in the wider EMBA) commonly occur as adults in estuarine environments and the terminal reaches of coastal streams and mangroves rather than on coral reefs or in the open sea (Dawson 1985) and so are unlikely to be found within the operational area.

Site-attached fishes

It is not expected that there is any coral reef associated site-attached fish assemblages within the operational area due to the water depth being below the photic zone. The Rowley Shoals adjacent to the operational area and within the EMBA support a wide variety of fish, site-attached fishes would also be expected within the Scott Reef complex and the Glomar Shoals at the farthest extents of the EMBA.

Over 500 fish species, including many species not found on nearshore coral reefs, are known to occur in the Rowley Shoals. As well as being inhabited by several species not recorded from other WA coral reefs, the coral and fish communities of the Rowley Shoals are unique in their composition and relative abundance of species (Edgar et al. 2017). The marine communities of the Rowley Shoals are more characteristic of south-east Asia than other WA reefs. Scott Reef is a submerged reef more than 250 km from the mainland and other reefs within the region, rising from 300 -700 m (DAWE 2020). Scott Reef is known as a highly diverse reef system supporting over 300 species of corals, 400 molluscs, 118 crustaceans, 117 echinoderms and approximately 720 fish species (Woodside 2007).

Site-attached fish assemblages of the Rowley Shoals are comprised of small to medium sized species and are most abundant from 30 – 40 m depth in association with hard coral coverage. Invertebrate species (excluding corals) at the Rowley Shoals include sponges, cnidarians (e.g. jellyfish, anemones), worms, bryozoans (e.g. sea mosses), crustaceans (e.g. crabs, lobsters, etc.), molluscs (e.g. cuttlefish, baler shells, giant clams, etc.), echinoderms (e.g. starfish, sea urchins) and sea squirts (DEC 2007). The most common macroinvertebrate recorded in recent biological surveys at the Rowley Shoals, the Trinidad clam (*Tridacna crocea*), was at least six times more abundant in this shoal system than any other in the NWMR, and cryptic fish occurrence was twice more likely on Mermaid and Clerke Reef than at Imperieuse Reef (Edgar et al 2017). Surveys have also identified 389 species of finfish at the reefs (DEWHA 2008). Mermaid and Clerke Reefs, along with Scott Reef, had the highest biomass of large (more than 20 cm) reef fishes in comparison to other recently surveyed reefs of the NWMR network (Edgar et al. 2017). The most commonly occurring species across the three reef systems include the fine-lined tang (*Ctenochaetus stiraus*) occurring on 98% of surveys across the reefs, the daisy parrotfish (*Chlorurs sordidus*, 92%), cleaner wrasse (*Labroidess dimidiatus*, 86%), bird-nose wrasse (*Gomphosus varius*, 86%) and peacock grouper (*Cephalopholis argus*, 82%) (Reef Life Survey 2020). The abundance and composition of reef fish assemblages changes to species that are not considered site-attached in depths greater than 50 m (Brokovich et al. 2008; Bejarano et al. 2014).

The Glomar Shoals, located in the EMBA, are geographically isolated from other emergent features in the region and so provide important habitat for site-attached fishes. Hard coral cover was found down to 60 m water depth from a multibeam survey conducted in 2013 (Wahab *et al.* 2018). Stereo Baited Remote Underwater Video Stations (SBRUVS) surveys were completed at the same time and found a high abundance of lyretails, triggerfish, bryozoans, hydroids, urchins, zoanthids, ascidians, anemones, annelids, crinoids, holothurians, corallimorphs, starfish, and gastropods (Wahab *et al.* 2018).

4.6.4.6 Avifauna

Twelve (12) LMS of avifauna (seabirds and shorebirds) may occur within the operational area, including four LTS: the far eastern curlew, red knot, Abbot's booby and Greater Sand Plover. A further nine LTS may occur in the wider EMBA: the curlew sandpiper, northern Siberian Bar-tailed Godwit, southern giant petrel, night parrot, Australian painted snipe, painted snipe, Australian Lesser Noddy and Australian fairy tern, and the bar-tailed godwit (baueri). Nine LMS may occur in the operational area and 13 additional LMS may occur within the wider EMBA.

Migratory shorebirds are listed as Migratory and Marine species under the EPBC Act, and many are also listed under the Convention on Migratory Species. Additionally, some species are listed on the CAMBA, the JAMBA, or the ROKAMBA.

Far Eastern Curlew

The far eastern curlew (*Numenius madagascariensis*) is listed as critically endangered under the EPBC Act and managed under the Conservation Advice *Numenius madagascariensis* eastern curlew (DoEE 2015e). The species is the largest migratory shorebird in the world with a wingspan of approximately 110 cm (DAWE 2020). The eastern curlew has a primarily coastal distribution, rarely being recorded inland (DAWE 2020). They have a continuous distribution from Barrow Island and Dampier Archipelago, WA, through the Kimberley and along the NT, Queensland, and NSW coasts and the islands of Torres Strait (DAWE 2020). The eastern curlew does not breed in Australia (DAWE 2020). The eastern curlew mainly forages on soft sheltered intertidal sandflats or mudflats, open and without vegetation or covered with seagrass, often near mangroves, on salt flats and in saltmarsh, rockpools and among rubble on coral reefs, and on ocean beaches near the tideline (DAWE 2020). There is no BIA for this species within the EMBA. There is habitat on Rowley Shoals that could support this species, however they have not been recorded there and are not expected to occur.

Red Knot

The red knot (*Calidris canutus*) is listed as endangered under the EPBC Act and managed under the Conservation Advice *Calidris canutus* Red knot (TSSC 2016). The species is a small seabird with a wingspan of approximately 45-54 cm (DAWE 2020). The red knot mainly inhabits intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs (DAWE 2020). The red knot usually forages in soft substrate near the edge of water on intertidal mudflats or sandflats exposed by low tide (DAWE 2020). Red knots have also been recorded foraging on beds of eelgrass on tidal sandflats, on a thick algal mat in shallow waters, and in shallow pools on crest of coral reef (DAWE 2020). The red knot roosts on sandy beaches, spits and islets, and mudflats; also, in shallow saline ponds of saltworks (DAWE 2020). There is no BIA for this species within the EMBA. There is habitat on Rowley Shoals that could support this species, however they have not been recorded there (Lapwood 2004) and so are not expected to occur.

Abbot's Booby

The Abbott's booby (*Papasula abbotti*) is listed as endangered under the EPBC Act and managed under the Conservation Advice *Papasula abbotti* Abbott's booby. Currently the species is only known to breed on Christmas Island and to forage in the waters surrounding the island (DAWE 2020). The species is a marine species, spending most of its time at sea, but comes ashore to breed (DAWE 2020). Abbott's booby feeds on squid and fish and are known to go on long fishing trips in a north-west direction, towards one of the major upwellings (DAWE 2020). It is thought the species can travel up to 400 km to feeding grounds when they are breeding (DAWE 2020). There is no BIA for this species within the EMBA and due to the distance between Christmas Island and the operational area (more than 400 km) they are not expected to occur, however may occur in the outer extent of the EMBA.

Greater Sand Plover

The Greater Sand Plover (*Charadrius leschenaultii*) is listed as Vulnerable under the EPBC Act and managed under the Conservation Advice *Charadrius leschenaultia* Greater sand plover. The greater sand plover is mainly found in northern Australia however distribution in Australia during the non-breeding season is widespread. n Western Australia they are especially widespread between North West Cape and Roebuck Bay and also occasionally recorded along the coast of southern Western Australia (TSSC 2016a). The species has also been recorded on Ashmore Reef, Cocos (Keeling) Islands, Christmas Island and Lord Howe Island (TSSC 2016a). Breeding in the northern hemisphere during the boreal summer, the Greater Sand Plover is known to annually migrate to the non-breeding grounds of Australia along the East Asian-Australasian Flyway for the austral summer (TSSC 2016a). The species is almost entirely coastal, inhabiting littoral and estuarine habitats (TSSC 2016a), therefore they are not expected to occur in the Operational Area, however may occur in the outer extent of the EMBA.

Curlew Sandpiper

The curlew sandpiper (*Calidris ferruginea*) is listed as critically endangered under the EPBC Act and managed under the Conservation Advice *Calidris ferruginea* curlew sandpiper (DAWE 2020). This species is a small, slim sandpiper with a wingspan of approximately 38-41 cm (DAWE 2020). The curlew sandpiper's distribution is around the coasts and are also quite widespread inland, though in smaller numbers (DAWE 2020). Curlew sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms (DAWE 2020). The species rarely forages on exposed reefs (DAWE 2020), and hence is unlikely to be encountered in the operational area or EMBA. There is no BIA for this species within the EMBA, however they have been known to occur on the Rowley Shoals (Lapwood 2004).

Northern Siberian Bar-tailed Godwit

The Northern Siberian Bar-tailed Godwit (*Limosa lapponica menzbieri*) is listed as critically endangered under the EPBC Act and managed under the Conservation Advice *Limosa lapponica menzbieri* Bar-tailed godwit (northern Siberian). The bar-tailed godwit (northern Siberian) is a large migratory shorebird that breeds in northern Siberia, Russia. The species spends the nonbreeding period mostly in the north and northwest of WA, but has been recorded in areas of all Australian states mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays (TSSC 2016b). They are not expected to occur in the Operational Area, however, may occur in the outer extent of the EMBA.

Southern giant petrel

The southern giant petrel (*Macronectes giganteus*) is widespread throughout the Southern Ocean. It breeds on six subantarctic and Antarctic islands in Australian territory (DSEWPaC 2011). In summer, it predominantly occurs in subantarctic to Antarctic waters. The winter dispersal is circumpolar, extending north from 50°S to the Tropic of Capricorn (23°S) and sometimes beyond these latitudes. The waters off south-eastern Australia may be particularly important wintering grounds (Marchant & Higgins 1990). In south-eastern Australia, birds (mostly immatures) were recorded in all months except February, but most were recorded between June and December (Reid et al. 2002).

The National recovery plan for threatened albatrosses and giant petrels 2011–2016 (DSEWPaC 2011) lists the key critical habitat for the southern giant petrel as breeding and foraging habitats, particularly below 25°S. The key threats to albatrosses and giant petrels are impacts at their breeding sites (including feral animals), marine pollution and debris, impacts from longline fishing and trawling, ingestion of hooks and plastics, intentional shooting/killing, and collisions with gear used on fishing boats (DSEWPaC 2011). At the northern limit of their range, it is not expected to be encountered in the operational area or EMBA.

Night Parrot

The Night Parrot (*Pezoporus occidentalis*) is listed as endangered under the EPBC Act and managed under the Conservation Advice *Pezoporus occidentalis* night parrot. The night parrot is a medium-sized, nocturnal, ground-feeding parrot. The current distribution of the night parrot is not known however there are accepted historical records from remote arid inland regions of Western Australia and sightings in the Pilbara, Western Australia. The species has been reported, with a noted lack of evidence, to be nomadic and have very large home ranges, moving dependent on seed availability. Their habitat consists of grasslands and/or chenopod shrublands and occasional watercourses with roosting and nesting sites within clumps of dense vegetation, primarily old and large Spinifex clumps . They are not expected to occur in the Operational Area and are unlikely to be encountered in the wider EMBA (TSSC 2016c).

Australian painted snipe

The Australian painted snipe (*Rostratula benghalensis*) and painted snipe (*Rostratula benghalensis (sensu lato)*) are listed as endangered under the EPBC Act and managed under the approved Conservation Advice for Rostratula australis (Australian painted snipe) 2013. This species has been recorded at wetlands in all states of Australia but is most common in eastern Australia, with records throughout much of QLD, NSW, VIC and south-eastern SA. Australian painted snipes generally inhabit shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They are not expected to be encountered within the Operational Area or EMBA due to the lack of habitat.

Australian Lesser Noddy

The Australian Lesser Noddy (*Anous tenuirostris melanops*) is listed as vulnerable under the EPBC Act and managed under the Conservation Advice *Anous tenuirostris melanops* Australian lesser noddy. This tropical tern has a long slender straight bill, long narrow wings and slightly wedgeshaped tail. A unconfirmed population is thought to possibly breed on Ashmore Reef however generally the species is confined to the tropical and subtropical Indian Ocean and breeds only on three islands in the Houtman Abrolhos, off Western Australia. It nests in mangroves and appears to remain near the breeding islands all year (TSSC 2016d). They are not expected to be encountered within the Operational Area however, may occur in the outer extent of the EMBA.

Australian fairy tern

The Australian fairy tern (*Sternula nereis nereis*) is found between Australia, New Zealand and New Caledonia on sheltered sandy beaches, offshore islands and wetlands. The WA population seems to be stable and is not known to migrate, however the Tasmanian, Victorian and South Australian populations migrate and have declining populations with less than a few hundred pairs (DAWE 2020). Individuals roost on sandy beaches at night and forage for small baitfish in daylight. This species is not expected to occur in the Operational Area but may occur on sandy beaches in the EMBA.

Grey Falcon

The Grey Falcon (*Falco hypoleucos*) is listed as vulnerable under the EPBC Act and managed under the Conservation Advice *Falco hypoleuco*s Grey Falcon. The Grey Falcon is an elusive species endemic to mainland Australia. It is a medium-sized raptor and the rarest of six Australian members of the genus Falco (TSSC 2020). The species occurs mainly where annual rainfall is less than 500 mm in arid and semi-arid Australia, including the Murray-Darling Basin, Eyre Basin, central Australia and Western Australia. Grey Falcons mainly feed on birds, small mammals and lizards. The species frequents timbered lowland plains, particularly acacia shrublands that are crossed by tree-lined water courses (TSSC 2020). They are not expected to be encountered within the Operational Area, however, may occur in the outer extent of the EMBA.

Bar-tailed godwit

The bar-tailed godwit (*Limosa lapponica*) is a large wader species that migrates from breeding grounds in north Eurasia from Taymyr to Lappland . This species can be found throughout the coastal areas of all Australian states in the summer months. This species is found in coastal habitats including wetlands, lagoons, mudflats and sandflats. They are less likely to occur on sandy beaches. This species is not expected to occur within the Operational Area but may frequent habitat on the coastal fringe of the wider EMBA.

Tropicbirds

Tropicbirds are predominantly pelagic species, rarely coming to shore except to breed. Bedwell Islet (of Clerke Reef) is recognised as a breeding and foraging BIA for a single pair of white-tailed tropicbirds (*Phaethon lepturus*) that breed in May and October (DSEWPaC 2012e; Figure 4.23). The species nests in hollows and has been known to construct experimental artificial stone structures for nesting. The red-tailed tropic bird (*Phaethon rubricauda*) is also known to breed on Bedwell Islet and this location is one of only two known breeding locations in WA for the species, although this is not a recognised BIA for the red-tailed variety. Both the red and white-tailed tropicbird forages in warm waters and over long distances (up to 1,500 km away from breeding sites) on fish and cephalopods by plunge-diving (DSEWPaC 2012e). Both the red- and white-tailed tropicbird may be encountered, particularly since breeding pairs are known to occur at the Rowley Shoals.

Little Tern

Bedwell Islet and Cunningham Islet (of Imperieuse Reef) are identified as a resting BIA (Figure 4.18) for the little tern (*Sternula albifrons;* Figure 4.18). The little tern is widespread in Australia, with breeding sites widely distributed from north-western WA, around the northern and eastern Australian coasts to south-eastern Australia and Tasmania. While there is a small resident population in the Kimberley region, the species breeds in small numbers along Eighty Mile Beach (more than 180 km away from the operational area). The little tern breeds from December–March, and the population migrates or disperses during the non-breeding season (DSEWPaC 2012e). The little tern forages close to breeding colonies in the shallow water of estuaries, coastal lagoons and reefs inshore of the operational area. It mainly feeds on small fish but also on crustaceans, insects, annelids and molluscs (DSEWPaC 2012e). While the little tern is classified as a non-breeding visitor, they utilise the offshore reefs and islands of the Rowley Shoals as resting areas. Significant numbers of little terns are unlikely to be encountered during the survey, and observations would be limited to transient individuals during their migration between their breeding grounds and the offshore areas of the NWS. Based on the ecology of the species, it is unlikely that significant numbers of the little tern will be encountered within the Operational Area, and any occurrence will be temporary and infrequent as individuals transit the area.

Listed Migratory Avifauna Species

Three species of sandpiper, the common (*Actitis hypoleucos*), sharp-tailed (*Calidris acuminata*) and pectoral (*Calidris melanotos*) sandpiper may occur within the operational area and EMBA. The common and sharp-tailed sandpiper breeds in Europe and Asia, visiting Australian coastal wetlands or marshes in Australian summer (BirdLife Australia 2020). The pectoral sandpiper is rarely recorded in WA as it breeds in northern Russia and North America before migrating to shallow saline wetlands in Australian summer (DAWE 2020). There are no BIA for these species within the EMBA.

The Asian Dowitcher (*Limnodromus semipalmatus*) is a large shorebird that migrates southwards to overwinter in Asia and Australia duing the non-breeding season. A small number reaches Australia each year, typically between September and April. Most of the visiting Australian population remains in the north-west, but smaller numbers have been reported from coastal areas across northern Australia and down the east. This species seeks out sheltered coasts and intertidal mudflats feeding on polychaetes, molluscs and insect larvae and will also roost on sandy beaches or in shallow lagoons (Birdlife International 2021). There is no BIA for this species within the EMBA.

The osprey (*Pandion haliaetus*) is considered moderately common in Australia (Dennis & Clancy 2014). The species is most abundant in northern Australia, where high population densities occur in remote areas (Dennis & Clancy 2014). It has been recorded in coastal areas around much of Australia (Dennis & Clancy 2014). It is unlikely to be encountered in the EMBA due to the distance from the coastline. There is no BIA for this species within the EMBA.

The common noddy (*Anous stolidus*) is the largest noddy (dark tern) found in Australian waters. The species is widespread through the tropics and occur at sea outside of breeding season (spring and autumn) and near islands during breeding season, where they remain in colonies of over 10,000 pairs (BirdLife Australia 2020). This species is not known to nest near to the operational area however they may be encountered outside of breeding season within the wider EMBA. There is no BIA for this species within the EMBA.

The streaked shearwater (*Calonectris leucomelas*) occurs most frequently in northern Australia, with observations from WA around the north coast and south to central New South Wales (DSEWPaC 2012). Foraging mainly in the North Marine Region, streaked shearwaters are generally sighted over inshore and pelagic waters (more than 18 km from the coast) and eating fish and squid caught by surface-seizing or by shallow plunges (with diving depth up to 5 m). This species does not breed in Australia, the species is primarily found in northern Australia from October to March. Therefore, although streaked shearwaters may occur offshore and forage in open waters, it is unlikely that significant numbers of this species will be encountered within the operational area, especially given their migratory presence mostly in the northern regions of Australia. There is no BIA for this species within the EMBA.

Both the lesser and greater frigatebird (*Fregata ariel*; *F. minor*) are identified as species that may occur within the EMBA and operational area. A breeding BIA for the lesser frigatebird occurs within 50 km to the south of the operational area (Figure 4.18) and within 100 km to the east of the operational area along the coast of Cape Leveque. Breeding BIA for both species occur north of Cape Leveque in the EMBA. Frigatebirds are unusual as they cannot land in the water (Weimerskirch *et al.* 2016), therefore survey interactions would be limited to their contact with shoreline oil or when foraging/diving for prey in the unlikely event of a hydrocarbon spill or consuming affected prey.

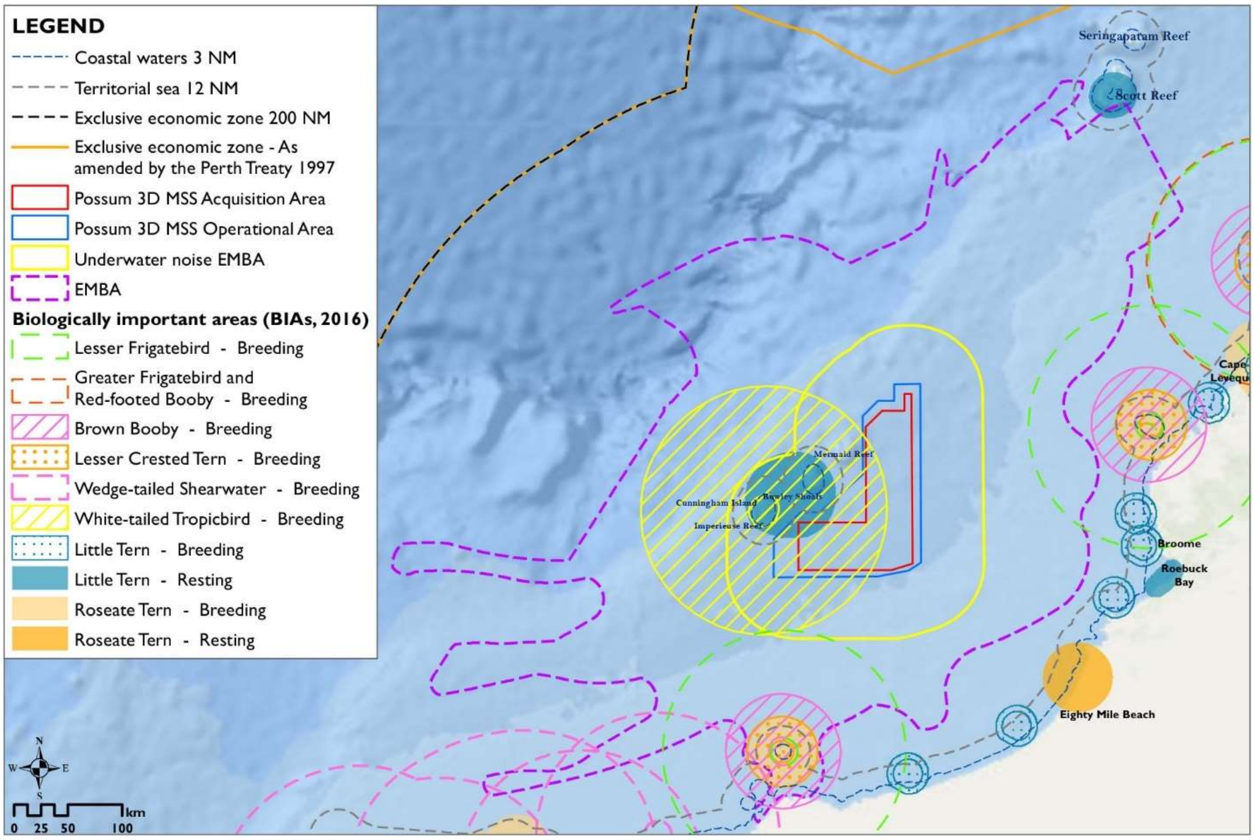


Figure 4.18 – Seabird BIAs within the Possum 3D MSS operational area and EMBA

4.7 SOCIO-ECONOMIC ENVIRONMENT

4.7.1 Commercial Fisheries

The principal commercial fisheries in the NWMR focus on tropical finfish and high-value invertebrates, such as crystal, champagne, and mud crabs. The NWMR has a number of small, limited-entry trawl fisheries for prawns, producing about 700 t annually. There are also significant fisheries for Spanish mackerel, barramundi/threadfin salmon and shark and blue swimmer crabs. The bioregion is increasingly coming under threat from international poaching, particularly for sharks. A number of finfish activities, including offshore demersal line fishing and near-shore beach seining and gillnetting, also occur in the region (DPIRD 2021a).

A thorough investigation of the Commonwealth and WA State fisheries was undertaken to determine the fisheries authorised to operate within the proposed operational area, primarily based on the following resources:

- GIS shapefiles of license areas, including Fisheries status reports map data (ABARES 2021a/2021b)
- current status reports of the fisheries and aquatic resources (ABARES 2018/2020/2021a)
- Fish cube data (DPIRD catch and effort data recorded between 2014-2019 sourced 28 October 2019 and recorded between 2018-2020 sourced 19 July 2021)
- current list of license holders extracts (AFMA 2021d)
- scientific literature
- information provided directly by fishers through the stakeholder consultation process.

From this assessment, fourteen commercial fisheries were identified to be authorised to operate within the proposed operational area, and eighteen within the wider EMBA, however only one is historically active within the operational area (Table 4.8).

Table 4.8 – Commercial fisheries within the Possum 3D MSS operational area and EMBA

Fishery	Historically active within operational area	Permitted to fish	
		Within operational area	Within EMBA
WA State Fisheries			
Mackerel Managed Fishery	✗	✓	✓
Kimberley Crab Managed Fishery	✗	✗	✓
Marine Aquarium Fish Managed Fishery	✗	✓	✓
North Coast Prawn Managed Fisheries			
• Broome Prawn Managed Fishery	✗	✗	✓
• Nickol Bay Prawn Managed Fishery	✗	✓	✓
Northern Demersal Scalefish Managed Fishery	✗	✓	✓
Pilbara Crab Managed Fishery	✗	✓	✓
Pilbara Demersal Scalefish Fisheries			
• Pilbara Fish Trawl (Interim) Managed Fishery	✗	✓	✓
• Pilbara Trap Managed Fishery	✗	✗	✓
• Pilbara Line Fishery	✗	✓	✓
Pearl Oyster Managed Fishery	✗	✓	✓
Specimen Shell Managed Fishery	✗	✓	✓
South-west Coast Salmon Fishery	✗	✗	✓
West Coast Deep Sea Crustacean Managed Fishery	✗	✓	✓
Commonwealth Fisheries			
North West Slope Trawl Fishery	✓	✓	✓
Southern Bluefin Tuna Fishery	✗	✓	✓
Western Skipjack Tuna Fishery	✗	✓	✓
Western Tuna and Billfish Fishery	✗	✓	✓

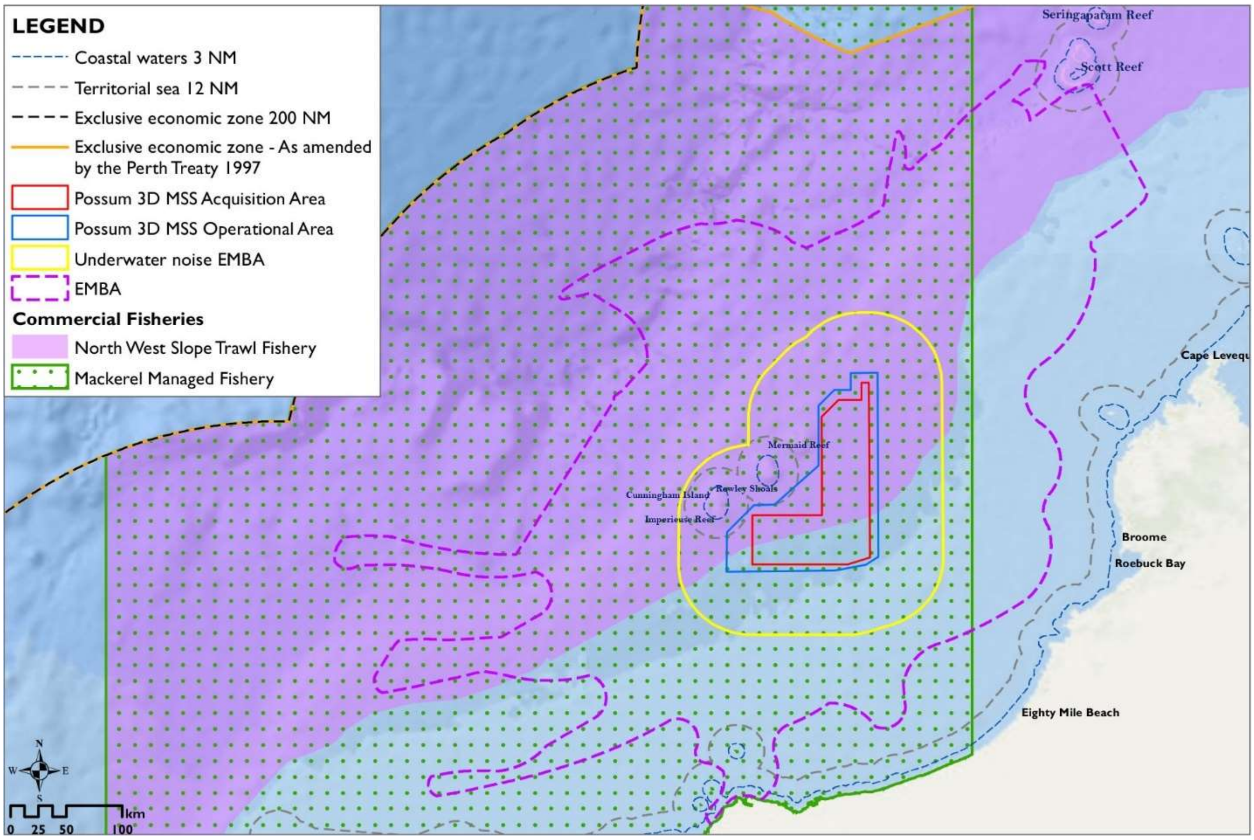


Figure 4.19 – Commercial fisheries that have reported activity in the Possum 3D MSS operational area from 2014-2020

4.7.1.1 State Administered Fisheries

Mackerel Managed Fishery

Primarily targeting spawning schools of Spanish mackerel (*Scomberomorus commerson*) and grey mackerel (*S. semifasciatus*) (Mackie *et al.* 2003), the Mackerel Managed Fishery (MMF) uses near-surface trolling and jig fishing techniques (DPIRD 2021a). The fishery extends from 27°S (north of Kalbarri WA) north to the WA/NT border. While fishing may occur year-round, a maximum mackerel quota restricts the effort for each of the three management areas.

There are currently 65 licences in the fishery, 34 of which (with 9 unique licence holders) are authorised for Area 2 (Pilbara) which overlaps with the operational area. The majority of catch is taken in Area 1 (Kimberley), reflecting the tropical distribution of mackerel species (Molony *et al.* 2013). Approximately 13,420 km^2 of Area 2 overlaps the operational area, which is ~2.7% of the total size of Area 2. Generally, mackerel fishers do not operate in water depths more than 70 m (via consultation with WAFIC 7/01/2020, Appendix E). The actively fished area is considered to be approximately 79,735 km^2 (16 %) of Area 2, none of which overlaps the operational or acquisition areas due to the depth of the areas (Figure 4.20). Initial fisheries catch and effort data recorded between 2014-2019 sourced from DPIRD on 28/10/2019 identified one 2018 record of fishing effort in approximately 400m of water within the acquisition area, which is considered unusual as the depth of the acquisition area is outside the usual actively fished area for this fishery (via consultation with WAFIC and DPIRD, 2020). Subsequent fisheries catch and effort data recorded between 2018-2020 sourced from DPIRD on 19/07/2021 shows no reference to the one 2018 record of fishing effort which has been removed from the list.

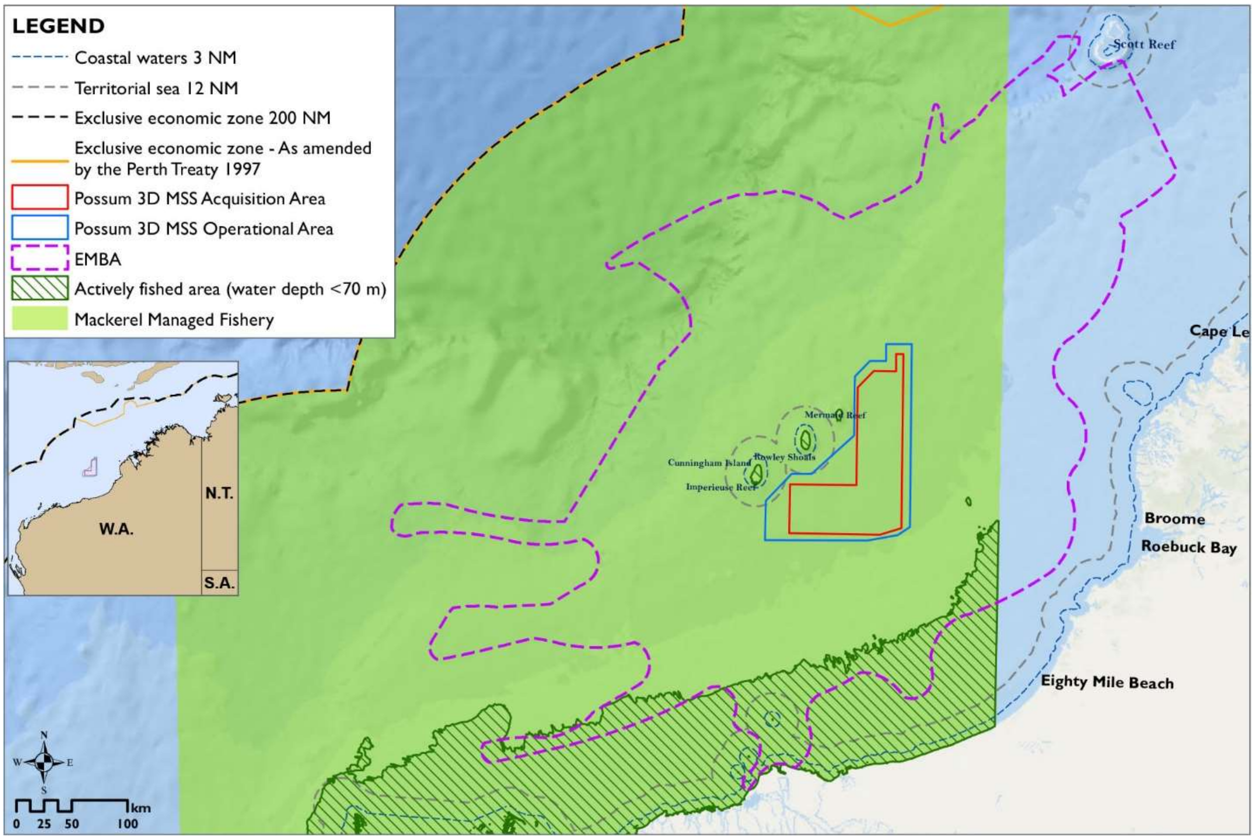


Figure 4.20 – Actively fished area of the Mackerel Managed Fishery

Based on the low number of active fishing vessels, the small portion of overlap with the fishery jurisdiction, the lack of historical effort in the area and the deep water depths of the operational area being outside the preferred fishing range of the fishery, it is unlikely that MMF fishing operations will occur within the operational area.

Northern Demersal Scalefish Managed Fishery

The Northern Demersal Scalefish Managed Fishery (NDSMF) operates off the northwest coast of WA in the waters east of 120°E and out to the edge of the Australian Fishing Zone (AFZ) at 200 nm from shore (DPIRD 2021a). Catch and effort data sourced from DPIRD on the 28/10/2019 and again on 19/07/2021 (Fish Cube WA) shows that there was no activity by this fishery within the operational area for the years 2014 – 2020, however there has been effort (values not released due to DPIRD privacy restrictions) recorded to the immediate south east (Zone B). A review of the Global Fishing Watch database with catch and effort data provided by DPIRD, demonstrates that fishing vessels frequently traverse the Operational Area en-route to shallower ground north of the Rowley Shoals (Global Fishing Watch 2021).

The permitted means of operation within the fishery include handline, dropline and fish traps. However, operations have essentially been trap-based since 2002 (DPIRD 2021b). Targeted species of the fishery include several species of snapper, cod and emperor, which comprise the majority of the catch (Newman et al. 2013).

The NDSMF is divided into two areas, of which Area 2 overlaps the operational area and is open to both trap and line methods. The operational area overlaps approximately 4,326 km^2 or 1.08% of the whole of Area 2. Area 2 is historically where fishing effort is concentrated (DPIRD 2000) and is further divided into three zones, A – C. The operational area overlaps approximately 4,290 km^2 of zone C (2.58% of the whole zone) and approximately 42 km^2 of zone B (0.06% of the whole zone, and no overlap with the acquisition area). There is no overlap with zone A.

Most fishing effort is recorded within zone B; in 2016 the catch was 965 t of the total 1,173 t recorded for the fishery (DoFWA 2016). The fishing range of operators within the NDSMF extends throughout the area of Zone B (Principal Fisheries Scientist DPIRD pers. Comm. 6 May 2019), with the majority of effort occurring north of Broome (FishCube data obtained from DPIRD 19/07/21) and limited effort occurring within Zone C. The indicator species for the fishery (see Table 4.9) are found in 10-180 m water depths.

Based on the lack of historical effort in the operational area, it is unlikely that NDSMF fishing operations will occur within the operational area, however vessels may be encountered transiting the Operational Area and fishing is expected within 10 km of the operational area to the east and south.

Kimberley Crab Managed Fishery

The Kimberley Crab Managed Fishery management plan was drafted in October 2018. The fishery targets mud and blue swimmer crabs within State coastal waters. Although the fishery management plan includes all WA waters, the fishery is closed seaward of the WA coastal waters (DPIRD 2018). Consequently, interactions between fishing vessels and the survey vessel will not occur.

Marine Aquarium Fish Managed Fishery

The Marine Aquarium Fish Managed Fishery management plan allows effort within all WA State waters, however effort is concentrated in waters near Perth, Geraldton, Exmouth and Dampier (Newman et al. 2017). The fishery targets more than 950 species of marine aquarium fishes, plus coral, live rock, algae, seagrasses and invertebrates. Due to the special handling requirements of live fish, catch effort is relatively low and is concentrated in nearshore coastal waters. Catch and effort data sourced from DPIRD on the 28/10/2019 and again on 19/07/2021 (Fish Cube WA) shows that there was no activity by this fishery within the operational area for the years 2014 – 2020 and therefore it is unlikely that interactions with vessels of this fishery will occur during the activity.

North Coast Prawn Managed Fisheries

The North Coast Prawn Managed Fisheries are the Onslow Prawn Managed Fishery, the Nikol Bay Prawn Managed Fishery, the Broome Prawn Managed Fishery and the Kimberley Prawn Managed Fishery. The fisheries boundaries of the Broome Prawn Managed Fishery and Nickol Bay Prawn Managed Fishery overlap the Possum 3D operational area, however the Broome Prawn Managed fishery is not permitted to operate in the area which overlaps the Possum operational area. The Nikol Bay fishery targets banana prawns (*Penaeus merguiensis*) and the Broome Prawn fishery targets the western king prawn (*Penaeus monodon*). All the North Coast Prawn Managed Fisheries operate as trawl fisheries with input controls (WAFIC 2020). Catch and effort data sourced from DPIRD on the 28/10/2019 and again on 19/07/2021 (Fish Cube WA) shows that there was no activity by this fishery within the operational area for the years 2014 – 2020 and therefore it is unlikely that interactions with vessels of this fishery will occur during the activity.

Pilbara Crab Managed Fishery

The Pilbara Crab Managed Fishery was gazetted in 2018. The fishery targets mud and blue swimmer crabs within State waters. Although the fishery management plan includes all WA waters, the fishery is closed seaward of the WA coastal waters (DPIRD 2018). Consequently, interactions between fishing vessels and the survey will not occur.

Pilbara Demersal Scalefish Fisheries

Pilbara Fish Trawl (Interim) Managed Fishery

The Pilbara Fish Trawl (Interim) Managed Fishery (PFTIMF) operates in the Pilbara region and is managed through a combination of area closures, gear restrictions, and the use of input controls in the form of individual transferable effort allocations (WAFIC 2021, DPIRD 2021a). Trawl nets are used to target demersal fish species. The fishery is primarily active outside the cyclone season of December to March with generally three or four licence holders per season. Total annual trawl catches have reduced from an annual average of approximately 2,500 t during the period 1995-2004 to an annual average of 1,159 t from 2008-15, in response to the effort reductions imposed since 2008. The total annual catch taken by PFTIMF in 2019 exceeded the acceptable catch range (i.e. 940-1,416 t) suggesting effort reductions since 2008 have resulted in increased fish abundance and stock rebuilding in the PFTIMF. (DPIRD 2012a). The fishery targets numerous demersal scale fishes, with the red emperor, bluespotted emperor and rankin cod used as indicator species to represent health assessment of the whole fishery (DPIRD 2021a). Catch and effort data sourced from DPIRD on the 28/10/2019 and again on 19/07/2021 (Fish Cube WA) shows that there was no activity by this fishery within the operational area for the years 2014 – 2020 and therefore it is unlikely that interactions with vessels of this fishery will occur during the activity.

Pilbara Trap Managed Fishery

There are six licences in Pilbara Trap Managed (PTMF) fishery, with the allocations managed primarily by the use of input controls in the form of individual transferable effort allocations monitored with a satellite-based VMS and through a partial closure of the fishery since 1998. (WAFIC 2021). The total annual catch taken by PTMF has remained relatively consistent over the past decade with an average of 479 t per annum (DPIRD 2021a). The total catch of the PTMF exceeded the acceptable catch range in 2019 for the trap fishery (i.e. 241-537 t) (DPIrD 2021a) The fishery targets numerous demersal scalefishes, with the red emperor, bluespotted emperor and rankin cod used as indicator species to represent health assessment of the whole fishery (DPIRD 2021a). Catch and effort data sourced from DPIRD on the 28/10/2019 and again on 19/07/2021 (Fish Cube WA) shows that there was no activity by this fishery within the operational area for the years 2014 – 2020 and therefore it is unlikely that interactions with vessels of this fishery will occur during the activity.

Pilbara Line Fishery

The Pilbara Line Fishery (PLF) license holders are permitted to operate anywhere within “Pilbara Waters” with the northern limit at the longitude 120 E (Newman et al. 2013). The PLF is managed under the Prohibition on Fishing by Line from Fishing Boats (Pilbara Waters) Order 2006. Nine fishing boat licenses are exempt from this prohibition for any nominated five-month block period within the year (WAfIC 2021). The total annual catch taken by PLF has remained relatively consistent over the past decade with an average of 108 t per annum (DPIRD 2021a). The total catch of the PLF exceeded the acceptable catch range in 2019 for the line fishery (i.e. 36-127 t). The fishery targets numerous demersal scalefishes with Ruby snapper also used as an indicator species for the PLF in addition to species used for PFTIMF and PTMF to represent health assessment of the whole fishery. . Catch and effort data sourced from DPIRD on the 28/10/2019 and again on 19/07/2021 (Fish Cube WA) shows that there was no activity by this fishery within the operational area for the years 2014 – 2020 and therefore it is unlikely that interactions with vessels of this fishery will occur during the activity.

Pearl Oyster Managed Fishery

The WA Pearl Oyster Managed Fishery is the only remaining significant wild-stock fishery for pearl oysters in the world. It is a quota-based, dive fishery, operating in shallow coastal waters (less than 35 m depth) along the NWS from Exmouth to the Lacepede Islands north of Broome. The harvest method is drift diving (WAFIC 2021). Considering the operation depth of the fishery is 35 m, and the shallowest waters of the operational area are 80 m, it is unlikely that interactions with vessels of this fishery will occur during the activity due to depth restrictions to divers.

Specimen Shell Managed Fishery

The Specimen Shell Managed Fishery is based on the collection of shell specimens for display, sale, or cataloguing. Over 200 species are allowed to be taken under the management plan by either diving of Remotely Operated Vehicle (ROV) at depths from 60 m-300 m. Fishing is permitted within all WA waters, however historical effort is concentrated in coastal waters adjacent to population centres such as Broome, Karratha, Carnarvon and Perth (Hart et al. 2017). Catch and effort data sourced from DPIRD on the 28/10/2019 and again on 19/07/2021 (Fish Cube WA) shows that there was no activity by this fishery within the operational area for the years 2014 – 2020 and therefore it is unlikely that interactions with vessels of this fishery will occur during the activity.

South-west Coast Salmon Managed Fishery

The South-west Coast Salmon Managed Fishery is active on various metropolitan beaches in southern WA. The fishing methods are haul, beach seine and gill netting (DPIRD 2021a). The fishery is not expected to be active within the Operational Area or EMBA based on historical data (DPIRD 2021a).

West Coast Deep Sea Crustacean Managed Fishery

The West Coast Deep Sea Crustacean Managed Fishery (WCDSCF) targets crystal (snow) crabs (*Chaceon albus*), giant (king) crabs (*Pseudocarcinus gigas*) and champagne (spiny) crabs (*Hypothalassia acerba*) (WAFIC 2021) and is a quota-based 'pot' fishery, in which up to 200 pots are baited (i.e. traps) and operated in a long-line formation (DPIRD 2020). The fishery mostly operates in water depths of 500–800 m, with minimum size limits and specific regulations in place to protect breeding females (DPIRD 2020). The WCDSCF boundaries comprise all the waters lying north of latitude Cape Leeuwin, west of the NT border and offshore of the 150 m contour out to the extent of the AFZ (DPIRD 2021a). Among the seven permits operating in the fishery, each permit has a total allowable split catch limit for crystal crabs, giant and champagne crabs (DPIRD 2020). Catch and effort data sourced from DPIRD on the 28/10/2019 and again on 19/07/2021 (Fish Cube WA) shows that there was no activity by this fishery within the operational area for the years 2014 – 2020 and therefore it is unlikely that interactions with vessels of this fishery will occur during the activity.

4.7.1.2 Commonwealth Administered Fisheries

North West Slope Trawl Fishery (NWSTF)

The NWSTF operates off northern WA from 114°E–125°E, roughly along the 200 m contour and the outer boundary of the AFZ (ABARES 2021a). The NWSTF target scampi and deep-water prawns and has a limited entry management system with regulations on gear type (AFMA 2021b). The harvest strategy contains catch trigger for scampi, deepwater prawns and some finfish. (ABARES 2021a). Fishing may occur year-round. Using demersal trawl gear, most of the effort and catch occurs over soft, muddy sediments or sandy habitats, typically at depths of 420-500 m on the continental slope (Figure 4.21).

Areas fished encompassed the deep offshore waters west of Barrow Island and north of Scott Reef, which are more than 470 km and more than 70 km away (respectively) from the operational area. Generally seven fishing permits are issued in the NWSTF. In 2019-2020 six vessels were active in the fishery over 306 days and in 2018-2019 four vessels active in the fishery over 151 days, indicating unused fishing effort is reducing (ABARES 2021a).

The operational area overlaps 9,221 km (2.34%) of the NWSTF license area and it is possible that fishing operations may occur within the vicinity of the proposed survey activities. However, considering the large size of the fishery management area, the low effort level within the fishery (ABARES 2021a) and a review of the Global Fishing Watch database, interactions between the NWSTF and the proposed survey activities are expected to be minimal.

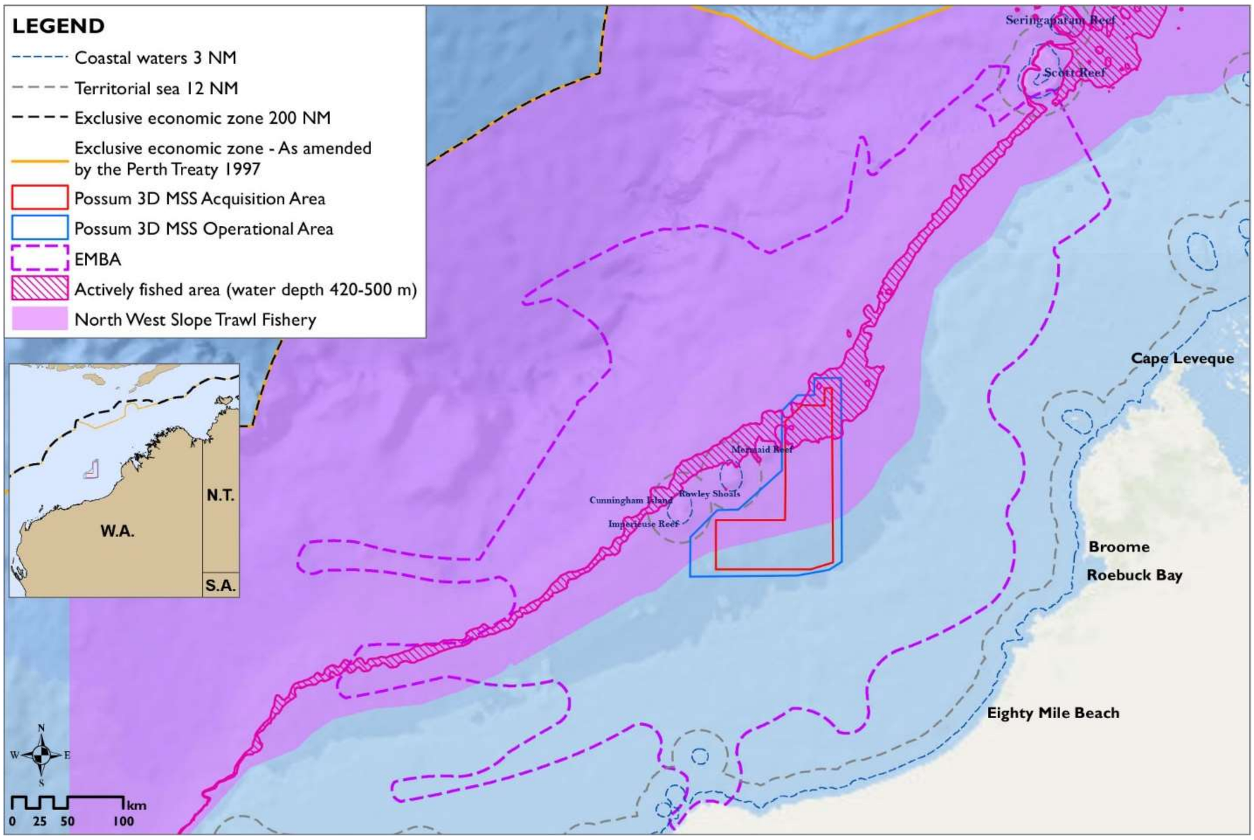


Figure 4.21 – Actively fished area of the North West Slope Trawl Fishery

Southern Bluefin Tuna Fishery

The Southern Bluefin Tuna Fishery targets southern bluefin tuna (SBT; *Thunnus maccoyii*) under the Southern Bluefin Tuna Fishery Management Plan 1995. Effort in this fishery is concentrated in the Great Australian Bight, several thousand kilometres from the location of the proposed activity, with this trend demonstrated historically from 2014 to 2019 (ABARES 2020). SBT catch in 2016 represented 10.68% of all Commonwealth fisheries catch for that year (ABARES 2018). Southern bluefin tuna are highly migratory and travel long distances. They are a pelagic species that can be found to depths of 500 metres. Spawning in the north-east Indian Ocean (off the North West Shelf region of WA, south of Indonesia) during spring and summer they migrate southwards from the spawning ground after spawning. (AMFA 2021c).

Migrating adult tuna may transit through the region however due to the large distance between the actively fished area and the location of the activity, vessels participating in this fishery are not expected to be encountered during the activity.

Western Skipjack Tuna Fishery

The Western Skipjack Fishery is part of the Skipjack Tuna Fishery, which contains two stocks: one to the east and one to the west that are assessed separately but managed together under various management arrangements and general conditions in addition to the Fisheries Management Act 1991. The Western Skipjack Fishery targets only skipjack tuna *Katsuwonus pelamis*. While the operational area lies within the boundary of the fishery, effort within this fishery is mainly confined to the southern coast of Australia, several thousand kilometres away. No fishing effort has been recorded since the 2008-2009 season (ABARES 2021a) and whilst the concession holder database accessed on 22/10/2021 show there are nine unique owners of the 12 possible current permit holders (AFMA 2021d) there is no expected effort as the fishery is not currently active and management arrangements are under review (AFMA 2021a). As such, vessels within this fishery are not expected to be encountered during the activity.

Western Tuna and Billfish Fishery

The Western Tuna and Billfish Fishery area operates in Australia's Exclusive Economic Zone and high seas of the Indian Ocean.Fishing effort in recent years shows occasional activity off South Australia but is mainly concentrated off south-west Western Australia, south of Geraldton which is >1,500 km south of the operational area (ABARES 2021a).There are currently 94 vessel Statutory Fishing Rights (SFR). and as the operational area overlaps the licence area for the WTBF, it is possible that fishing operations could occur in the vicinity of the operational area during the proposed survey activities (ABARES 2021a). As the majority of WTBF fishing is concentrated well away from the operational area and fishing effort is currently low, interactions between the fishery and the proposed survey operations are highly unlikely.

4.7.1.3 Key commercial fish species

The NWMR hosts several commercial fisheries (Section 4.7.1). Some fisheries, such as the NDSMF cover a large spatial range and do not target a single species, so indicator species are used to assess the risk to sustainability of all 'like' species susceptible to capture within a fishery resource. Red emperor, rankin cod and bluespotted emperor are considered to be 'indicator species' for the Pilbara region, and the additional goldband snapper for the Kimberley region (Newman et al. 2018). These indicator species are determined via information on their inherent vulnerability (e.g. biological attributes); risk to sustainability (e.g. stock status); and management importance (e.g. commercial prominence, social and/or cultural amenity value of the resource) (Newman et al. 2018).

Table 4.9 identifies which species have been historically active within the operational area from 2014-2020 (FishCube 2021. The spread of fish spawning periods throughout the year indicates that there are no specific periods of higher sensitivity with respect to fish spawning for key commercial fisheries species which may potentially spawn within the operational area. There are no known spawning aggregations for key or indicator species for commercial fisheries historically active within 10 km of the Possum 3D MSS acquisition area (Mackie and Lewis, 2001; Mackie *et al.* 2003). There is no evidence to indicate that there are key fish migrating occurrences, of target or indicator species, for the fisheries that are able to fish within the operational area. Southern bluefin tuna, which migrate seasonally north to their single spawning ground in the Timor Sea do not follow any distinct depth or feature, instead preferring the temperature range of 19-21°C and adjusting their depth to suit (DAWE 2020) generally on the outer limit of the AFZ. It is possible that south-migrating juveniles may occur within the operational area as they follow the Leeuwin Current to the feeding grounds in the Great Australian Bight.

Table 4.9 – Spawning periods for indicator/ target species of commercial fisheries that overlap the EMBA

Fishery	Key Species	J	F	M	A	M	J	J	A	S	O	N	D	Distribution
West Australian Fishery actively fishing within the operational area (2014-2020)														
North-West Slope Trawl Fishery (Cwlth)	Scampi													Benthic, in tropical Australian waters from 420-500 m throughout the North-West Shelf (AFMA 2021c)
West Australian Fishery not actively fishing within the operational area (2014-2020)														
Mackerel Managed fishery (WA)	Spanish mackerel													Single genetic stock along the WA coast. Adults in waters up to 50 m, (Mackie and Lewis, 2001; Mackie *et al.* 2003)
Northern Demersal Scalefish Managed Fishery (WA)	Red emperor													Adults in waters 10-180 m near reefs, lagoons, limestone sand flats and gravel patches from the Abrolhos, WA, along the northern coast to the Qld/ NSW border. (DPRID Principal Scientist, pers. Comm. 2019)
	Rankin cod													Adults in waters 10-150 m near drop-offs, deep rocky reefs. Juveniles near inshore coral reef from the Abrolhos to Cape Leveque (DoFWA 2004).
	Blue spotted emperor													Single genetic stock (Johnson at el. 1993) and dispersed spawning along the entire continental shelf from Geraldton to Darwin, occurring near coral reefs and on sandy or weedy bottoms, to 180 m (Gaughan et al. 2018; Rome & Newman 2010).
	Goldband snapper													Adults in waters 50-200 m near shoals, flat bottom and offshore reef (DPRID Principal Scientist, pers. Comm. 2019) found throughout northern Australia and the tropical Indo-West Pacific
Kimberley and Pilbara Crab Managed Fisheries	Mud crab													Estuaries throughout northern WA south to Shark Bay (DPIRD 2021b)
	Blue Swimmer crab													Estuaries and offshore waters to 50 m depths throughout Australian coastal waters (DPIRD 2021b)
Marine Aquarium Fish Managed Fishery	*N/A – fishery targets no specific species*													
Broome Prawn Managed Fishery	Western king prawn													Juveniles in shallow estuaries or seagrasses, adults in deep waters to 30 m on mud or sand throughout the West-Pacific region (Penn 1980)
Nickol Bay Prawn Managed Fishery	Banana prawn													Juveniles in shallow estuaries or seagrasses, adults in deep waters to 45 m on mud or sand throughout northern Australian waters (Penn 1980)
Pilbara Fish Trawl (Interim) Managed Fishery and Pilbara Trap Managed Fishery	Red emperor													Adults in waters 10-180 m near reefs, lagoons, limestone sand flats and gravel patches from the Abrolhos, WA, along the northern coast to the Qld/ NSW border. (DPRID Principal Scientist, pers. Comm. 2019). Adults in waters 10-180 m near reefs, lagoons, limestone sand flats and gravel patches (DPRID Principal Scientist, pers. Comm. 2019)

Fishery	Key Species	J	F	M	A	M	J	J	A	S	O	N	D	Distribution
	Rankin cod													Adults in waters 10-150 m near drop-offs, deep rocky reefs. Juveniles near inshore coral reef from the Abrolhos to Cape Leveque (DoFWA 2004). Adults in waters 10-150 m near drop-offs, deep rocky reefs. Juveniles near inshore coral reef (DPRID Principal Scientist, pers. Comm. 2019)
Pilbara Line Fishery	Ruby snapper													Adults found in depths 80-300 m, associated with reef in the tropical waters of the Indo-Pacific (Allen 2009)
	Goldband snapper													Adults in waters 50-200 m near shoals, flat bottom and offshore reef (DPRID Principal Scientist, pers. Comm. 2019) found throughout northern Australia and the tropical Indo-West Pacific
Pearl Oyster Managed Fishery	Pearl oyster													Flat bottom with high water movement, up to 76 m but most common at less than 40m (Whalan 2021) found in northern Australian coastal waters from Shark Bay.
West Coast Deep Sea Crustacean Managed Fishery	Crystal (snow) crabs													13 – 2,200 m, commonly fished at 500-800 m in WA (PIRSA 2015) and limited to WA waters.
	Giant (king) crabs													180-720 m (PIRSA 2015)
	Champagne (spiny) crabs													500-800 m, commonly fished at 200 m in WA (PIRSA 2015) found in coastal waters off southern Australia and New Zealand.
Specimen Shell Managed Fishery	*N/A – Fishery targets no specific species*													
Commonwealth Fishery not actively fishing within the operational area (2014-2020)														
Western Skipjack Tuna Fishery	Skipjack tuna													Pelagic, to 260 m (AFMA 2021c) throughout tropical waters of the Pacific, Atlantic and Indian Oceans.
Western Tuna and Billfish Fishery	Yellowfin tuna													Pelagic to 250 m (AFMA 2021c) throughout tropical waters of the Pacific, Atlantic and Indian Oceans.
Southern Bluefin Tuna Fishery	Bluefin tuna													Pelagic to 500 m (AFMA 2021c) throughout tropical waters of the Pacific, Atlantic and Indian Oceans.

4.7.2 Commercial Shipping

There is significant commercial shipping activity within the NWMR, the majority of which is associated with the on and offshore mining and oil and gas industries. Shipping within the NWMR includes:

- international bulk freighters/tankers arriving and departing from Dampier and Port Hedland, including mineral ore, hydrocarbons (LNG, liquefied petroleum gas, condensate) and salt carriers
- domestic support/supply vessels servicing offshore facilities and Barrow Island development
- construction vessels/barges/dredges
- offshore survey vessels
- commercial fishing vessels.

Major shipping routes in the vicinity of the operational area are associated with entry to the Port of Dampier and Port Hedland, with less traffic through the Port of Broome (Figure 4.22). The Australian Maritime Safety Authority (AMSA) introduced a network of commercial shipping fairways on the NWS in order to reduce the risk of vessel collisions with offshore infrastructure (AMSA 2015), one of which traverses through the western edge of the operational area.

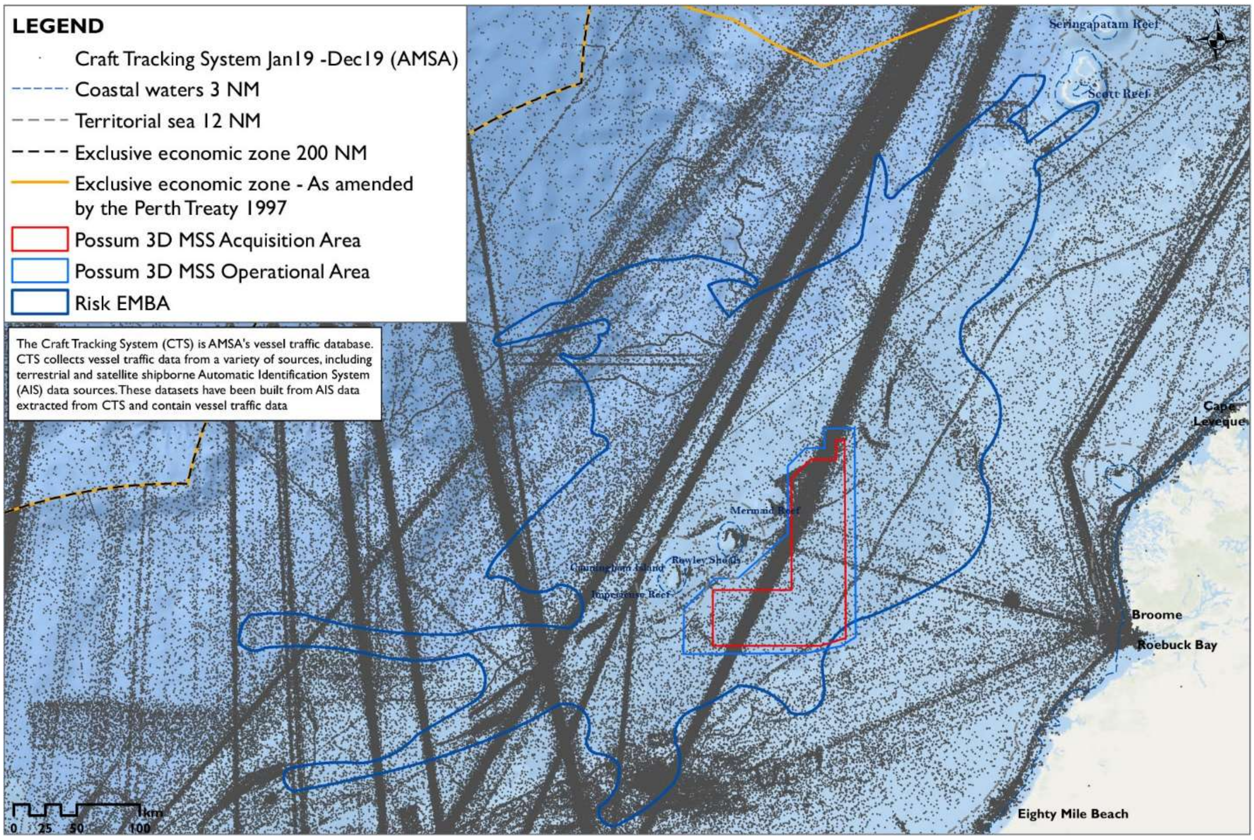


Figure 4.22 – Major shipping lanes in the vicinity of the Possum 3D MSS operational area

4.7.3 Tourism and Recreation

The Rowley Shoals MP and Mermaid Reef MP (Section 4.4.1) has limited visitation due to the distance offshore (300 km west of Broome), with the major activities in the area being nature-based tourism and recreational fishing, primarily by charter vessel. Charter operators take passengers to the Rowley Shoals on trips of up to 10 days in duration (DEC 2007). Most operators visit the shoals from October – November, however the season is accepted to be from September – December, and vessels operate out of Broome (DEC 2007; Kimberley Quest pers. Comm.).

The shallow, sheltered lagoons support snorkelling, while SCUBA diving occurs at lagoons, channels, and reef walls. The zoning scheme provides diving locations free from conflicting uses (such as fishing) in all the major habitats found in the Marine Park (DEC 2007). There are numerous, popular SCUBA dive sites around Clerke and Mermaid Reefs. Charter boats also visit Imperieuse Reef, but trips are limited as the anchorage site is more exposed. Most boats are unable to enter the lagoon through the small channel and must anchor on the leeward side of the reef.

The Rowley Shoals have a relatively low level of fishing effort, primarily due to their isolation from major population centres. There is no recreational fishing permitted within the Mermaid Reef MP, and limited fishing permitted within the Rowley Shoals MP. The key target species likely to be found in the marine park include pelagic species (mackerel, tuna and trevally) in the oceanic waters surrounding the reefs, and emperors and red bass on the outer slope of the reef and in the sheltered lagoons (DPRID 2020).

4.7.4 Petroleum exploration and production

Over the past 40 years, the NWMR has been the target of significant petroleum exploration activity, with several MSS undertaken in the region in addition to the drilling of both exploration and appraisal wells (DoEE 2018). Various production facilities are located within the NWMR including Floating Production Storage Offshore (FPSO) facilities, manned and unmanned monopods and larger production platforms. Analysis confirmed that there are no petroleum production facilities or pipelines within the operational area (DMIRS 2020). Titleholders within the OA are listed in Table 4.10.

Table 4.10 – Titleholders within the EMBA

Titleholder	Title	Operational Area
3D Oil Limited	WA-527-P	✓
Pathfinder Energy Pty Ltd	WA-479-P	✓
Pathfinder Energy Pty Ltd	WA-487-P	✓
Santos Offshore Pty Ltd	WA-540-P	✓
Santos WA Northwest Pty Ltd	WA-436-P	✓

Previous and future planned seismic surveys in the vicinity of the Possum 3D MSS are identified in Table 4.11. Associated vessels may transit through the operational area.

Table 4.11 – Previous and future planned seismic surveys within the vicinity of Possum 3D MSS

Titleholder	Project Name	Location compared to Possum	Activity Window
EP out for public comment or under assessment – NIL			
Approved EP – not yet acquired			
3D Oil Limited	Sauropod 3D MSS	Small overlap of acquisition area	Jan – April 2021 or 2022 (Max 60 days)
INPEX Browse E&P Pty Ltd	2D Seismic Survey WA-532-P, WA-533-P and WA-50-L	No overlap of acquisition area, small overlap with operational area	Nov 2021 – May 2022
PGS Australia Pty Ltd	Rollo MMSS (Beagle)	South West of operational area, no overlap	The specific acquisition dates and durations of individual surveys has not been confirmed – Valid to 2023. (PGS has advised they have no current acquisition plans in the vicinity of the Possum 3D MSS)
Santos WA Northwest Pty Ltd	Keraudren 3D Extension	No overlap with acquisition area, small overlap with operational area	1st Feb – 31st July 2020-2022 (Est 132 days total)
Santos WA Northwest Pty Ltd	Archer 3D MSS	South West of operational area, no overlap	1st Feb – 31st July 2021-2022 (Est 38 days total)
TGS-NOPEC Geophysical Company Pty Ltd	Capreolus-2 3D marine seismic survey 2020 – 2024	South West of operational area, no overlap	Northern zone Jan-Mar and September only, Southern zone in April – June only, the whole activity for a maximum of 190 days between 2020-2024
Expired EP			
TGS-NOPEC Geophysical Company Pty Ltd	North West Shelf Renaissance North Multi Client MSS	West of operational area, no overlap	2018-2020 Acquisition dates and durations of individual surveys have not been confirmed and no acquisition has been

Titleholder	**Project Name**	**Location compared to Possum**	**Activity Window**
			conducted under the accepted EP to date – Valid to 2020
Past surveys			
Woodside Browse Pty. Ltd.	North-west Australia 4D MSS (Pluto 4D and Harmony 4D)	West of operational area, no overlap	Acquired Q1, 2020
Santos WA Northwest Pty Ltd	Keraudren 3D	South of operational area, no overlap	Acquired May – July 2019
PGS Australia Pty Ltd	Rollo MC	West of operational area, no overlap	Feb 2019 – May 2019
TGS-NOPEC Geophysical Company Pty Ltd	North West Shelf Renaissance 2D MSS	West of operational area, no overlap	Acquired 2016
Searcher Seismic Pty Ltd	Bilby 2D MSS	Overlap with acquisition area	Acquired 2015-2016
Polarcus Seismic Limited	Capreolus Phase II 3D Multi-client MSS	West of operational area, no overlap	Acquired 2016
Fugro Multiclient	Zeester 3D	Overlap with acquisition area	Acquired 2012

4.7.5 Defence

There are no defence activities or known UXOs overlapping with the operational area or EMBA.

4.7.6 Research Activities

Research activities have previously been undertaken throughout the operational area and EMBA. This research is predominantly conducted by the Australian Institute of Marine Science (AIMS), CSIRO, Reef Life Survey and partnered universities. In 2017, AIMS commenced the three-year North-West Shoals to Shore Research Program, involving geophysical, ecological and biological studies of the north-west region including Scott Reef, Ashmore Reef and Rowley Shoals. Review of current Notice to Mariners indicates that there is one long term research oceanographic mooring (monitoring) deployed within the acquisition area to within 15 m of the sea surface.

5 ENVIRONMENTAL RISK ASSESSMENT

This section outlines Searcher's environmental risk assessment methodology for the identification, analysis and evaluation of potential environmental impacts and risks associated with the Possum 3D MSS.

In accordance with Regulation 4 of the OPGGS(E)R, environmental impact is taken to mean any change to the environment, as described in Section 4 of this Plan, whether adverse or beneficial, that wholly or partially results from the activity. As required by Regulations 10A(b), 10A(c), 13(5) and 13(6), analysis and evaluation is conducted in this EP to demonstrate that the identified environmental impacts and risks associated with this activity are reduced to ALARP and are of an acceptable level. The assessment considers direct and indirect environmental consequences of routine activities, unplanned events and potential emergency conditions associated with the Possum 3D MSS.

The outcomes of the environmental impact and risk assessments are presented in Section 6.

5.1 ASSESSMENT OVERVIEW

The Possum impact and risk assessment methods have been drawn from Searcher's Integrated Management System (IMS), Searcher's Risk and Hazard Management Procedure (HSE-PRO-01), and the following guidelines:

1. International Standards Organization 31000:2018 Risk Management – Guidelines (ISO 2018);
2. NOPSEMA Guidance Note N04750-GN1344 Environment plan content requirements; (NOPSEMA 2019e);
3. NOPSEMA Guidance Note N-04300-GN0166 ALARP; (NOPSEMA 2015);
4. Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009;
5. NOPSEMA Guideline GL1721 Environment plan decision making (NOPSEMA 2019c);;
6. Australian/New Zealand Standard 14001:2016 Environmental management systems – Requirements with guidance for use (Standards Australia/ Standards New Zealand 2016);
7. Matters of national environmental significance – Significant impact guidelines 1.1 EPBC Act 1999 (DoEE 2013);
8. Oil & Gas UK Guidance on Risk Related Decision Making (Issue 2, July 2014) (OGUK 2014).

Consistent with international nomenclature, the impact assessment process is considered to be encapsulated within the risk management process. Environmental risk assessment is a systematic process comprising the following stages:

- Risk Identification (Section 5.2):
  - Identifying specific activities associated with the Possum 3D MSS (Section 2.4)
  - Identifying aspects of the activities which will result in an environmental impact or represent a risk to the environment
  - Understanding the existing environment (Section 4), including consultation with external stakeholders (Section 8 and Appendix E).
- Risk Assessment (Section 5.3):
  - Identifying potential impacts and risks associated with each aspect of the Possum 3D MSS, considering the nature and scale of the consequence
  - Identifying and evaluating appropriate industry 'Good Practice' control measures in relation to the overall context of the activity
  - Identifying consequence and likelihood ratings and residual impact and risk (with the application of industry 'Good Practice' control measures).
- Risk Evaluation (Section 5.4):
  - Evaluating ALARP status (including analysis of alternate or additional control measures to those identified by 'Good Practice' as required)
  - Identifying any changes to the level of impact or residual risk resulting from adoption of alternate and/or additional control measures from the ALARP evaluation
  - Demonstrating the environmental impacts and risks will be of an acceptable level.

Each stage of the risk assessment is undertaken with consideration of stakeholder functions, interests and activities, with any merited feedback from stakeholder consultation being taken into account (see Section 8). Terms used in the environmental impact and risk assessment are defined in Table 5.1.

Table 5.1 – Definitions of terms used in environmental impact and risk assessment

Term	Definition
Acceptable level[1]	An 'acceptable level' is the specified amount of environmental impact and risk that an activity may have which is tolerable, is consistent with all relevant principles, and does not compromise the management/conservation/protection objectives of the environment.
As Low as Reasonably Practicable[2]	The operator has to show through reasoned and supported arguments that there are no other practicable options that could reasonably be adopted to reduce risks further.
Likelihood[3]	The chance of something happening. The likelihood may be determined using quantitative means (where data is available), or via qualitative means.
Consequence[1]	The extent, duration, severity and certainty of what would happen should prevention control measures fail.
Control measure[3,4]	A system, an item of equipment, a person or a procedure, that is used as a basis for managing environmental impacts and risks. Control measures maintain and/or modify risk.
Cost[5]	The sacrifice required for implementing a control measure, which includes an impost such as the money, time, and/or trouble required to implement a particular control measure. Environmental cost may also be a cost in some circumstances (e.g. dispersant use on an oil spill).
Environmental aspect[6]	An environmental aspect is an element of an organization's activities, products, or services that has or may have an impact on the environment.
Environmental impact[1,4]	Any change to the environment, whether adverse or beneficial, that wholly or partially results from an activity of a titleholder. Note – There is a distinction between environmental impacts and risks. Environmental impacts are planned as they are inherent part of the activity.
Risk[3]	Risk is a deviation (positive or negative) from what is expected and reflects the uncertainty associated with unexpected events. A combination of the consequences of an event occurring and the likelihood of its occurrence.
Residual risk[5]	The level of risk after risk treatment (with control measures implemented).
Environmental performance outcome[4] (EPO)	An environmental performance outcome is the measurable level of performance required for the management of an environmental aspect of an activity to ensure that environmental impacts and risks will be of an acceptable level.
Environmental performance standard[4] (EPS)	An environmental performance standard is a statement of the performance required of a control measure.
Measurement criteria[1] (MC)	Define how environmental performance will be measured and determine whether the outcomes and standards have been met during the activity.

Source of definitions:

1. NOPSEMA Guidance Note N04750-GN1344 Environment plan content requirements. (NOPSEMA 2019e
2. NOPSEMA Guidance Note N-04300-GN0166 ALARP (NOPSEMA 2015).
3. International Standard 31000:2018 Risk Management – Guidelines (ISO 2018).
4. Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009.
5. NOPSEMA Guideline GL1721 Environment plan decision making (NOPSEMA 2019c).
6. Australian/New Zealand Standard 14001:2016 Environmental management systems – Requirements with guidance for use (Standards Australia/ Standards New Zealand 2016).

5.2 RISK IDENTIFICATION

The risk identification stage includes a systematic review of all activities under consideration and the subsequent identification of the potential aspects of the activities which could cause an environmental impact or engender risk. The timing, location and magnitude (e.g. underwater sound energy level) of the activities is taken into account (Section 3). Further, information on the sensitivities of the biological and social EMBA is considered. The EMBA is described in Section 4.

5.3 RISK ASSESSMENT

The risk assessment stage involves the assessment of the aspects in context of the particular values and sensitivities (environmental and social) which may be affected, with consideration given to the proposed "Good Practice" control measures to be implemented (as defined in Section 5.3.2). Based on this assessment and using the Searcher Risk Assessment Matrix (Table 5.4), a rating is given to:

1. The severity of the consequences of the potential impacts and risks, considering the nature and scale of the effect
2. The likelihood of the identified consequences occurring, based on upon knowledge/historical data of similar events/incidents occurring within Searcher or in the exploration and petroleum industry
3. The relative level of residual risk.

Risk assessments may be based on a qualitative or quantitative evaluation depending on the level of rigour and certainty required, level of consequences and the availability of relevant data to support such assessment. For aspects with a higher potential consequence to the environment, such as sound and vibration, evaluation based on quantitative data (e.g. modelling studies, fisheries catch and effort data) is considered appropriate. Where a quantitative assessment is not possible or not required, a qualitative evaluation is made relying on the professional judgement, knowledge and experience of relevant personnel.

5.3.1 Assessment of Nature and Scale

When evaluating the consequence level of an impact or risk, the nature and scale of the consequence is determined considering:

- the timing and duration of the activities and aspects, with particular reference to seasonal sensitivities for matters protected under Part 3 of the EPBC Act, i.e., MNES
- impact pathways and the environmental sensitivities at risk
- the relative sensitivity of the receiving environment, considering the importance (e.g. local, national or international significant values) and the resilience to change of the EMBA
- extent of impacts, i.e. whether the impact affects the local or wider regional environment
- severity of impacts, i.e. individual effects, population-level effects or ecosystem-level effects
- duration and frequency of the impact, i.e. how often the impact will occur and how long it will interact with the receiving environment
- potential cumulative impacts
- uncertainty in the above information.

The receptors which have been determined as relevant to this activity are:

- plankton communities
- benthic communities
- marine fauna
- shoreline habitats
- protected areas
- commercial fisheries
- commercial shipping
- tourism and recreation
- petroleum exploration and production
- defence activities
- research activities.

5.3.2 Identification of 'Good Practice' Control Measures

In alignment with OGUK 2014, 'Good Practice' is taken to be the recognised risk management practices and measures that are used by competent organisations to manage well-understood impacts and risks arising from their activities. For this EP, sources of good practice are considered to include (where relevant):

- requirements from Australian Legislation and Regulations
- relevant Australian Government Policies & Guidance
- relevant International Conventions
- Australian IUCN reserve management principles for Commonwealth marine protected areas and bioregional marine plans
- conservation actions, objectives or a target in recovery plans/approved conservation advice for relevant listed threatened species
- management plans, including features such as advice on permitted uses, objectives, targets, goals or key performance indicators for marine reserve areas
- relevant conditions of approval set under other legislation
- national and international requirements for managing pollution from ships
- national biosecurity requirements
- industry guidelines (e.g. FC, IOGP, IPIECA, APPEA, API, IAGC)
- Searcher internal practices.

When 'Good Practice' is reflected in Australian legislation or relevant Australian Government policies and guidance, these requirements will be applied. When identified in non-regulatory source material, relevant 'Good Practice' will be adopted when feasible and reasonably practicable to implement.

5.3.3 Determine Consequence Rank

To determine the consequence rank, Searcher determine the severity of the credible worst-case impact or risk which would reasonably occur if controls fail. The applicable consequence rank is then chosen from the definitions in Table 5.2.

Table 5.2 – Environmental consequence Definitions

Severity Consequence /Rank		Environmental Consequence
E	**Critical**	Large Scale (>250 km^2) Major long-term impact (recovery takes decades) Significant restoration work spanning years/decades Tier 3 oil spill Destruction of physical environment or protected species populations or ecosystems. Loss of integrity of a protected value.
D	**Major**	Major Scale (25 – 250 km^2) Long term impact (recovery time 2-10 years) Restoration work spanning a few years Tier 2 oil spill Major impact on physical environment or protected species populations (death of multiple individuals) or ecosystems.
C	**Serious**	Medium Scale (2.5-25 km^2) Medium term impact (recovery time 1-2 years) Restoration work spanning a few months Tier 1 Oil Spill Serious impact on physical environment or protected species populations (recoverable impact to multiple individuals, death of an individual) or ecosystems.
B	**Moderate**	Localised Scale (<2.5 km^2) Short term impact (recovery time <1 year) Restoration work negligible spanning a few weeks Minimal oil spill with no lasting effects Moderate impact on physical environment or recoverable impact to individual of a protected species (not affecting ecosystem function)
A	**Minor**	Localised scale (immediate area) Temporary impact (recovery time days to weeks) Restoration work negligible Slight oil spill with no significant effects No or minor measurable impacts to physical environment or behaviour of protected species individuals

5.3.4 Determine Likelihood Rank

Establishing the likelihood of an environmental effect considered the effective implementation of 'Good Practice' control measures. The likelihood rank of the credible worst-case impact or risk is based upon knowledge/historical data of similar events/incidents occurring within Searcher or in the industry. Likelihood definitions are provided in Table 5.3.

Table 5.3 – Environmental likelihood Definitions

Rank		Definition		
		Description	**Frequency**	**Historical frequency**
5	**Almost Certain**	Expected to occur in most circumstances	Event occurs weekly.	Has occurred frequently in Company
4	**Likely**	Will probably occur in most circumstances	Event occurs monthly.	Has occurred once or twice in Company
3	**Possible**	Might occur at some point	Event occurs once a year.	Has occurred many times in industry, but not in the company
2	**Unlikely**	Could occur but would not be expected	Event occurs once in ten years.	Has occurred once or twice in industry
1	**Rare**	Practically impossible	Event occurs once in more than 10 years.	Unheard of in industry

5.3.5 Determining Residual Risk

The residual level of impact or risk reflects the reduction in impacts and risks due to implementing all control measures; the 'Good Practice' measures and those required to further manage impacts and risks to ALARP and acceptable levels.

The residual risk rating for a given consequence and likelihood rating is determined directly from the Searcher Risk Assessment Matrix (Table 5.4). The box shadings reflect the Tolerability of Risk criteria defined by Searcher:

- **Unacceptable**: The RED region denotes an unacceptable or intolerable risk; any risk falling within this category requires further control measures to be in place. Note that an Unacceptable risk will typically correlate to a Risk Type C, as described in Section 5.4.1.3.
- **Tolerable**: The YELLOW region denotes a risk that is acceptable providing that it can be shown that all practicable risk reduction measures have been taken and are continuing to be taken. This region is known as the ALARP region. Note that an Unacceptable risk will typically correlate to a Risk Type B.
- **Acceptable**: The GREEN region denotes that the risk is low and acceptable without further reduction measures being required. Note that an Acceptable risk will typically correlate to a Type A risk.

Table 5.4 – Searcher Risk Assessment Matrix

			LIKELIHOOD				
			Rare	Unlikely	Possible	Likely	Almost Certain
			1	2	3	4	5
CONSEQUENCE	Critical	E	11	16	20	23	25
	Major	D	7	12	17	21	24
	Serious	C	4	8	13	18	22
	Moderate	B	2	5	9	14	19
	Minor	A	1	3	6	10	15

5.4 RISK EVALUATION

The risk evaluation stage involves comparing the results of the risk assessment with risk criteria to decide whether additional risk treatment is necessary before the activity should go ahead. The two overarching criteria assessed are whether the risks and impacts are ALARP (sub-regulation 10A(b)) and are at an acceptable level (sub-regulation 10A(c)).

5.4.1 Determination of ALARP

The approach developed by Oil and Gas UK (OGUK) (formerly UKOOA) and presented in Guidance on Risk Related Decision Making (Oil & Gas UK, 2014) has been adopted for use in an environmental context. This approach provides a framework to determine the assessment technique required to demonstrate that potential impacts and risks are ALARP (Figure 5.1). Specifically, the framework considers consequence severity based upon contextual information relating to the:

1. Activity type
2. Potential (environmental) risk/impact and (engineering / scientific) uncertainty
3. Stakeholder influence (objections or claims).

Once the overall context for each risk is established it is allocated to one of the three "Types" defined below. In accordance with the regulatory requirement to demonstrate that environmental impacts and risks are managed to ALARP, the risk context determines the level of ALARP assessment required. Figure 5.1 indicates the assessment techniques, including:

1. Good Practice
2. Engineering risk assessment
3. Precautionary approach.

The application of each assessment technique in relation to the risk context is discussed further below.

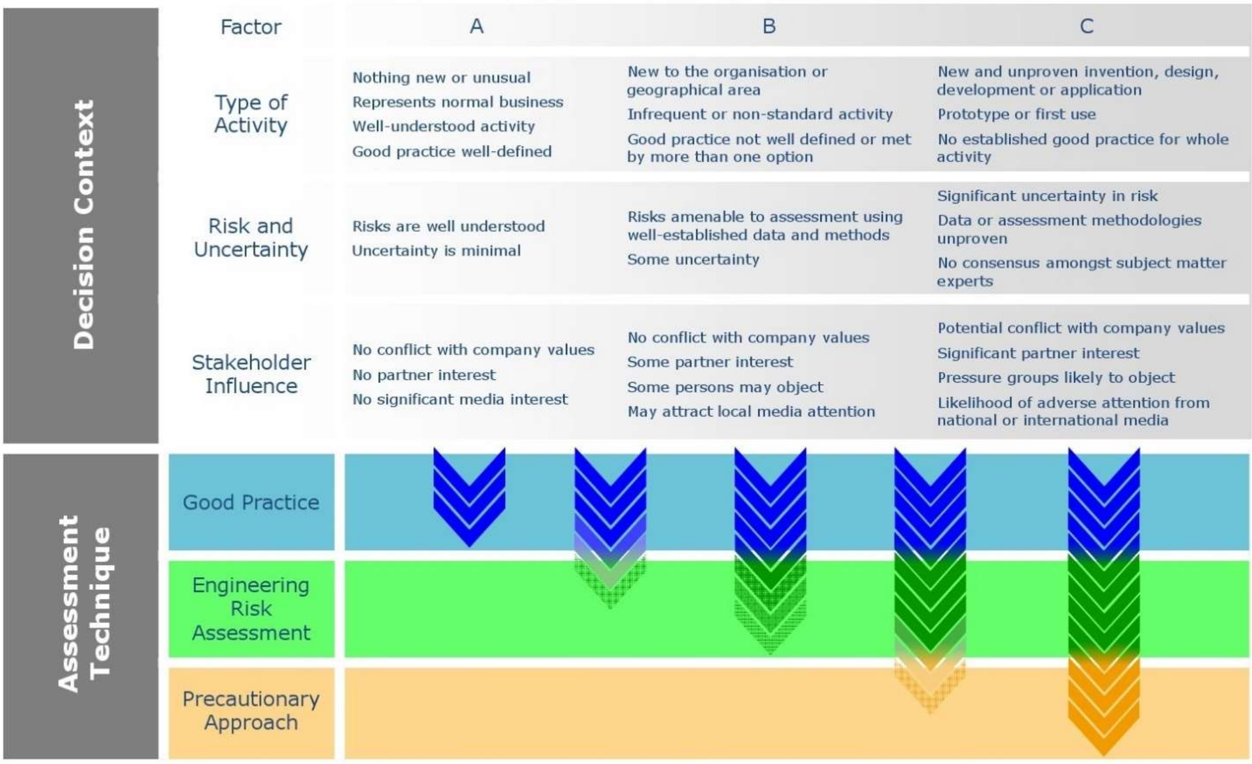


Figure 5.1 – Risk Related Decision Making Framework (Oil & Gas UK 2014).

5.4.1.1 Type A Risk

The risk is determined to be 'Type A' if the activity is relatively well understood, the predicted residual risk is within the Acceptable region, activities are well practiced, and/or there is no significant stakeholder interest.

If the risk context is categorised as 'Type A', the application of 'Good Practice' (Section 5.3.2) is considered sufficient to demonstrate potential impacts and risk are managed to ALARP (NOPSEMA Decision Making Guideline Rev 6 2019) and further assessment ('Engineering Risk Assessment') is not necessarily required to identify additional controls.

5.4.1.2 Type B Risk

The risk is determined to be 'Type B' if there is greater uncertainty or complexity around the activity and/or risk, the predicted residual risk is Tolerable or greater, or the activity generates several concerns from stakeholders.

If the risk is categorised as 'Type B', an "Engineering Risk Assessment" is performed. Additional quantitative risk assessment (e.g. sound modelling) may be performed to further define the risk and cost/ benefit analysis will be performed which may identify alternate and/or additional control measures to those identified as 'Good Practice'. The cost/ benefit analysis is based upon the balance and weight of evidence for the possible environmental benefit and the costs of adopting alternate, additional and/or improved control measures.

In performing the cost benefit analysis, a risk management hierarchy (Table 5.5) encourages the implementation of hard/ engineering control measures and provides for an effective spread of controls measures.

Table 5.5 – Hierarchy of Controls

Control	Effectiveness	Seismic survey examples
Eliminate		Use options with a lower impact on receptors. Get rid of the impact or risk. Avoid acquiring data near sensitive turtle nesting beaches during nesting season.
Substitute		Change the impact or risk for a lower one. Substitute a large seismic source array for a smaller one. Use products and/or processes with a lower impact on receptors.
Engineer		Engineer out the impact or risk. Use solid streamers rather than fluid-filled streamers.
Administrative		Provide instructions or training to people to lower impact or the risk. The use of procedures (e.g. at sea refuelling procedures) and pre-work job hazard analysis (JHAs) to assess and minimise the environmental impacts or risks of an activity.
Personal protective equipment		Use of properly fitted PPE where other controls are not practical or have not totally removed the hazard.

All identified control measures are categorised according to their type, allowing for an effective spread of measures in the event of a failure of a single critical element.

5.4.1.3 Type C Risk

A risk is determined to be 'Type C' if it is sufficiently complex, available engineering and scientific evidence is insufficient, inconclusive, or uncertain, the predicted residual risk is Unacceptable or there is sufficient stakeholder interest to require a precautionary approach. In this case, relevant Good Practice still must be met and additional "Engineering Risk Assessment" is required.

For a 'Type C' risk a precautionary approach is applied to risk management. The precautionary approach will mean that uncertainty is counterbalanced with the use of conservative assumptions when undertaking environmental risk assessment and additional control measures are more likely to be adopted. Environmental and social considerations are expected to take precedence over cost considerations when evaluating the suitability of additional controls.

5.4.1.4 Identification of Changes to Residual Risk

Following the ALARP evaluation, any changes to the predicted residual risks resulting from adopting alternate and/or additional control measures are identified to determine whether potential impacts and risks have been reduced to an acceptable level.

5.4.1.5 ALARP Justification

A statement is provided for each aspect to justify the overall certainty and effectiveness of reducing each potential impact and risk to ALARP using the adopted control measures.

5.4.2 Acceptable Level

A risk or impact is determined to be of an acceptable level if the general criteria and receptor specific criteria detailed in Section 5.4.2.1 and 5.4.2.2 have been met.

Searcher does not consider it acceptable for an emergency situation to occur. Emergencies assessed in this EP include establishment of an invasive marine pest and a marine oil pollution emergency resulting from vessel fuel tank rupture. Searcher considers the level of risk to be acceptable when preventative and response control measures are demonstrated to reduce potential environmental impacts and risks to ALARP (as per General Criteria 1 below).

5.4.2.1 General criteria

1. The environmental impact or risk is deemed to be ALARP.
2. The aspect of the activity under assessment does not compromise the relevant principles of Ecologically Sustainable Development (ESD) or breach relevant requirements for environmental approvals (EPBC Act Part 3, Division 1), namely:
    a. It does not pose a threat of serious or irreversible environmental damage to matters of national environmental significance
        i. the world heritage values of a declared World Heritage property
        ii. the national heritage values of a National Heritage place

        iii. the ecological character of a declared Ramsar wetland
        iv. any values and sensitivities that exist in, or in relation to, part or all of a Commonwealth marine area or Commonwealth land.
    b. It does not pose a [significant] threat to biodiversity and ecological integrity of:
        i. a listed threatened species or listed threatened ecological community
        ii. a listed migratory species
    c. It does not pose a threat to the quality of the environment available to future generations.
3. The management of the activity is consistent with any relevant plan of management for affected Marine Parks and/or a recovery plans for threatened species that include specific management and conservation requirements.
4. All relevant legislative and other requirements have been met or considered in context.
5. All relevant internal Searcher requirements have been met.
6. All relevant person(s) have been provided with sufficient information with respect to potential impacts and risks to their functions, interests or activities and all merited objections or claims made by relevant person(s) have been sufficiently addressed.

5.4.2.2 Receptor specific criteria

For particular values and sensitivities that may be impacted by routine operations that are rated as a Type B Risk or above (see Section 5.4.1) the criteria in Table 5.6 have been developed to determine whether the predicted impact is below an acceptable level of impact.

Table 5.6 – Receptor specific criteria for acceptable level of Impact – routine seismic operations

Identified Value or Sensitivity	Acceptable level of impact
Plankton communities	Searcher considers it unacceptable for there to be long term or permanent impacts to plankton communities as a result of the activity.
Benthic communities	Searcher considers it unacceptable for there to be a permanent change in benthic communities as a result of the activity.
Marine fauna	Searcher considers it unacceptable to have a significant impact on an EPBC listed (marine fauna) species or other marine fauna species.
Shoreline habitats	Searcher considers it unacceptable to have an impact on a shoreline as a result of routine operations.
Protected areas	Searcher considers it unacceptable to have impacts on values of marine protected areas not inconsistent with the management principles and objectives of the marine park or other protected area.
Commercial fisheries	Searcher considers limiting displacement of commercial fisheries to the caution zone around the seismic survey vessel to represent an acceptable level of disruption to commercial fishers. It is unacceptable to have long-term effects on stock, spawning or fishing activities due to the activity.
Commercial shipping	Searcher considers limiting disturbance to the caution zone around the seismic survey vessel to be an acceptable level of disruption to commercial shipping.
Tourism and recreation	Searcher considers limiting displacement of tourism and recreation activities to the mutually agreed area during SIMOPS planning to be an acceptable level of disruption to tourism and recreation. No health impacts on divers or recreational activities from seismic sound are acceptable.
Petroleum exploration and production	Searcher considers limiting disturbance to the caution zone around the seismic survey vessel and to that agreed under SIMOPS planning to be an acceptable level of disruption to petroleum exploration and production vessel activities.
Defence activities	Searcher considers it unacceptable to cause disruption to defence activities.
Research activities	Searcher does not consider any disruption to research activities, beyond that which is agreed through a SIMOPS plan, to be acceptable.

5.4.2.3 Acceptable Level Decision

For each impact or risk assessment (Section 6), if general criteria 1-6 (Section 5.4.2.1) and all relevant criteria applicable to particular values and sensitivities (Section 5.4.2.2) have been met then the risks and impacts are determined to be of an acceptable level.

6 ENVIRONMENTAL IMPACT AND RISK ASSESSMENT

This section of the EP describes the results of the impact and risk assessment for the Possum 3D MSS using the methodology described in Section 5. As required by the OPGGS(E)R, this evaluation demonstrates that control measures will be in place to reduce the impacts and risks associated with the Possum 3D MSS to ALARP and to an acceptable level.

The impact and risk assessment has considered the environmental aspects listed in Table 6.1. The planned and unplanned environmental aspects which could arise as during routine and emergency response activities have been considered.

Table 6.1 - Aspects associated with Routine and Emergency Response Activities

Reference	Environmental Aspect	EP Section	Residual Risk
Routine Activities			
R1	Physical Presence of Vessels	Section 6.1	Acceptable
R2	Invasive Marine Species	Section 6.2	Tolerable
R3	Artificial Light	Section 6.3	Acceptable
R4	Anthropogenic Sound	Section 6.4	Tolerable
R5	Atmospheric Emissions	Section 6.5	Acceptable
R6	Discharge of Sewage, Greywater and Putrescible Waste	Section 6.6	Acceptable
R7	Discharge of Deck Drainage and Bilge Water	Section 6.7	Acceptable
R8	Discharge of Cooling Water and Desalination Brine	Section 6.8	Acceptable
R9	Dropped Objects and Solid Waste	Section 6.9	Acceptable
R10	Marine Hydrocarbon Spills	Section 6.10	Tolerable
Emergency Response Activities			
ER11	Oiled Fauna Displacement and Handling	Section 6.11	Acceptable

6.1 PHYSICAL PRESENCE OF VESSELS

Nature and Scale of Impacts and Risks

The Possum 3D MSS involves the use of a survey vessel (travelling at slow speed along defined paths) and up to two support vessels for the duration of the activity (max 70 days) conducting 24-hr operations. The physical presence of the survey and support vessel(s) could result in interference with the movement of other marine users and physical interaction with marine fauna. The survey vessel and towed array represent a potential navigational hazard due to restricted manoeuvrability when the streamers are deployed, requiring avoidance measures by other vessels to prevent vessel collisions or entanglement. The survey vessel will have a caution zone of 3nm around the vessel and deployed seismic array (see Section 3).

The receptors that may be affected by the physical presence of vessels are marine fauna, commercial fisheries, commercial shipping, tourism/recreation vessels and research oceanographic mooring. Plankton and benthic communities, shoreline habitats, protected areas, petroleum exploration and production, and research or defence activities are considered unimpacted by physical presence and are not considered further here. The operational area overlaps the Multiple Use Zone of the Argo-Rowley Terrace MP (Figure 4.3). The values of this zone are considered unimpacted by the vessels presence and are not considered further.

Marine Fauna

The survey and support vessels may present a physical hazard to marine fauna (e.g. animal displacement or vessel strike). Additionally, the tail buoys that are attached to the end of seismic streamers create a risk of entanglement for marine reptiles. During seismic data acquisition, the survey vessel will be moving at a speed of approximately 4 -6 knots (approximately 7–11 km/hr) and will acoustically announce its approach from distance; therefore, marine fauna are likely to be aware of its presence and will be able to evade the vessel.

Vessel collisions contribute to the mortality of marine fauna, notably turtles (Lutcavage et al. 1997, Hazel & Gyuris 2006, Hazel et al. 2007) and large cetaceans (Knowlton & Kraus 2001, Laist et al. 2001, Jensen & Silber 2003). Stranding records for Queensland indicated that 14 % of dead marine turtles were struck by vessels (Hazel & Gyuris 2006). These records were largely from populated areas of the state and comprised an unknown proportion of the total mortality. A report on vessel strikes in Queensland (DoE 2007) indicated that "both commercial and recreational boats have been responsible for striking marine animals. Recreational vessels, however, account for 96.9% and commercial vessels only 0.001% of registered vessels in Queensland in 2003". Given the susceptibility of cetaceans, whale sharks and marine turtles to vessel strikes, only potential impacts on these fauna groups were considered. Other marine fauna (such as birds and fish) are likely to avoid vessels operating in the area and so are considered at low risk of vessel strike or entanglement and are not considered further.

Cetaceans

The timing and location of surveys within the operational area may partly coincide with sensitive periods of the pygmy blue whale migrations. The northern part of the operational area overlaps the distribution BIA for pygmy blue whales (Figure 4.11). The operational area also overlaps the migration BIA for pygmy blue whales (Figure 4.11). The operational area overlaps less than a quarter the width of the primary migratory pathway at a point where the migration route is more than 250 km wide. Given this overlap, pygmy blue whale individuals may be encountered within the operational area if the survey timing coincides with the migration period. The operational area does not overlap the foraging BIA of the pygmy blue whale. Sei and fin whales may be present in the deep, offshore waters of the operational area. However, it is unlikely that they will be present in significant numbers.

The operational area of the survey does not overlap any of the humpback whale BIA's.

The likelihood of a lethal vessel/whale collision is influenced by vessel speed: the greater the speed at impact, the greater the risk of mortality (Laist *et al.* 2001, Jensen & Silber 2003). Vanderlaan and Taggart (2007) found that the probability of lethal injury to a large whale as a result of a vessel strike increases from about 20% at 8.6 knots to 80% at 15 knots. During seismic data acquisition, the survey vessel will be moving at a speed of approximately 4- 6 knots (approximately 7–11 km/hr). At a speed of 4 knots, Vanderlaan and Taggart (2007) estimated the risk of a vessel-whale collision resulting in lethal outcome to be <10%. Vessel/ whale collisions at this speed are uncommon. Based on reported data contained in the US National Ocean and Atmospheric Administration database (Jensen & Silber 2003), there were only two known instances of collisions when the vessel was travelling <6 knots. Both were from whale-watching vessels that were deliberately placed amongst whales. Management actions identified in the *Conservation Management Plan for the Blue Whale*, *Sei Whale Conservation Advice* and *Fin Whale Conservation Advice* require vessel collisions to be avoided by carrying out risk assessments and implementing mitigation measures if required, as well as ensuring all vessel strike incidents are reported in the National Ship Strike Database.

Marine reptiles

As the operational area does not overlap any recognised turtle BIA or habitat critical, it is highly unlikely that significant numbers of marine turtles will occur, and their occurrence is expected to be rare and infrequent.

Turtles on the sea surface or in shallow coastal waters have been observed to avoid approaching vessels by typically moving away from the vessels track, which was suggested as an avoidance behaviour based primarily on visual cues despite the vessel sound being within range of turtle hearing (Hazel *et al.* 2007). The success of this behaviour in avoiding a vessel strike is largely dependent on the speed of the approaching vessel and the prevailing water clarity. While the potential for vessel strikes at various speeds has not been quantified, the success of avoidance behaviour is a factor of the response time available (i.e. visual observation distance/ vessel speed). Hazel *et al.* (2007) suggested that higher vessel speed is more likely to cause impacts, particularly in shallow waters where turtles are abundant. There is less opportunity for turtles to avoid vessels travelling at higher speeds in turbid waters. Additionally, vessel draft may also contribute to the risk of vessel strikes, as vessels with less draft provide a greater clearance distance between the turtle and the vessel. In the event of a collision, the turtle's carapace provides a level of protection from serious injury, although the type and severity of the injuries would be dependent on the force of the collision, the structure of the vessel and whether the animal was struck by the hull or propellers. The Recovery Plan for Marine Turtles in Australia 2017-2027 (DoEE 2017) states that "although the outcome can be fatal for individual turtles, boat strike (as a standalone threat) has not been shown to cause stock level declines."

Turtle entanglement with streamer tail buoys has the potential to cause mortalities (Ketos Ecology 2007, 2009). In recent years, geophysical acquisition companies and seismic contractors designed and implemented "turtle guards", which are modifications to the tail buoys that minimise and reduce the potential for turtle entrapment. More recently, developments in the design

Whale sharks

The southern extent of the operational area overlaps with a small portion of the foraging BIA for whale sharks (Figure 4.17). However, it is not expected that whale sharks will be encountered in significant numbers, and any observation of whale sharks are likely to be rare and infrequent.

Although the whale shark's skin is thicker and tougher than any other shark species, the species may be behaviourally vulnerable to boat strike. As a significant amount of time is spent close to the water surface, whale sharks are often recorded bearing scars that have probably been caused by boat contact (DEH 2005, Norman 1999). In additional, several reports documented whale sharks impaled on the bows of larger ships (Norman 1999).

Commercial Fisheries

Seismic survey vessels towing seismic equipment, including streamers and energy source arrays are classified in the Navigation Act 1912, Schedule III and COLREGS, as a vessel restricted in their ability to manoeuvre. As such, under the Navigation Act 1912 "A vessel engaged in fishing when underway shall, so far as possible, keep out of the way of a vessel restricted in her ability to manoeuvre." (Rule 18, c, ii).

According to the Navigation Act 1912, the term "vessel engaged in fishing" means "any vessel fishing with nets, lines, trawls or other fishing apparatus which restrict manoeuvrability, but does not include a vessel fishing with trolling lines or other fishing apparatus which do not restrict manoeuvrability. Transiting commercial fishing vessels are assessed under 'commercial shipping' as they will not have apparatus deployed that will restrict their manoeuvrability.

Commercial fishing vessels are expected to be encountered as they work within the operational area. Although the management areas of several commercial fisheries overlap the operational area, only one Commonwealth commercial fishery is expected to be active within the operational area – the North West Slope Trawl Fishery (NWSTF) (Table 4.8). The operational area overlaps 9,221 km^2 (2.34%) of the NWSTF management area, and it is possible that fishing operations may occur within the vicinity of the proposed survey activities. The actively fished area of the WA Mackerel Managed Fishery (MMF)is approximately 79,735 km^2 (16 %) of Area 2, none of which overlaps the operational or acquisition areas. Initial fisheries catch and effort data recorded between 2014-2019 sourced from DPIRD on 28/10/2019 identified one 2018 10nmi^2 block record of fishing effort in approximately 400m of water within the acquisition area, which is considered unusual as the depth of the acquisition area is outside the usual actively fished area for this fishery (via consultation with WAFIC and DPIRD, 2020). Subsequent fisheries catch and effort data recorded between 2018-2020 sourced from DPIRD on 19/07/2021 shows no reference to that 2018 record of fishing effort which has since been removed from the list and therefore fishers in the MMF are not expected to be active in the survey operational or acquisition areas.

Consultation conducted with a NWSTF licence holder and feedback from WAFIC highlighted concerns regarding potential negative impacts to key indicator species, including the NWSTF resource (see section 6.4.9), displacement of fishers and loss of catch, communication policy with all staff and vessel crew, contractors and sub-contractors regarding interacting and protecting the rights of active commercial fishers on the water with appropriate sharing of ocean resources

The predicted minor impacts to crustaceans are not expected to have an impact on the broader crustacean populations in the region as the area of seabed exposed is extremely small in the context of the very large and the likely inter-connected crustacean populations of the north west Australian waters (Wilson 2013) that are likely to be inherently resilient to such a small perturbation. The risk would be the key spawning periods for the resource, identified as September to October.

The potential consequence to NWSTF licence holders are displacement, loss of catch from usual fishing locality and therefore minor disruption to fishing. There is no impact to catch predicted as a result of the physical presence of the survey vessel due to the large area available to commercial fishers, who are mobile and can move away from the seismic vessel whilst still fishing (for example trawlers in the NWSTF). This is because the seismic vessel will be travelling at a slow speed and occupies a small space relative to the broader survey area which will remain open to fishing activity. An adjustment strategy aligned with the National Energy Resource Australia (NERA) Adjustment Protocol, negotiated with a broad range of commercial fishing peak bodies and individual license holders for evidence based loss of catch, displacement and equipment loss or damage, will mitigate risk of commercial fishers being worse off as a result of the seismic survey.

The potential risk regarding interacting and protecting the rights of active commercial fishers on the water with appropriate sharing of ocean resources will be mitigated by the temporal or spatial design of the survey, forecast of operations and appropriate policies and controls for effective communication on the water, including AIS tracking to aid identification and policy of no recreational fishing from the survey vessel (s)..

Commercial Shipping
Commercial shipping vessel interactions are expected to occur within the operational area as they transit inbound and outbound from the Port of Dampier, Port Hedland, Barrow Island and the Port of Broome, and as transiting fishing vessels potentially move to fishing grounds. The potential consequences to commercial shipping vessels are the requirement for longer transits (in the order of hours) to avoid the survey vessel while the streamers are deployed and potential for entanglement/ collision with streamers. The highest risk will be when the survey vessel is performing slow-speed turning during line changes or when it is moving perpendicular to the normal passage of commercial shipping.

Tourism and Recreation
Interactions with tourism/recreational vessels are expected to occur as they transit through the operational area to access the Rowley Shoals during October and November. The potential consequence to tourism/recreational vessels from the physical presence of the survey vessel is the requirement for longer transits due to avoid the vessel and towed array around the survey vessel while the streamers are deployed and reducing the visual impact during the tourist vessel nature based activity.

Research Oceanographic Mooring
Review of current Notice to Mariners indicates that there is one long term research oceanographic mooring (monitoring) deployed within the acquisition area to within 15 m of the sea surface. The highest risk will be entanglement when the survey vessel is passing close to the buoy location (NWSROW: S 17deg 45.481', E 119 deg 54.366').

Good Industry Practice
Navigation Act 2012 specifically Chapter 6 Part 6 Division 5, which establishes the Australian Hydrographic Office (AHO) to collect, compile and collate hydrographic data and maintain and disseminate hydrographic and other nautical information and nautical publications of maritime safety/navigation procedures which include: • Notices to Mariners (EPS 1.2/EPS 1.4)
Notification of activity details to relevant stakeholders four weeks prior to the survey commencing, containing specific information of the survey vessels, planned tracks, contact information and establishment of exclusion (safety) zone around the vessel. (EPS 1.2/ EPS 1.3/EPS 1.4/EPS 1.5)
AIS tracking device installed and operational on survey vessels to aid identification by other vessels.(EPS 1.6)
Marine Orders Part 30: Prevention of Collisions 2016, Section 9 – Requirements of International Regulations: (EPS 1.7) (1) The measures required by the International Regulations in the navigation, management and working of a vessel for the prevention of collisions must be observed in the operation of a vessel. (2) The lights and signals required by the International Regulations must be provided and used on a vessel. The above which implement the Navigation Act 2012 and Chapter 5 of the International Convention on the Safety of Life at Sea (SOLAS Convention). These Acts implement aspects of COLREGS (International Regulations for Preventing Collisions at Sea 1972), Chapter IV (Radiocommunications) and Chapter V (Safety of Navigation) of SOLAS (International Convention on the Safety of Life at Sea 1974) in Australia.
Offshore Petroleum and Greenhouse Gas Act 2006, specifically Chapter 2 Part 2.14 Section 280 – Interference with Others Rights applying to a petroleum exploration permit; (EPS 1.8) (2) A person (the first person) carrying on activities in an offshore area under the permit, lease, licence, authority or consent must carry on those activities in a manner that does not interfere with:

(a) navigation; or (b) fishing; or (c) the conservation of the resources of the sea and seabed; or (d) any activities of another person being lawfully carried on by way of: (i) exploration for, recovery of or conveyance of a mineral (whether petroleum or not); or (ii) construction or operation of a pipeline; or (e) the enjoyment of native title rights and interests (within the meaning of the *Native Title Act 1993*); to a greater extent than is necessary for the reasonable exercise of the rights and performance of the duties of the first person.
Relevant to support vessels only: (EPS 1.10) EPBC Regulations 2000, specifically Part 8 (Division 8.1 'Interacting with Cetaceans') 8.05 Other craft – adult cetaceans: (2) Within the caution zone for a cetacean to which this regulation applies, the person must: (a) operate the vessel at a constant speed of less than 6 knots and minimise sound; and (b) make sure the vessel does not drift or approach closer to the cetacean than: (i) for a dolphin—50 metres; or (ii) for a whale—100 metres; and (c) if the cetacean shows signs of being disturbed, immediately withdraw the vessel from the caution zone at a constant speed of less than 6 knots; and (d) if there is more than 1 person on the vessel, post a lookout for cetaceans; and (e) subject to paragraph (b), approach the cetacean only: (i) from the rear, no closer than 30 degrees to its observed direction of travel; or (ii) by positioning the vessel ahead of the cetacean at more than 30 degrees from its observed direction of travel; and (f) make sure the vessel does not restrict the path of the cetacean; and (g) make sure the vessel is not used to pursue the cetacean. (4) If a whale (other than a calf) approaches the vessel or comes within the limits mentioned in paragraph 2b, the person must: (a) disengage the gears and let the whale approach; or (b) reduce the speed of the vessel and continue on a course away from the whale 8.06 – Other craft – calves (2) The person must not allow the vessel to enter the caution zone of a calf. (3) If a calf appears within an area that means the vessel is then within the caution zone of the calf, the person: (a) must immediately stop the vessel; and (b) must: (i) turn off the vessel's engines; or (ii) disengage the gears; or (iii) withdraw the vessel from the caution zone at a constant speed of less than 6 knots.
Use of MFOs as described in Section 7.3.2 . (EPS 4.7)
Whale Shark Wildlife Management Program no. 57 (DpaW 2013) – Whale shark interaction code of conduct for vessels: • Maximum speed of 8 knots within 250 m radius of a whale shark and do not approach within 30 m of a whale shark. (EPS 1.11)
Streamer tail buoys fitted with appropriate turtle guards. (EPS 1.12)
Vessels will travel less than 6 knots within 300 m of an observed turtle. (EPS 1.13)
Streamers fitted with Automatic Streamer Recovery Devices (SRD) (EPS1.14)
Up to two support vessels used throughout the activity to manage vessel interactions and maintain communications with commercial shipping in the survey area, assist in the recovery of lost streamers and warning the survey vessel of in-water hazards 24/7. In case of emergency one support vessel will be capable of taking survey vessel under tow with all equipment deployed (to keep survey vessel and in-water equipment under control and in forward motion. A dedicated support vessel with tow capabilites will always remain with the survey vessel at all times when within 20km of Mermaid Reef or other marine park. (EPS 1.16) Wherever possible the Mermaid and other reefs will be avoided as an emergency anchorage. (EPS 1.24)
Entangled marine fauna recovered to the seismic or support vessels returned to the sea as quickly as practicable. (EPS 1.15)

Environmental Impact Assessment

Potential Consequence	Rank	Likelihood Discussion	Rank	Residual Risk
Marine Fauna				
Few encounters with large marine fauna are expected and likely limited to individuals transiting through the area. No impact at population levels are predicted, however avoidance behaviour of marine turtles due to sighting the vessels (as	B Moderate	The activity will be conducted with slow vessel speeds, and support vessel operations compliant with all maritime law relating to cetacean interactions and there is expected to	[2] Unlikely	[5] Acceptable

opposed to being alerted by vessel or seismic sound, see Section 6.4) is considered to have a Minor potential consequence (negligible effect on behaviour of species). Collision with vessels/ entanglement with streamers could have a potential consequence of injury or death to individuals.	B Moderate	be low numbers of marine fauna in the operational area during the proposed acquisition windows. Seismic sound during operations will encourage sound sensitive marine fauna to move away from the vessel, reducing the likelihood of collision or entanglement and the use of an MFO to reduce the impact of seismic sound on marine fauna (as detailed in Section 6.4.) will also reduce the likelihood of collision/ entanglement with the seismic vessel.	[2] Unlikely	[5] Acceptable
Commercial Fisheries				
Small overlap of the operational area with the actively fished area and impacts to commercial fisheries will be localised to the caution area of the vessel and duration of the survey. Physical presence of the survey and support vessels and therefore potential loss of catch or displacement of fishers will be limited to the few hours that the caution area of the survey vessel passes through the actively fished area.	[A] Minor	Given the low fishing effort within the OA, and well-established communication protocols, it is considered Possible that commercial fishers will only be required to alter course to avoid the survey vessel and it is also Possible that claims for adjustment may be appropriate if fishers are displaced from their actively fished fishing grounds.	[3] Possible	[6] Acceptable
Commercial Shipping				
Impacts to commercial shipping vessels, including transiting fishing vessels, will be localised to the caution area of the vessel. Displacement will be limited to the few hours that the caution area of the survey vessel passes through the planned track of the commercial vessel.	[A] Minor	Given the presence of commercial shipping vessels within the operational area as they transit inbound and outbound from various ports, it is considered Possible that commercial shipping vessels will be required to alter course to avoid the survey vessel.	[3] Possible	[6] Acceptable
Tourism and Recreation				
Impacts to tourism and recreation vessels will be localised to the caution area of the vessel. Displacement will be limited to the few hours that the caution area of the survey vessel passes through the planned track of the tourism or recreational vessel.	[A] Minor	Given the presence of tourism and recreation vessels and the transit from various ports to the Rowley Shoals it is considered Possible that vessels will be required to avoid the survey vessel.	[3] Possible	[6] Acceptable
Research Oceanographic Mooring				
Impacts to the buoy will be limited to the few hours that the survey vessel passes close to the location of the buoy	[A] Minor	The activity will be conducted with slow vessel speeds, and up to two support vessel operational to assist with identification of in-water hazards ahead of the seismic vessel. Application of a 1000m buffer around Research Oceanographic Mooring, (NWSROW buoy location: S 17deg 45.481', E 119 deg 54.366') will reduce the likelihood of entanglement with the seismic vessel.	[3] Possible	[6] Acceptable

Risk Type		**Overall Residual Risk**
Type B Risk	Risk is determined to be Type B as: • there has been stakeholder feedback concerning the potential impact of the presence of the survey and support vessels Based on the maximum likelihood level ranking (3-Possible) and maximum **Consequence** level as Moderate by receptor the overall residual risk is considered Acceptable. Although the activity and risk are well understood, and good practice control measures are well defined, there has been stakeholder feedback concerning the potential impact of the presence of the survey and support vessels. To reduce the risk to ALARP Searcher has undertaken additional analysis to identify further control measures to those identified as 'Good Practice' above.	Acceptable

Environmental Performance Outcomes (EPOs) relating to this aspect include:
EPO 3 No physical injury, mortality or disturbance during peak breeding or migration period to EPBC Act listed (marine fauna) species due to noise associated with the operation of vessels and seismic sources and Seismic acquisition is consistent with the Recovery Plans for EPBC listed marine species.

EPO 6 Displacement of commercial fisheries is limited to the caution zone around the seismic survey vessel as an acceptable level of disruption.
EPO 7 No serious or irreversible impact to fish stock, spawning or fishing activities due to the activity
EPO 8 No loss of total annual catch to commercial fishing licence holders, they are no worse off as a result of the seismic survey
EPO 9 Disturbance to commercial shipping is limited to the caution zone around the seismic survey vessel
EPO 10 Displacement of tourism and recreation is limited to the mutually agreed area during SIMOPS planning.
EPO 14 No disruption to research activities beyond that which is agreed to in SIMOPS planning
EPO 18 Consultation with directly affected stakeholders prior, during and after the activity

Additional Control Measures to those identified as 'Good Practice' above and considered for this aspect are shown below with Environmental Performance Standards (EPSs) and Measurement Criteria for the EPOs described in Section 9, Table 9-2.

Evaluation of Additional Control Measures (Detailed ALARP Evaluation)					
Control Measure	***Type***	***Benefit***	***Cost (% of project)***	***Implemented***	***Rationale***
Do nothing – no MSS	Eliminate	Avoids impacts to activities of other stakeholders, although these are not significant.	Elimination of total project cost	Not adopted	The purpose of the MSS is to assist the hydrocarbon exploration effort in the area of interest and better understand the subsurface geology and prospectivity of the licensed title. Titleholders of permits covered by the Possum 3D MSS are required by NOPTA to follow through with stated work commitments, which may include acquiring seismic data within specified time frames. Not acquiring the data would result in possible loss of the Title due to lack of execution of exploration commitments and/or ineffective planning of a subsequent drill program. Minimal benefit would be gained by not acquiring the data given the predicted low impact of the activity on other users and the environment.
Multi-Client Survey: Conduct survey as multi-client operation (EPS 1.26)	Eliminate	Multiple Titleholders can access the seismic data.	Not quantifiable	Adopted	Minimises environmental impacts compared to the alternative of multiple independent seismic surveys.
Stakeholder Consultation: Annually, and at least 12 weeks prior to the survey (unless the annual review falls within the same period), Searcher will undertake a pre-survey review of the EP (EPS 1.25)	Administrative	To make sure all relevant stakeholder update are captured.	<0.05%	Adopted	Relevant Stakeholders may change over time and review will capture any changes, such as annually allocated fisheries license holders. Benefit outweighs cost
No night-time operations	Eliminate	Daylight only operations may reduce the risk of adverse interactions with marine fauna, other vessels or equipment including research buoys.	>50%	Not adopted	There are substantial additional costs and risk considerations in limiting acquisition to daylight hours. Restricting daily acquisition will significantly extend the survey duration and so increase potential impacts from the physical presence of the vessel. Navigation aids enable acceptable night-time Interactions between vessels. Support vessels will scout ahead for in-water hazards such as research buoys. Costs disproportionately higher than benefits.
Seismic acquisition will only occur outside peak fishing, tourism or shipping seasons.	Eliminate	Eliminate/ minimise potential negative interactions with other vessels	5-10%	Partially adopted	Commercial shipping and fishing occur year-round whereas the duration of the survey (<70 days) and area of the survey are small. Timing the survey to avoid peak seasons is therefore not possible. Peak tourism periods are avoided.
Reduction of the operational and acquisition areas	Eliminate	Eliminate/ minimise impacts to tourism, recreational, fishing operators and marine fauna	0.5-2%	Adopted	Reduction to minimise survey area including near marine parks whilst still ensuring survey objective, reduces risk of adverse interactions with tourism, recreational, fishing vessels and marine

Evaluation of Additional Control Measures (Detailed ALARP Evaluation)					
Control Measure	***Type***	***Benefit***	***Cost (% of project)***	***Implemented***	***Rationale***
					fauna. Modification of survey area was made to avoid overlap with NDSMF historical operational areas.
Stakeholder Consultation : Stakeholder review conducted two months prior to the commencement of survey activities if the survey commences more than 4 months following EP acceptance. (EPS 1.1)	Eliminate	Eliminate/ minimise potential negative interactions with other vessels.	<0.5%	Adopted	Ensuring all relevant stakeholders have been identified, provided with sufficient information regarding the survey, and any merited objections or claims are considered in survey planning. This will also allow them to plan activities around the survey and avoid negative interactions by being included in the lookahead notification if applicable. Benefit outweighs cost.
Navigation equipment and procedures: AIS tracking device and Automatic Radar Plotting Aid (ARPA) installed on survey vessels and operating to aid identification by other vessels, including vessel speed, heading and virtual outer tail buoy locations to cover the extent of the seismic array. (EPS 1.6)	Engineer	Minimise potential negative interactions with other vessels.	<0.5%	Adopted	Navigation equipment that enables other marine users to track and avoid the survey vessel including vessel speed, heading and virtual outer tail buoy locations to cover the extent of the seismic array. Benefit outweighs cost.
Most efficient survey design possible to reduce survey duration.	Engineer	Minimise potential negative interactions with other vessels.	<0.05% of project cost	Adopted	Reduction will minimise survey time whilst still ensuring survey objectives, reduces risk of adverse interactions. Benefit outweighs cost
Survey Design: Survey temporally and spatially designed with northern area acquired toward the end of the survey acquisition (EPS 1.18)	Engineer	Minimise potential negative interactions with other vessels and support sharing of ocean resources between survey vessels and active commercial fishers.	<0.05% of project cost	Adopted	Survey temporally and spatially designed with northern area acquired toward the end of the survey acquisition to minimise impact to NWSTF fishery license holder.
Survey Design: Survey temporally designed to be outside known peak fishing and key spawning periods for the NWSTF resource identified as September to October (EPS 1.18 / EPS 1.19)	Engineer	Minimise potential risk to fisheries resource	<0.05% of project cost	Adopted	Survey temporally designed to be outside known peak fishing and key spawning periods for the NWSTF resource identified as September to October.
Survey Design: Survey spatially designed with application of a 1000m buffer around the AIMS Research Oceanographic Mooring, (NWSROW buoy location:	Engineer	Minimise potential for entanglement with Research Oceanographic Mooring	<0.05% of project cost	Adopted	Buffer will provide clearance to minimise risk of adverse interaction with oceanographic mooring. Benefit outweighs cost

Evaluation of Additional Control Measures (Detailed ALARP Evaluation)					
Control Measure	***Type***	***Benefit***	***Cost (% of project)***	***Implemented***	***Rationale***
S 17deg 45.481', E 119 deg 54.366') (EPS1.20)					
Forecast of operations issued prior to the survey commencing, as per APPENDIX F, to relevant stakeholders. (EPS 1.2)	Administrative	Minimise potential negative interactions with other vessels.	<0.5%	Adopted	Notification of activity details to commercial fisheries management agencies, fishing industry bodies, relevant government agencies, individual companies and licence holders, prior to the survey commencing as per APPENDIX F, to inform them about the location of the survey area, survey and support vessel specifications, timing of operations, contact phone numbers and communication protocols. Alert charter boat operators (involved in fishing, diving, etc.) of activities and enables commercial and recreational operators to plan ahead of time to prevent incidents. Benefit outweighs cost.
Stakeholder consultation: Stakeholders actively operating in or near the operational area will be kept informed of daily survey activities through 24-hour look-ahead communication. (EPS 1.5)	Administrative	Minimise potential negative interactions with other vessels.	<0.5%	Adopted	Ongoing notification of activities during the survey will allow stakeholders to plan activities around the survey and avoid negative interactions. Benefit outweighs cost.
Communication and interaction protocols: Searcher will ensure that suitable protocols for communication and interaction with vessel operators encountered during the survey are defined and implemented during the campaign. (EPS 1.9)	Administrative	Supports the appropriate sharing of ocean resources between the survey vessels and other vessels. Minimise negative incursions on the rights of other vessels on the water during the survey.	<0.05%	Adopted	Clear definition of communication and interaction requirements with vessel operators is a low-cost investment which will reduce the potential for negative interactions between survey vessels and vessels encountered during the survey.
Support Vessel Procedure: Up to two support vessels used throughout the activity to manage vessel interactions and maintain communications with commercial shipping in the survey area, assist in the recovery of lost streamers and warning the survey vessel of in-water hazards 24/7. One support vessel will be capable of taking survey vessel under tow with	Administrative	Warning other vessels that may not be aware of the presence of the seismic vessel, minimises the risk of negative interactions. Identification of in water hazards allows the seismic vessel to avoid damage. One support vessel will be capable of taking survey vessel under tow with equipment deployed (to keep survey vessel in control and in	<5% of project cost	Adopted	Warning errant or unaware vessels of the seismic vessel presence and pre-identification of in water hazards will allow avoidance actions to be undertaken in a timely manner. Benefit outweighs cost.

Evaluation of Additional Control Measures (Detailed ALARP Evaluation)					
Control Measure	***Type***	***Benefit***	***Cost (% of project)***	***Implemented***	***Rationale***
equipment deployed (to keep survey vessel and in-water equipment under control and in forward motion in case of emergency). A dedicated support vessel with tow capabilities will always remain with the survey vessel when within 20km of Mermaid Reef or other marine park. (EPS 1.16)		forward motion in case of emergency). A dedicated support vessel with tow capabilities will always remain with the survey vessel when within 20km of Mermaid Reef or other marine park.			
Commercial Fishery Adjustment: Payment of adjustment to commercial fishers for evidence-based loss of catch, displacement and Fishing gear loss or damage. (EPS 1.21)	Administrative	'Adjustment' arrangement for commercial fishery licence holders affected by the activity to reduce potential commercial impacts.	>10%	Adopted	Searcher is a member of the Collaborative Seismic Environment Plan (CSEP) consortium that underpins the NERA Commercial Fishing Industry Adjustment Protocol. As such, Searcher will adopt an adjustment strategy that is aligned with the Adjustment Protocol as negotiated with commercial fishing peak industry bodies, including AFMA, WAFIC and the Northern Territory Seafood Council. The CSEP Adjustment Protocol details an evidence-based process for commercial fishers to make a claim for loss of catch, displacement or gear damage within an Adjustment Area, a copy of which is available on the NERA website (NERA 2021).
Stakeholder Consultation: Consultation with stakeholders during the development of the EP, prior to and throughout the survey activity and EP validity (EPS 1.22)	Administrative	Keep stakeholders informed of any changes to the activity also allows stakeholders to advise Searcher of any updates.	<0.05%	Adopted	Allows Stakeholders and Searcher to be informed in advance of any prospective risks to their activity
Survey Vessel Procedure: Survey vessel will not leave the Operational Area with seismic source deployed unless in emergency situation (EPS1.23)	Engineer	Minimise potential negative interactions with other vessels and the existing environment	<0.05%	Adopted	To avoid impact on sensitive receptors such as marine fauna, reefs and other vessels outside of the defined Operational Area when conducting non-petroleum exploration related activities
Survey/Support Vessel Procedure: Where possible the Mermaid and other reefs will be avoided as an emergency anchorage (EPS 1.24)	Engineer	Minimise potential negative effects to the existing environment	<0.05%	Adopted	To avoid impact on sensitive receptors such reefs and other vessels during emergency.

Evaluation of Additional Control Measures (Detailed ALARP Evaluation)					
Control Measure	***Type***	***Benefit***	***Cost (% of project)***	***Implemented***	***Rationale***
Recreational fishing restrictions: No recreational fishing from any seismic or support vessel(s) (EPS 1.17)	Administrative	Remove	<0.05%	Adopted	Commitment to all commercial fisheries

Residual Risk Following the Application of Additional Controls	
In addition to implementing all 'Good Practice' management measures in accordance with regulations and industry guidelines, Searcher has also identified additional measures to manage the physical presence of the survey and support vessels. With the good practice and additional controls that have been proposed, the likelihood of impacts occurring is considered to be [2] Unlikely, the consequence remains [B] Minor. Therefore, the overall risk rating is considered Acceptable. The predicted impacts due to physical presence of survey vessels during the proposed activity are considered to be Low.	Acceptable

ALARP Justification

Given the decision context is 'Type B', and:

- Searcher has a high degree of certainty of the effectiveness of well-established control measures to ensure the level of impact to the environment from the physical presence of vessels is ALARP;
- All relevant 'Good Practice' control measures have been adopted by Searcher to manage the potential impacts and risks associated with the physical presence of vessels;
- A cost/benefit analysis of additional control measures (detailed ALARP assessment) has been performed and Searcher has adopted those assessed to be ALARP; and
- Additional controls have been evaluated and adopted as advised by stakeholders regarding temporal and spatial design of the survey with communication protocols for all staff, vessel crew, contractors and sub-contractors, including when interacting with commercial fishers on the water

Searcher considers that all potential environmental impacts and risks associated with the physical presence of vessels are managed to ALARP.

Demonstration of Acceptability

Acceptable Level Criteria (General)	***Statement of how the acceptance criteria has been met***
1. The environmental impact or risk is deemed to be ALARP, and the environmental consequence is ≤C from routine operations or ≤D from potential emergency conditions or emergency response operations.	The residual risks associated with the physical presence of vessels is ALARP and the environmental consequence from routine operations is Moderate (B).
2. Principles of ESD not compromised and relevant requirements for environmental approvals (EPBC Act Part 3, Division 1) met.	There is no threat of serious or irreversible environmental damage to any matters of national environmental significance associated with the physical presence of the survey vessels. There is no significant threat to biodiversity and ecological integrity associated with the physical presence of the survey vessels. There is no serious threat to the quality of the environment available to future generation associated with the physical presence of the survey vessels to the environment.
3. The management of the activity is consistent with a plan of management for a Marine Park and/or a recovery plan for a threatened species.	The physical presence of survey and support vessels does not pose any impact to marine parks so no management plans are applicable. Support vessels will comply with interaction limits set out in EPBC Regulations 2000, specifically Part 8 (Division 8.1 'Interacting with Cetaceans') and Whale Shark Wildlife Management Program no. 57 (DpaW 2013) – Whale shark interaction code of conduct for vessels in order to comply with the management actions set out in the below recovery plans and conservation advices: • Marine Bioregional Plan for the North West Marine Region (DSEWPaC 2012), • Recovery Plan for Marine Turtles in Australia, • Blue, Fin and Sei Whale Recovery Plan 2005-2010, • Conservation Advice *Balaenoptera borealis* sei whale 2015, • Conservation Management Plan for the Blue Whale (2015) – A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999, • Conservation Advice *Balaenoptera physalus* fin whale 2015, • Humpback Whale recovery Plan 2005-2010 • Conservation Advice *Megaptera novaeangliae* humpback whale 2015 (TSSC 2015a).
4. Legislation and Other Requirements.	The legislative and other requirements will be met via the effective implementation of control measures defined in the following: • Navigation Act 2012 specifically Chapter 6 Part 6 Division 5,

	• Offshore Petroleum and Greenhouse Gas Act 2006, specifically Chapter 2 Part 2.14 Section 280 – Interference with Others Rights, • Marine Order 28 (Operations standards and procedures) 2015, • Marine Orders Part 30: Prevention of Collisions 2016, Section 9 – Requirements of International Regulations.
5. Internal Context – Searcher.	Consistent with Searcher's Environmental Policy and company standards and procedures.
6. External Context – Stakeholder objects and claims addressed.	Additional controls have been evaluated and adopted for the following Stakeholder concerns: Stakeholder requests to be kept informed of survey including but not limited to, notifications to AMSA and AHO for start and end of operations to allow promulgation of radio navigation warnings to advise of physical presence of the survey vessel, DoT request for final OPEP, WA Museum discovery of any shipwreck, aircraft or other underwater cultural heritage feature, addressed by adding to commitments register and notifications table (APPENDIX F). ACMA raised concern regarding submarine cable operators to be consulted, this has been addressed in stakeholder communications with the operator of the North West Cable System submarine cable and Telstra have been addressed Stakeholders concerns regarding impacts to fish behaviour and stocks for key indicator species including the NWSTF resource (see section 6.4.9), displacement of fishers and loss of catch, communication policy with all staff and vessel crew, contractors and sub-contractors regarding interacting and protecting the rights of active commercial fishers on the water with appropriate sharing of ocean resources have been addressed.. Stakeholders concerns regarding an appropriate induction process and communication protocols for all staff, vessel crew, contractors and sub-contractors regarding interacting with commercial fishers on the water and strict no recreational fishing from survey vessels have been addressed. Stakeholder concern regarding location of oceanographic research mooring have been address by buffer zone. Searcher have also adopted control measures regarding the reduction of survey area including relevant buffer zones, timing, spatial and temporal design, stakeholder notifications, the use of AIS/ARPA on survey streamers and payment of adjustment to commercial fishers for evidence-based loss of catch, displacement and fishing gear loss or damage. Searcher will continue to consult regarding the NWSTF licence holders, including specifically stakeholder ID130's, concerns on displacement from fishing grounds.
Receptor Specific Criteria	***Comparison with the predicted level of impact***
Marine fauna Searcher considers it unacceptable to have a significant impact on an EPBC listed (marine fauna) species or other marine fauna species.	The worst credible predicted level of impact from the physical presence of the survey and support vessels is injury or death of an individual which is below the acceptable level of impact.
Commercial fisheries Searcher considers limiting disturbance displacement of commercial fisheries to the caution zone around the seismic survey vessel to represent an acceptable level of disruption to commercial fishers. It is unacceptable to have long-term effects on stock, spawning or fishing activities due to the activity.	The predicted level of impact from the physical presence of the survey and support vessels does not exceed the defined acceptable level of impact to commercial fishing activities. No impact to stock levels will occur as a result of the physical presence of vessels.
Commercial shipping Searcher considers limiting disturbance to the caution zone around the seismic survey vessel to be an acceptable level of disruption to commercial shipping.	The predicted level of impact from the physical presence of the survey and support vessels does not exceed the defined acceptable level of impact to commercial shipping activities.
Tourism and recreation Searcher considers limiting displacement of tourism and recreation activities to the mutually agreed area during SIMOPS planning to be an acceptable level of disruption to tourism and recreation.	The predicted level of impact from the physical presence of the survey and support vessels does not exceed the defined acceptable level of impact to tourism and recreation.

Research Oceanographic Mooring Searcher considers application of a 1000m buffer and scouting by support vessels to be an acceptable level of avoidance of the buoy.	The predicted level of impact from the physical presence of the survey and support vessels does not exceed the defined acceptable level of impact to the Research Oceanographic Mooring
Acceptable level decision	
All general and receptor specific criteria have been met and the impacts and risks are determined to be of an acceptable level.	

6.2 INVASIVE MARINE SPECIES

Nature and Scale of Impacts and Risks
There is the potential for vessels engaged in the Possum 3D MSS to transfer invasive marine species (IMS) into the operational area. The actual survey vessel and support vessels are yet to be confirmed. They may either be engaged from overseas, interstate, other project locations in WA waters or may mobilise to the operational area from a WA port. Sources of risk from vessels include: • discharge of high-risk ballast water; • biofouling on vessel hulls and other external niches; • biofouling of internal vessel areas; and • biofouling on equipment routinely immersed in water. The survey and support vessels will not be anchoring during the Possum 3D MSS, unless required in an emergency. IMS are marine plants or animals that were introduced into a region beyond their natural range and could survive, reproduce and establish populations. Species of concern vary from one region to another depending on environmental factors including water temperature, salinity, nutrient levels and habitat type. These factors dictate survival and invasive capabilities. IMS have been introduced and translocated around Australia by a variety of natural and human means, including discharge of ballast water, biofouling and aquaculture operations. In the unlikely event that a species is introduced and survives in the new environment, they then have the potential to colonise a new region and establish a new population. Once established, IMS may cause serious environmental, social and economic impacts through predation or displacement of native species and changes in ecosystem function across all sensitive receptors. Shallow water, coastal marine environments are most susceptible to the establishment of invasive populations, with most IMS associated with artificial substrates in disturbed shallow water environments such as ports and harbours (e.g. Glasby et al. 2007; Dafforn et al. 2009a, 2009b). Therefore, the undisturbed, deep water, offshore location of the operational area (water depth of approximately 118 m-approximately 566 m) is unlikely to represent suitable habitat for the establishment of IMPs. The nearest shallow shoal feature is Mermaid Reef which rises to a sand cay, noting that the distance of the 40 m bathymetry depth to the edge of the operational area is more than 8 km. Receptors considered relevant to assessing the risks and impacts related to the establishment of IMS are plankton communities, benthic communities, marine fauna, protected areas, commercial fisheries, tourism and recreation.
Good Industry Practice
Biosecurity Act 2015, specifically: Chapter 4, Managing biosecurity risks: conveyances: • Installations and vessels arriving in Australia from an international voyage to submit details of vessel particulars, port calls and journey history, and ballast water management history in a Pre-Arrival Report (PAR) 96-12 hours prior to arrival and be assessed by a biosecurity officer in a first entry port in Australia; (EPS 2.1) • If installations or vessels do not meet one of the exceptions outlined in the Biosecurity (Exposed Conveyances—Exceptions from Biosecurity Control) Determination 2016 , they are required to submit a PAR 96-12 hours prior to re-entry into Australian territorial waters and be assessed by a biosecurity officer in a first port of arrival. (EPS 2.1) Chapter 5, Ballast water and sediment: • vessels have a Ballast Water Management Certificate and Ballast Water Management Plan (BWMP) and undertake reporting and management of ballast in accordance with the Act. (EPS 2.2)
International convention on the Control of Harmful Anti-fouling Systems on Ships and Protection of the Sea (Harmful anti-fouling systems) Act 2006, specifically Part 3: • on or after 1 January 2008, an Australian ship with a gross tonnage of 400 or more which enters or leaves a shipping facility on an international voyage must have on board a current anti-fouling certificate for the ship that is not an exempt platform (EPS 2.4) Marine Order 98 (Marine pollution – anti-fouling systems) 2013 provides the applicable forms and notices to comply with this Act (applicable to Australian ships). (Note the certificate confirms that anti-fouling has been applied and the date of application)
WA Fish Resources Management Act 1994, specifically:

- Part 9 "Noxious fish" makes it an offence to bring a noxious fish into WA.

Australian Ballast Water Requirements Version 8 2020, specifically:

- vessel has a valid Ballast Water Management Plan (BWMP) (EPS 2.2) that shall include:
  - Ballast water exchange;
  - Ballast water management systems;
  - Sediment management;
  - Duties of officers and crew;
  - Coordination with local authorities; and
  - Record keeping
- vessel has a valid Ballast Water Management Certificate (BWMC) (EPS2.2)
- all operations are recorded in the Ballast Water Record System (EPS 2.3)
- vessel has met the reporting obligations below:
  - International vessels submit a Ballast Water Report through the Maritime Arrivals Reporting System (MARS) (EPS 2.1)
  - Domestic trading vessels can request a low risk exemption through a Domestic Risk Assessment. All applications must be submitted through MARS
- ballast water exchange should be conducted in at least 200 nm from nearest land and in waters 200 m deep. For voyages that cannot practically meet these requirements ballast water exchange must occur at least 12 nautical miles from the nearest land and in water at least 50 metres deep.

National Biofouling Management Guidance for the Petroleum Production and Exploration Industry 2009 (Commonwealth of Australia 2009), specifically:

- items periodically immersed in water, such as anchors and cables, ropes, fenders and small boats are clean of biofouling such as entangled seaweed, mud and other sediments after recovery and before stowage. For example, a high pressure wash down (using a firehose if cable wash down spray is not fitted) should be used to clean anchors and cables of mud and sediment at the time of retrieval (EPS 2.5)
- routine cleaning, maintenance and storage practices of most seismic survey equipment will ensure a low biofouling transfer risk (EPS 2.6)
- biofouling risk assessment shows low risk of IMS presence prior to entry into Australian waters
- survey vessel has a certified anti-fouling coating on the hull and coating is in sound condition. Anti-fouling system certification is in place in accordance with AMSA Marine Order Part 98 (Anti-fouling systems). (EPS 2.4)

Aquatic Biosecurity Solution, Vessel-Check tool (DHI 2021) applies to vessels entering western Australian waters from overseas or interstate. (EPS 2.7)

Environmental Impact Assessment

Potential Consequence	**Rank**	**Likelihood Discussion**	**Rank**	**Residual Risk**
Plankton communities				
Should IMS establish there is potential for a localised to widespread but negligible effect on plankton communities as a result of competition for resources.	[C] Serious	The remote, oceanic environment of the operational area and deeper water of the majority of the area where IMS could potentially be introduced is not conducive to the establishment of IMS even in the unlikely event of introduction into operational area. The distance from the operational area to shallow waters nearby shoals is approximately 8 km. There are no manmade structures, eg offshore drilling rigs, pipelines etc, at these locations which would support the establishment of IMS. Given the control measures to be implemented, the likelihood of establishment of IMS is rare.	[1] Rare	[4] Acceptable
Benthic communities				
Should IMS's establish within the operational area or surrounding shallow waters, there is potential for Major impact to the benthic communities of the Rowley Shoals.	[D] Major	As above	[1] Rare	[7] Tolerable
Marine Fauna				
Should IMS's establish within the operational area or surrounding shallow waters, there is the potential for indirect	[A] Minor	As above	[1] Rare	[1] Accept-able

effects on mammals, reptiles, sharks and listed fish species due to competition or effects on prey species. Impacts are expected to be Minor.	[A] Minor		[1] Rare	[1] Accept-able
Protected areas				
Should IMS's establish within the operational area or surrounding shallow waters, there is the potential for direct effects on benthic communities and the values of the marine parks and KEFs. Impacts could be at a Major level.	[D] Major	As above	[1] Rare	[7] Tolerable
Commercial Fisheries				
Should IMS's establish within the operational area or surrounding shallow waters (e.g. Rowley Shoals), there is the potential for indirect effects on commercial fish species due to competition or effects on prey species. Impacts are expected to be Serious.	[C] Serious	As above	[1] Rare	[4] Acceptable
Tourism and Recreation				
Recreational fishing and diving at the Rowley Shoals would be impacted in the event that IMS establish in the shallow waters of the shoals. Recreationally targeted fish species such as mackerel may be impacted. Visual amenity and the value of the shoals to divers would be impacted.	[D] Major	As above	[1] Rare	[7] Tolerable

Risk Type		**Overall Residual Risk**
Type B Risk	Risk is determined to be Type B as: • the residual risk is Tolerable or greater. Although the activity and risk are well understood, and good practice control measures are well defined and there has been no stakeholder concerns regarding the risk of IMS due to the activity, the residual risk is Tolerable. Searcher has undertaken additional risk assessment and cost/benefit analysis to identify further control measures to those identified as 'Good Practice' above.	Tolerable

Environmental Performance Outcomes (EPOs) relating to this aspect include:
EPO 15 No unplanned emissions or discharges to sea or air EPO 17 No introduction of marine pest species. The Control Measures considered for this aspect are consistent with the Good Industry Practice, Additional Control measures are provided below with Environmental Performance Standards (EPSs) and Measurement Criteria for the EPOs described in Section 9, Table 9-2.

Evaluation of Additional Control Measures (Detailed ALARP Evaluation)					
Control Measure	***Type***	***Benefit***	***Cost (% of project)***	***Implemented***	***Rationale***
Do nothing – no MSS	Eliminate	Avoids risk of IMS	Elimination of total project cost	Not adopted	The purpose of the MSS is to assist the hydrocarbon exploration effort in the area of interest and better understand the subsurface geology and prospectivity of the licensed title. Titleholders of permits covered by the Possum 3D MSS are required by NOPTA to acquire seismic data within specified time frames. Not acquiring the data would result in possible loss of the Title due to lack of execution of exploration commitments and/or ineffective planning of a subsequent drill program. Minimal benefit would be gained by not acquiring the data given the predicted low impact of the activity on other users and the environment.
IMS Hull cleaning and new anti-fouling coat application to vessel hull and niche areas on every occasion prior to entry into bioregion waters.	Engineering	Reduces likelihood of IMS establishment	>10%	Not adopted	The benefit of this control measure is limited due to the vessel complying with the Biosecurity Act 2015 and the oceanic location of the survey which already reduces the likelihood of IMS establishment to Rare. This action without a justifiable risk (i.e. known presence of IMS) is a substantial cost without a net environmental benefit due to the other risk reduction measures in place.
National Biofouling Management Guidance for the Petroleum Production and Exploration Industry 2009 and Aquatic Biosecurity Solution, Vessel-Check tool (DHI 2021): IMS risk assessment and Corrective Action (EPS 2.7)	Administrative/ Engineer	Reduces likelihood of IMS establishment	<0.1%	Adopted	Use of a recognised IMS risk assessment tool for vessels entering Western Australia waters for the purpose of working on the Possum 3D MSS will confirm low IMS risk or prompt action to remediate prior to mobilisation.
Contract vessels only operating out of Western Australian.	Administrative	Reduces potential risk species to those already introduced to WA Ports.	Up to 100%	Not adopted	The benefit of this control measure is limited due to the vessel complying with the Biosecurity Act 2015 and the oceanic location of the survey which already reduces the likelihood of IMS establishment to Rare. There are currently no seismic survey vessels permanently based and operating from WA ports. Appropriate seismic survey vessels are not always working and available in WA waters and the survey objectives could not be met if vessel source is restricted.
Ballast water management plan: Ballast water tanks of survey vessels within the operational area contain 'low-risk' ballast water (at least 95% of the ballast water in that tank is from a low-risk source) (EPS 2.8)	Administrative	Reduces likelihood of IMS establishment	<0.1%	Adopted	Ballast water exchange records demonstrate that ballast water on survey vessels within the operational area has been obtained from a low-risk source

Residual Risk Following the Application of Additional Controls	
In addition to implementing all 'Good Practice' management measures in accordance with regulations and industry guidelines, Searcher has identified additional measures to manage IMS. The risks and potential effects of the introduction and establishment of IMS during seismic surveys are well understood with legislative requirements and industry agreed good practices to manage risks. The application of recognised good practice is generally considered appropriate to manage the risk. Given the good practice and additional controls that have been proposed, the likelihood of impacts occurring is further reduced. However, the overall risk rating remains Tolerable.	Tolerable

ALARP Justification

Given the decision context is 'Type B', and:

- Searcher has a high degree of certainty of the effectiveness of well-established control measures to ensure the level of impact to the environment from the introduction of IMS is ALARP;
- All relevant 'Good Practice' control measures have been adopted by Searcher to manage the potential impacts and risks associated with the introduction of IMS; and
- A cost/benefit analysis of additional control measures (detailed ALARP assessment) has been performed and Searcher has adopted those assessed to be ALARP.

Searcher considers that all potential environmental impacts and risks associated with the introduction of IMS are managed to ALARP.

Demonstration of Acceptability

Acceptable Level Criteria (General)	***Statement of how the acceptance criteria has been met***
1. The environmental impact or risk is deemed to be ALARP.	The residual risks associated with the introduction of IMS is ALARP as demonstrated above.
2. Principles of ESD not compromised and relevant requirements for environmental approvals (EPBC Act Part 3, Division 1) met.	There is no threat of serious or irreversible environmental damage to any matters of national environmental significance associated with the introduction of IMS. There is no significant threat to biodiversity and ecological integrity associated with the introduction of IMS. There is no serious threat to the quality of the environment available to future generation associated with the introduction of IMS.
3. The management of the activity is consistent with a plan of management for a Marine Park and/or a recovery plan for a threatened species.	With the application of Good Practice control measures there is no impact to protected areas or specific management objectives of marine park management plans or protected species recovery plans.
4. Legislation and Other Requirements.	The legislative and other requirements will be met via the effective implementation of control measures defined in the following: • Navigation Act 2012 specifically Chapter 6 Part 6 Division 5, • Offshore Petroleum and Greenhouse Gas Act 2006, specifically Chapter 2 Part 2.14 Section 280 – Interference with Others Rights, • Marine Order 28 (Operations standards and procedures) 2015, • Marine Orders Part 30: Prevention of Collisions 2016, Section 9 – Requirements of International Regulations.
5. Internal Context – Searcher.	Consistent with Searcher's Environmental Policy and company standards and procedures.
6. External Context – Stakeholder objects and claims addressed.	DAWE concerns regarding vessel reporting, possible inspection and biosecurity assessment have been addressed to ALARP .
Acceptable Level of Impact – Receptor Specific Criteria	NA. Searcher does not consider it acceptable for an emergency condition to occur, including the establishment of IMS.

Acceptable level decision

All general criteria have been met and the impacts and risks are determined to be of an acceptable level.

6.3 ARTIFICIAL LIGHT

Nature and Scale of Impacts and Risks

For the duration of the seismic activities, safety and navigational lighting will be used on the vessels at night and in poor weather as per legislated requirements. Legislation provides minimum lighting requirements for safety (COLREGS, Navigation Act 2012, and the SOLAS Convention) as a minimum.

Light intensity and colour on work areas of a seismic vessel are designed for safe and practical working. Work areas of a survey vessel deck, such as gun decks, need to be lit at all times for personnel safety. Lighting for deck operations typically comprise bright white (metal halide, halogen, fluorescent etc) lights focussed on working areas but covering the vessel. For intermittent periods, spot lighting may be required for in-sea equipment inspection, deployment and retrieval. Navigation lights are typically elevated but less intense.

Direct illumination of surface waters is limited to the immediate vicinity of the survey and support vessels. The distance to the horizon at which the brighter components may be directly visible can be estimated using the formula:

$$\text{Horizontal distance (km)} = 3.57 \times \sqrt{\text{height (m)}}$$

For typical survey vessels, the highest lights that may be mounted are approximately 45 m above sea level and would be visible for roughly 24 km. The area of potential light impact has been assessed as the operational area plus approximately 24 km i.e. where light may be visible by sensitive receptors from the sea surface.

The receptors that may be affected by the presence of artificial light due to the survey are plankton communities and marine fauna including turtles and avifauna. The Marine Bioregional Plan for the North West Marine Region (DSEWPaC 2012) lists light as a threat to the region's values with respect to turtles and cetaceans. Light is not listed as a threat in the Conservation Management Plans or Approved Conservation Advices for the blue, humpback, sei or fin whales. As such, lighting impacts to whales are not assessed further. Commercial fish, demersal and site attached fish were not considered as a sensitive receptor due to the low intensity of light from moving vessels resulting in a small area of light directly on the ocean surface that will not penetrate to the depths at which demersal and site attached fish are found (water depths in the survey area from 118 – 566 m) and hence are not discussed further. Pelagic commercial fishery species, such as mackerel, may be attracted to planktonic and other prey species aggregations and therefore be at risk of increased predation. Socio economic receptors are considered unimpacted by vessels' light because of the large distances to the nearest communities. As such, impacts of light on socio economic receptors are not considered further. Light is not listed as a concern for any other conservation values or sensitivity, and so are not discussed further.

Plankton communities

Plankton communities are ubiquitous in the region without delineated aggregation areas. Zooplankton may be directly or indirectly attracted to the light field in the immediate vicinity of the vessels. Experiments using light traps have found that some zooplankton species are attracted to light sources (Meekan et al. 2001), with traps drawing catches from up to 90 m (Milicich et al. 1992). Lindquist et al. (2005) concluded from a study of larval fish populations around an oil and gas platform in the Gulf of Mexico, that an enhanced abundance of clupeids (herring and sardines) and engraulids (anchovies), both of which are highly photopositive, was caused by the platform's light fields. The concentration of organisms attracted to light results in an increase in food for predatory species, and marine predators are known to aggregate at the edges of artificial light halos. In a similar light trap study, juvenile tunas (*Scombridae*) and jacks (*Carangidae*), which are highly predatory, were thought to have been preying upon concentrations of zooplankton attracted to the light field of the platforms (Hernandez et al. 2003; Lindquist, Shaw & Hernandez 2005). This could potentially lead to increased predation rates compared to unlit areas.

Marine Fauna

Marine turtles

Artificial lights offshore can be detrimental to the sea-finding behaviours of marine turtle hatchlings if visible from nesting beaches because they can disrupt visual cues. Changes in ambient light levels may affect nesting behaviours with artificial lighting potentially deterring mature turtles from emerging from the water to nest (Salmon 2003; Salmon et al. 1992). Light is identified as a threat to nesting behaviours and hatchlings within the *Recovery Plan for Marine Turtles in Australia*. According to the 2020 National Light Pollution Guidelines for Wildlife, a precautionary 20 km threshold provides a limit based on observed effects of sky glow on marine turtle hatchlings (demonstrated to occur at 15-18 km). There are no known marine turtle rookeries within the precautionary 20 km radius around the operational area. When at-sea, hatchling visual cues are temporarily disrupted by the presence of vessel lighting. Therefore, impacts to marine turtles are expected to be limited to individuals transiting the operational area.

Fishes

Pelagic commercial fishery species, such as mackerel, may be attracted to plankton aggregations (as described above), or smaller prey aggregations that form due to the plankton aggregations. Potential impacts to fish species include change in behaviour and increased predation risk while aggregated.

Avifauna

Artificial lights offshore have been confirmed as the reason birds are attracted to offshore infrastructure (e.g. rigs; Marquenie *et al.* 2008). Potential impacts include disorienting migratory birds, affecting stopover selection and disrupting feeding (McLaren *et al.* 2018). Only one avifauna BIA overlaps the 24 km radius in which light may be visible – the white-tailed tropic bird breeding BIA on Bedwell Islet (the islet being approximately 29 km from the operational area boundary). The 2020 National Light Pollution Guidelines state that fledgling seabirds could be grounded in response to artificial lighting 15 km away (DoEE and DBCA 2020). Foraging adults of other species are likely in the area, including the red-tailed tropicbird which also breeds on Bedwell Islet. Shorebirds may cross the region during migration. The 2020 National Light pollution Guidelines for Wildlife (Appendix H- migratory shorebirds) states that 'overall the effect of artificial light on migratory shorebirds remains understudied and consequently any assessment should adopt the precautionary principle and manage potential effects from light unless demonstrated otherwise.' (DoEE and DBCA 2020).

Good Industry Practice

National Light Pollution Guidelines for Wildlife (DoEE and DBCA 2020) – Best practice lighting design (as applicable to short duration seismic and support vessels and safe navigation and operational requirements):

1. Light only the object or area intended – keep lights close to the ground, directed and shielded to avoid light spill. (EPS 3.1)

Environmental Impact Assessment

Potential Consequence	Rank	Likelihood Discussion	Rank	Residual Risk
Plankton communities				
The vessel will be in the operational area for up to 70 days and will require artificial lighting for safety during operations. Impacts to plankton communities are expected within 90 m of the vessel, at night-time. As the vessels and associated light source are moving constantly, it is expected that any potential impact of increased predation would be undetectable at a population level and be recovered within days.	[A] Minor	The likelihood of artificial lighting having an impact on plankton communities is Possible.	[3] Possible	[6] Acceptable
Marine fauna				
There are no breeding BIA's within the predicted lit zone, therefore there are no predicted effect on nesting behaviours of marine turtles, however, occasional transiting individuals may be present. The worst-case impact would be a negligible effect on the behaviour of individual turtles. In the event that deck or navigational lighting acts as an attractant to occasional seabirds or migratory shorebirds, it is not expected that this will permanently impact on migration, foraging or other behaviours. Lighting impacts to breeding pairs or fledglings are not expected due to the distance between the breeding location and the light source (min 29 km). In the event that lighting forms plankton aggregations that are opportunistically targeted by pelagic fish species, there may be Minor impacts to the population.	[A] Minor	Given the transient nature of marine turtles and that the vessel is constantly moving it is considered unlikely for artificial light to have an adverse impact on marine reptiles. The vessel will be continually moving and therefore unlikely to attract birds or disrupt breeding or fledglings, and any fish aggregation, relocation or behavioural effects are likely to be temporary.	[3] Possible	[6] Acceptable

Risk Type		**Overall Residual Risk**
Type A Risk	Risk is determined to be Type A as: • the activity and risks are well understood, with little uncertainty • good practice control measures are well defined • there has been no stakeholder feedback concerning the potential impact of artificial lighting. Given the application of 'Good Practice' control measures, the activity is relatively well understood, the predicted residual risk is well understood and there is no significant stakeholder interest the basis of ALARP has been made on a 'Type A' decision context.	Acceptable

Environmental Performance Outcomes (EPOs) relating to this aspect include:

EPO 3 No physical injury, mortality or disturbance during peak breeding or migration period to EPBC Act listed (marine fauna) species due to noise and light associated with the operation of vessels and seismic sources and Seismic acquisition is consistent with the Recovery Plans for EPBC listed marine species.

EPO 9 Disturbance to commercial shipping is limited to the caution zone around the seismic survey vessel as an acceptable level of disruption.

The Control Measures considered for this aspect are consistent with Good Industry Practice with Environmental Performance Standards (EPSs) and Measurement Criteria for the EPOs described in Section 9, Table 9-2. No additional Control measures have been considered and proposed for this aspect

ALARP Justification

Given the decision context is 'Type A', and:

- Searcher has a high degree of certainty of effectiveness of well-established control measures to ensure the predicted level of impact of artificial light is equal to or lower than the acceptable level;
- All good practice control measures have been adopted by Searcher to manage the potential impacts and risks associated with artificial light; and
- There has been no stakeholder feedback concerning the potential impact of artificial lighting.

Searcher consider that all potential environmental impacts and risks associated with artificial lighting due to the survey are managed to ALARP.

Demonstration of Acceptability

Acceptable Level Criteria (General)	***Statement of how the acceptance criteria has been met***
1. The environmental impact or risk is deemed to be ALARP.	The residual risks associated with artificial light due to the survey are ALARP as described above.
2. Principles of ESD not compromised and relevant requirements for environmental approvals (EPBC Act Part 3, Division 1) met	There is no threat of serious or irreversible environmental damage to any matters of national environmental significance associated with artificial lighting from the survey.

	There is no significant threat to biodiversity and ecological integrity associated with artificial lighting from the survey. There is no serious threat to the quality of the environment available to future generation associated with artificial light to the environment.
3. The management of the activity is consistent with a plan of management for a Marine Park and/or a recovery plan for a threatened species	Artificial lighting poses no impact to any protected areas, therefore, there are no relevant management plans. There are no rookeries within the precautionary radius there are no relevant recovery plan requirements. The activity is considered to be conducted in a manner that is consistent with the National Light Pollution Guidelines and the Recovery Plan for Marine Turtles in Australia. The impacts of lighting to the receiving environment are considered acceptable.
4. Legislation and Other Requirements	There is no legislation that reduces the environmental impacts of light in Western Australia or nationally.
5. Internal Context – Searcher	Consistent with Searcher's Environmental Policy.
6. External Context – Stakeholder objects and claims addressed	No stakeholder objections or claims were raised relating to artificial lighting.
Acceptable level decision	
All general criteria have been met and the impacts and risks are determined to be of an acceptable level.	

6.4 ANTHROPOGENIC SOUND

During the Possum 3D MSS underwater noise will be generated by the operation of vessels and by the seismic source.

Vessels
The Possum 3D MSS will involve the use of a survey vessel (travelling at slow speed along defined paths) and up to two support vessels for the duration (max 70 days) of the survey conducting 24-hour operations. The introduction of additional anthropogenic noise in the region from the survey and support vessels (e.g. from engines, propellers, hull flow noise – excluding noise generated by the seismic acoustic source) will result in potential short-term localised behavioural disturbance to marine fauna in the immediate vicinity.

Noise levels from the survey vessels will be significantly lower than the seismic source noise levels, as discussed below, and the control measures applied to reduce the impact of seismic sound on the environment will also reduce the impact of all lesser sources of anthropogenic noise on the environment. The implementation of EPBC Policy Statement 2.1 and Regulation Part 8, as detailed in Section 6.1, will also reduce the impacts of noise from vessels. The remainder of this section therefore addresses the risks associated with the seismic source.

Seismic source
Acquisition of the Possum 3D MSS will involve the use of a seismic source, consisting of a seismic source array with a maximum capacity of 2820 in^3, frequency range of 2-250Hz, towed at a water depth of 6-8 m (±1 m). The source will generate acoustic pulses by periodically discharging compressed air into the water column, at intervals of approximately 5 – 8 seconds as the vessel transits along acquisition lines within the acquisition area.

Sound emitted by the seismic source used during the Possum 3D MSS has the potential to cause physiological impacts to a range of sensitive receptors. Recognising the differential sensitivity of various marine faunal groups, the assessment of sound impacts is presented in separate sections, as follows:

- plankton communities;
- benthic communities ;
- marine fauna:
  - marine mammals
  - marine reptiles
  - bony fishes and sharks
  - avifauna;
- protected areas:
  - marine parks
  - KEFs;
- commercial fisheries; and
- tourism and recreation.

6.4.1 Acoustic modelling approach

To assess the potential magnitude and scale of impacts from underwater sound produced during the seismic survey, JASCO was commissioned to model the source levels of the seismic source arrays and the propagation of the sound through the marine environment. The full underwater sound modelling report is included in Appendix C.

6.4.1.1 Sound units

Sound energy is measured in specific units according to whether it is the peak sound level, the full amount of energy in a single pulse, or the cumulative energy of a series of pulses. Refer to Appendix A of the acoustic modelling report provided in Appendix C of this EP for a description of the different sound energy units and their mathematical basis.

6.4.1.2 Acoustic source

Searcher has not yet selected the seismic source array to be used in the survey and therefore a conservative approach was followed whereby the most powerful array of those under consideration was assessed. This is considered representative of whichever array is selected, as long as the power of the array is not higher than the ones modelled. JASCO's specialised Airgun Array Source Model (AASM) was used to predict acoustic signatures and spectra for the three arrays under initial consideration for the Possum 3D MSS. The total volumes of the arrays were 2380 in^3, 2495 in^3 and 2820 in^3. AASM accounts for individual seismic source element volumes, bubble interactions, and array geometry to yield accurate source predictions. For these three arrays, impulse energies at a nominal source location within the survey area was used to compare received levels. The array with the highest volume (2820 in^3) was selected as the representative seismic source and the sound emission characteristics of this array, in all directions, are presented in Table 6.2.

Table 6.2 – Far-field source level specifications for the 2820 in^3 seismic source array, for a 6 m tow depth

Direction	Peak source pressure level (LS,pk) (dB re 1 µPa m)	Per-pulse source SEL (LS,E) (dB 1 µPa^{2}m^{2}s)	
		10–2000 Hz	2000–25000 Hz
Broadside	248.8	224.4	186.0
Endfire	244.8	223.0	186.6
Vertical	254.9	227.9	194.3
Vertical (surface affected source level)	254.9	230.6	197.3

6.4.1.3 Modelling approach

Six sites were modelled to assess the impacts from single seismic source impulses (Figure 6.1). These sites were selected to represent the range of water depths and sound propagation characteristics within the Operational and Acquisition Areas. The orientations of the single impulse sites and line scenarios were selected to provide the greatest sound propagation radii broadside from the seismic source in relation to key receptors, including Mermaid Reef, the Rowley Shoals and the BIA for migrating pygmy blue whales.

Single impulses (SPL and SEL) and cumulative SEL transect scenarios were modelled to represent the range of survey lines and impact types in the acquisition area. Table 6.3 provides coordinates and water depth of the single impulse sites and Figure 4.4 shows the location of the modelled sites and 24-hour scenarios. The cumulative transect scenarios represent the extent of shots to be discharged within a 24-hour period at the closest point to Mermaid Reef (Scenario 1), intermediate water depth (Scenario 2) and the shallowest water (Scenario 3). The sound field was also sampled at the 40 m contour surrounding Mermaid Reef to assist with assessing maximum exposure of SCUBA divers at the closest potential dive site.

Table 6.3 - Location details for the single impulse modelled sites

Relevant Scenario	Site	Latitude (S)	Longitude (E)	UTM Zone 50		Water depth (m)	Tow direction (°)
				X (m)	Y (m)		
1 – Mermaid Reef	1	16° 57′ 22.0023″	119° 50′ 25.6849″	802522	8123112	427	0 & 180
	2	17° 12′ 03.2284″	119° 50′ 37.7815″	802485	8095999	375	0 & 180
	3	17° 05′ 51.1411″	119° 47′ 45.5615″	797558	8107519	401	0 & 180
2 – Intermediate depth	4	17° 41′ 43.4187″	119° 20′ 07.8975″	747722	8041979	311	90 & 270
	5	17° 45′ 39.2581″	119° 40′ 53.5241″	784339	8034236	220	90 & 270
3 – Shallow site	6†	18° 01′ 42.3635″	119° 13′ 22.4300″	735332	8005255	121	90

†Seafloor receptors modelled site only (VSTACK).

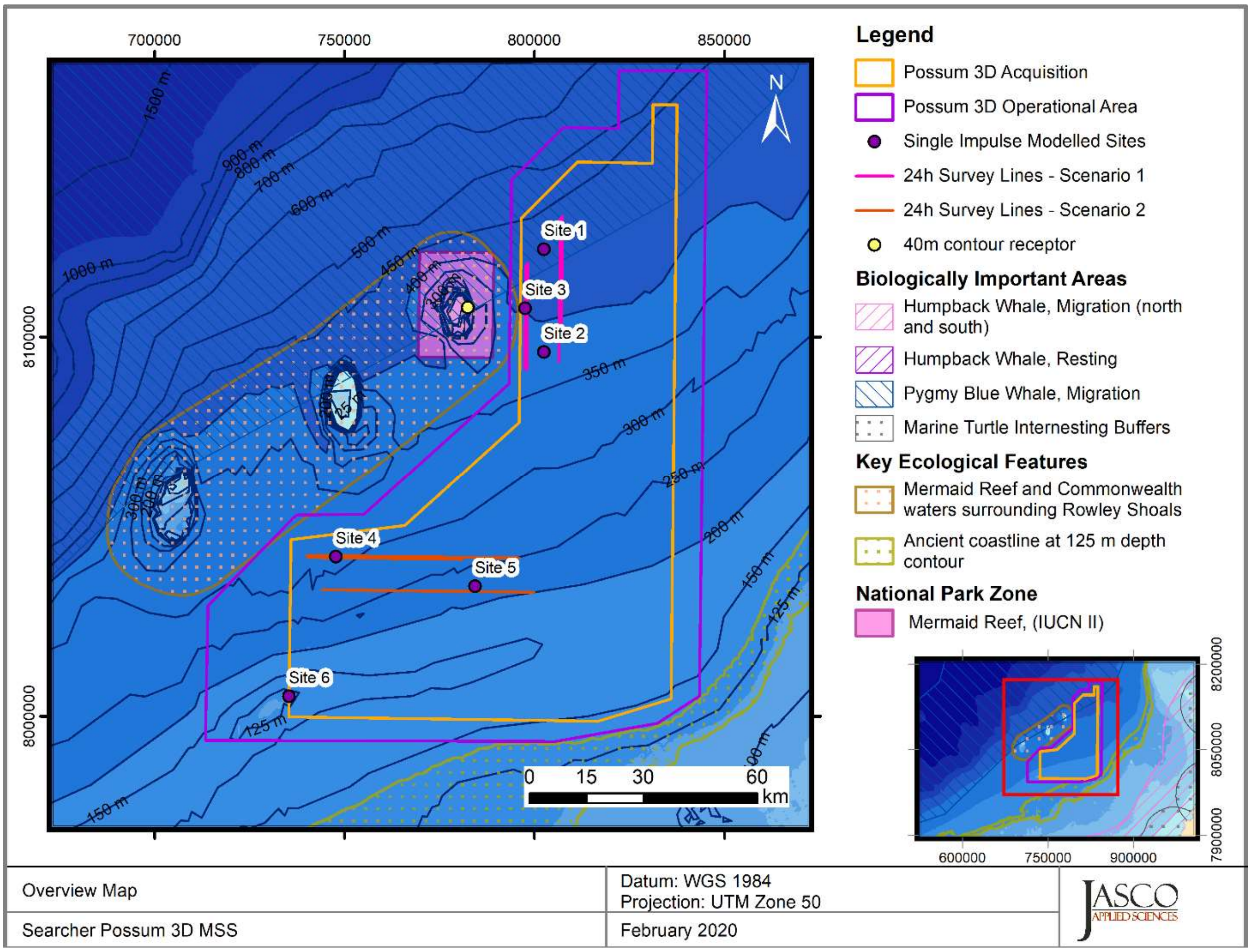


Figure 6.1 – Possum 3D MSS Acquisition Area and modelling sites

6.4.2 Impact assessment – Plankton

6.4.2.1 Exposure thresholds and nature of impact

This assessment focusses on zooplankton including eggs and larval fish, crustaceans and other invertebrate phyla. Zooplankton populations are typically very widespread in the ocean and are characterised by rapid generation times and high levels of variability in space and time. They often exhibit diurnal vertical migration whereby they rise towards the sea surface at night and descend in daylight to avoid visual predators. This means that their potential exposure to a sound source near the sea surface varies through the day/night cycle. Defined thresholds of effect have not been developed across this range of organisms with some conflicting evidence from recent studies examining the effects of seismic sound on zooplankton.

A pilot study by McCauley et al. (2017) showed potential for mortality and reduction in zooplankton abundance out to 1.2 km, in response to sound at levels up to 178 dB re 1 µPa ($SPL_{PK\text{-}PK}$) pressure; however, the outcomes of this study were ambiguous and the validity of the interpretations have been questioned. Various aspects of the study methodology were reviewed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) which noted that some aspects of the study warranted further investigation (Richardson et al., 2017), but questioned elements of its veracity, specifically:

- why there was no attenuation of the impact with distance, which would be expected as the sound energy dissipated;
- why there was an immediate decline in abundance, faster than the rate dead zooplankton would sink to the seabed or be predated; and
- the fact the study was based on a very small size, which means the results may reflect random variation in the plankton populations.

In addition to the CSIRO review, International Association of Geophysical Contractors (IAGC) commissioned five independent scientists (IAGC 2017) to critically review McCauley et al. (2017) and the review found the results are inconclusive due to a number of limitations associated with the experimental design including:

- inadequate sample size;
- water column movement data insufficient to support the contention of a 'hole' in the plankton field;
- towed net and acoustic survey data disagreeing about zooplankton class size; and
- bottom sampling that should have been undertaken but was not conducted.

Furthermore, McCauley et al (2017) conflicts with the broader body of literature on the effects of seismic sound on zooplankton. For the reasons outlined above, the threshold developed by McCauley et al (2017) has not been used to predict impacts to plankton in this EP.

Through reviewing the available literature and for the purpose of developing thresholds, Popper et al (2014) established 207 dB re 1 µPa (SPL_{PK}) and 210 dB re 1 µPa^2·s (SEL_{24h}) as mortal/potential mortal injury (PMI) thresholds for larval fish and eggs. The levels of these thresholds are comparable (although not directly comparable due to different units) with the findings of Fields et al (2019) who found that sound levels above approximately 200 dB re 1 µPa^2·s (SEL L_E) resulted in increased mortality in a species of copepod. Therefore, for the purposes of this assessment, the Popper et al (2014) thresholds for fish eggs and larvae have been used to assess sound impacts on zooplankton.

6.4.2.2 Evaluation of impacts

The Popper et al (2014) thresholds have been combined with numerical propagation modelling to predict sound exposure effect distances for zooplankton in the vicinity of the seismic array. Table 6.4 details the distances from the seismic array at which the various effects could occur.

Table 6.4 – Maximum predicted distances (Rmax) to mortality/PMI thresholds (Popper et al (2014) in the water column for fish eggs and larvae

Receptor	Potential impact	Sound exposure threshold	Maximum-over-depth (MOD)
			Rmax (km)
Fish eggs and larvae Zooplankton	Mortality/ PMI	210 dB re 1 µPa2·s (SEL_{24h})	0.06
		207 dB re 1 µPa (SPL_{PK})	0.12

The acquisition area is not a known area of upwelling or important pelagic feeding ground for fish, marine mammals or seabirds, which indicates the area is unlikely to support increased or regionally significant populations of zooplankton. Lethal or potentially lethal impacts are predicted to occur in the water column up to 120 m from the source as the vessel moves along the sail line. However, zooplankton population dynamics are characterised by natural rapid expansion, crashes and recovery due to the nature of their life history traits (Richardson et al 2017). The Richardson et al (2017) modelling study found that, even based on the much more conservative threshold set by McCauley et al. (2017), zooplankton populations would recover within three days. Therefore, based on more realistic thresholds by Popper et al (2014) the recovery of local zooplankton populations is likely to be significantly less than three days. As such, any small impacts from the seismic survey are highly unlikely to have a measurable effect on broader zooplankton population dynamics in the region.

There are no known studies or anecdotal evidence of seismic noise effects on coral spawn.

6.4.3 Impact assessment – benthic communities

This section assesses the impacts on benthic invertebrates. The impacts on site-attached benthic fish are addressed in Section 6.4.6. Benthic invertebrates that are targeted fisheries species are addressed below:

6.4.3.1 Exposure thresholds and nature of impact

Well defined effect thresholds for a broad range of invertebrate types are yet to be defined in the literature. Therefore, this assessment combines the most recent peer-reviewed evidence for effect thresholds for lobster, scallops and corals to assess impacts to benthic invertebrates. This is considered appropriate because these taxa represent a broad cross-section of the important benthic invertebrate phyla in the area which are more likely to be susceptible to sound impacts. Lobsters are considered representative of scampi and other benthic crustaceans. Scallops are considered representative of oysters, pearly oysters and other benthic molluscs. Corals are considered representative of benthic reef-building organisms in the Marine Park. The relevant thresholds are presented in Table 6.5.

Table 6.5 - Effect thresholds for benthic invertebrates.

Receptor	Exposure level	Effect
Lobsters, scampi, crustaceans in general	209-213 dB re 1 µPa, (SPL L_{pk-pk})	Statocyst damage and effects on righting reflex response time (Day et al 2019)
	202 dB re 1 µPa, (SPL L_{pk-pk})	No effect (Payne et al 2008)
Scallops, oysters, squid, other molluscs	212-213 dB re 1 µPa, (SPL L_{pk-pk})	Slightly increased mortality and physiological response (changes in haemolymph chemistry) (Day et al 2017)
Coral, reef-builders	226 dB re 1 µPa, (SPL L_{pk})	No effect (Wahab et al 2018)

Crustaceans

Physical effects in the form of statocyst damage, which could influence reflexes in crustaceans on the seabed, could occur at sound levels beyond the exposure levels for lobsters presented in Table 6.5. The evidence suggests this effect in lobster could last for at least a year after exposure (Day et al 2019). However, statocysts are shed when crustaceans moult and although the damage received to individual statocysts in this experiment did not repair, it is expected that the development of new setae may correct the damage (Day et al 2019).

At the lowest level of exposure detailed in Table 6.6, American lobster did not show any sub-lethal effects (Payne et al 2008). Based on this evidence it is reasonable to infer that crustaceans are unlikely to experience sublethal effects beyond the physical injury described above.

Thresholds for seismic sound effects on behaviour of crustaceans have not been developed in the scientific literature. However, Christian et al (2003) showed that crabs monitored by video camera and telemetry tags did not show any changes in movement or behaviour when exposed to received sound level of 197 to 237 dB re 1 µPa. Similarly, Andriguetto-Filho et al (2005) showed that fishing yields of a shrimp species were unchanged after exposure to seismic sound in shallow waters and Celi et al (2013) showed shrimp did not respond behaviourally to low frequency sound.

A detailed scientific study that exposed berried female rock lobsters to seismic sound showed that embryos and larvae were not affected (Day et al 2016). Embryos in early stage development were exposed to sound levels between 209 – 212 dB re 1 µPa (SPL) while still attached to the berried females. The study tracked both the success of hatching, and the survival and fitness of the larvae once hatched and found that seismic sound had no effects (Day et al 2016). Furthermore, since seismic sound is unlikely to influence behaviour (discussed above), seismic activity is also unlikely to influence spawning behaviour.

Molluscs

Slightly increased levels of mortality compared to natural mortality have been observed in scallops exposed to seismic sound. These effects on molluscs could possibly occur at sound levels presented for scallops in Table 6.5. The physiological effects included a reduction in haemocytes; a stress reaction that is thought to impact the immune function of the scallops. The evidence suggests that under repeated seismic exposure at the levels outlined in Table 6.6, the physiological stress is likely lead to increased mortality over time (Day et al 2017).

Laboratory studies that exposed two species of squid to seismic sound showed that *Alloteuthis sublata* was tolerant to a sound level up to 260 dB, *Loglio vulgaris* was fatally injured at levels of 246 – 252 dB within 3 – 11 minutes of exposure (Norris & Mohl 1983). However, sound levels from the seismic source used for this survey will not reach these levels.

Studies of seismic or low frequency sound effects on behaviour in molluscs show they can respond with startle response behaviour. Fewtrell and McCauley (2012) found that squid inked and jetted in response to seismic sound exposure. Day et al (2016a) showed scallops distinctively flinched when exposed to seismic sound, however no energetically costly responses such as swimming were observed. Samson et al (2014) showed that cuttlefish inked and jetted in response to low frequency sound levels of 140 dB re 1 µPa (SPL_{RMS}). However, the sound was generated by speakers and the exposure regime is unlikely to mimic the physical effects (pressure and particle motion) of seismic-generated sound. Furthermore, Mooney et al (2016) showed that squid did habituate to the sound and showed fewer responses over time. Based on this evidence, seismic sound from the proposed survey may elicit a behavioural response in molluscs, however the response will be temporary and may decrease with duration of exposure.

Corals

No adverse effects from seismic sound have been shown for corals. At the highest levels measured there was no impact to the corals. Corals and other invertebrate reef-building invertebrates are not considered susceptible to seismic sound effects (Table 6.6).

6.4.3.2 Evaluation of impacts

The thresholds for invertebrates have been combined with numerical propagation modelling to predict a sound exposure regime on crustaceans, molluscs and corals. Table 6.6 below details the distances at which the various effects could occur at the seabed.

Table 6.6 - Maximum predicted distances (Rmax) to effect thresholds for invertebrates at the sea floor, for all single pulse sites

Receptor	Exposure level	Effect	Site 5 (220 m depth)	Site 6 (121 m depth)
Lobsters, scampi, crustaceans in general	209-213 dB re 1 µPa, (SPL L_{pk-pk})	Statocyst damage and effects on righting reflex response time (Day et al 2019)	87-217 m	141-344 m
	202 dB re 1 µPa, (SPL L_{pk-pk})	No effect (Payne et al 2008)	666 m	560 m
Scallops, oysters, squid, other molluscs	212-213 dB re 1 µPa, (SPL L_{pk-pk})	Slightly increased mortality and physiological response (changes in hemolymph chemistry) (Day et al 2017)	87-114 m	141-153 m
Coral, reef-builders	226 dB re 1 µPa, (SPL L_{pk})	No effect (Wahab et al 2018)	Threshold not reached	Threshold not reached

Crustaceans

The seismic survey has the potential to cause statocyst damage in crustaceans as detailed above, however these impacts are likely to be partially recoverable after successive moulting (Day et al 2019). Sound at the seabed that could cause statocyst damage to crustaceans is predicted to 344 m either side of each sail line in shallower waters. However, as the vessel moves into deeper water, this effect distance at the seabed will become smaller, as shown by the difference in propagation distance between sites 5 and 6 (Table 6.6). The sail lines for the survey are planned to be separated by 112.5 m therefore, dependent on depth, most or all the seabed within the survey in shallower water could be affected by sound levels that could induce statocyst injury in crustaceans. However, the available crustacean habitat within the ensonified area is expected to be much smaller as most of the important crustacean habitats are associated with the coral reefs of the Marine Park.

The predicted minor impacts to crustaceans are not expected to affect the broader crustacean populations in the region for the following reasons:

- minor statocyst impacts are not expected to be lethal and are predicted to repair through time;
- no other sub-lethal effects are known to occur; and
- the area of seabed exposed is extremely small in the context of the very large and the likely inter-connected crustacean populations of the north-west Australian waters (Wilson 2013) that are likely to be inherently resilient to such a small perturbation.

Molluscs

The seismic survey has the potential to increase levels of mortality and physiological stress in benthic molluscs, based on research on scallops. However, the study conducted by Day et al (2017) showed only slightly increased levels of mortality compared with naturally high rates of mortality in scallops which can range from 11-51% (Day et al 2016a). Sound levels are not expected to propagate beyond approximately 153 m at the effect levels described by Day et al (2016a).

The sound levels from the activity may be sufficient to influence the behaviour of mobile molluscs, most likely squid and cuttlefish beyond the boundary of the acquisition area. Without adequate research on effect thresholds to seismic exposure, the distance at which this could occur is difficult to predict. It could be conservatively assumed that effects on mollusc behaviour could extend kilometres beyond the acquisition area, however this effect will be temporary, and the evidence suggests that squid and cuttlefish may habituate to the sound (Mooney et al 2016).

The predicted minor impacts to molluscs are not expected to have an impact on the broader mollusc populations in the region for the following reasons:

- mortality in benthic molluscs as a result of seismic sound exposure is unlikely to be significantly greater than natural levels of mortality;

- the stress response that molluscs may undergo when exposed to seismic sound is not expected to increase mortality levels beyond natural levels;
- behavioural effects will be temporary and will possibly reduce over time due to habituation. Due to the activity only lasting a few months, behavioural effects are unlikely to have population level impacts; and
- the area of seabed exposed is extremely small in the context of the very large and the likely inter-connected benthic mollusc populations of the north-west Australian waters (Wilson 2013) that are likely to be inherently resilient to such a small perturbation.

Corals

Any corals in the proximity of the seismic survey are not predicted to be affected due to effect thresholds not being discharged from the source and the nearest corals being several kilometres from the acquisition area.

6.4.4 Impact assessment – marine fauna – mammals

Several Listed Threatened marine mammals, specifically cetaceans and dolphins may occur in, or transit through, the region (Table 6.7).

Table 6.7 – Listed Threatened marine mammals that may transit the region during the period of the Possum 3D MSS

Species	Activity in region	Nearest BIA (km)	Present during activity
Pygmy blue whale	Known to occur and migrate through the region. No known foraging grounds in the region.	Operational and acquisition area slightly overlap a small portion of the known migration BIA and both overlap the distribution BIA.	Likely
Humpback whale	Migration and breeding/calving BIA landward of the operational area and acquisition area and not within a distance to be credibly affect by seismic noise.	Migration BIA approximately 80 km from acquisition area	Possible
Sei whale	Could occur in region	Unknown	Unlikely
Fin whale	Could occur in region	Unknown	Unlikely
Other Baleen Species	Could occur in region	Unknown	Unlikely
Toothed Whales	Could occur in region	Unknown	Unlikely
Dolphins	Could occur in region	Generally, occur landward of operational area and acquisition area.	Unlikely

6.4.4.1 Exposure thresholds and nature of impact

Table 6.8 provides effect thresholds which have been used for this marine mammal assessment.

Table 6.8 - Thresholds for acoustic effects on marine mammals.

Hearing group	Behaviour	Impairment (NMFS (2018) & Finneran et al. (2017))			
	SPL (dB re 1 µPa)	PTS onset thresholds* (received level)		TTS onset thresholds* (received level)	
		Weighted SEL_{24h} (dB re 1 µPa^2·s)	SPL L_{PK} (dB re 1 µPa)	Weighted SEL_{24h} (dB re 1 µPa^2·s)	SPL L_{PK} (dB re 1 µPa)
Low-frequency (LF) cetaceans	160[1]	183	219	168	213
Mid-frequency (MF) cetaceans		185	230	170	224
High-frequency (HF) cetaceans		155	202	140	196
Sirenians (dugong)		190	226	175	220

* Dual metric acoustic thresholds for impulsive sounds: Use whichever results in the largest isopleth for calculating PTS onset.

[1] NMFS (2014).

Permanent threshold shift (PTS)

Physiological impacts such as physical damage to the auditory apparatus, e.g. loss of hair cells or permanently fatigued hair cell receptors, can occur in marine mammals when they are exposed to intense or moderately intense sound levels and could cause permanent or temporary loss of hearing sensitivity. PTS is hearing loss from which marine fauna do not recover (permanent hair cell or receptor damage). Southall et al (2019) and NOAA (2018) define PTS as a permanent change in hearing and for the purpose of demonstrating acceptability in this EP, PTS is considered a form of injury.

Temporary threshold shift (TTS)
Guidance on key terms within the Blue Whale Conservation Management Plan (September 2021) defines TTS as a temporary reduction in hearing sensitivity and it is considered a form of injury. TTS can occur instantaneously near the seismic source or through cumulative exposure. TTS is completely recoverable and with 24-hours thought to be sufficient for recovery to occur NOAA (2018). Cumulative TTS exposure could occur as a result of repeated seismic shot exposure over a 24-hour period at a delineated distance from the source or within this distance over a shorter timeframe. The literature does not define a specific period within which TTS recovery occurs, however Southall et al (2019) noted that recovery is likely to be species specific and that recovery is likely to occur within 24-hours.

Cumulative PTS and TTS
Cumulative PTS and TTS exposure is a theoretical exposure, and for a realistic evaluation of the potential for cumulative exposure to occur, animal behaviour and the moving vessel must be considered. This assessment evaluates both the effects on behaviour and how this is likely to affect exposure regimes within the behavioural effect zone to ameliorate instantaneous and cumulative TTS and PTS.

Behaviour
There is a substantial body of peer-reviewed literature that suggests that low frequency hearing whales actively avoid anthropogenic sound. McCauley et al (1998) reported humpback whales began avoidance manoeuvres in response to seismic generated sound at 159 dB re 1µPa^2 (SPL_{pk-pk}) and general avoidance was observed at 168 dB re 1µPa^2 (SPL_{pk-pk}). Similarly, humpback whales (adults and calves) exposed to seismic sound (135 dB re 1µPa^2 SPL_{pk-pk}) during the Behavioural Response of Australian Humpback whales to Seismic Surveys (BRAHSS) project showed a behavioural response where females and calves slowed speed on their southern migration down the east coast; however the response was also observed in control trials when the seismic source was not operational, suggesting the response was in reaction to the presence of the seismic vessel (Dunlop et al 2015). Goldbogen et al (2013) showed that blue whales changed orientation and horizontal displacement in response to exposure to simulated mid-frequency sonar sound. The study found that blue whales feeding on deep, dispersed prey were more likely to change diving behaviour and avoid sonar sources than whales feeding at shallow depths on highly concentrated prey (Goldbogen et al. 2013). Southall et al (2016) also showed that baleen whales showed directional avoidance of a stationary sonar sound source and were more likely to do this if there was not a concentrated food source present, this is relevant because the operational area is not near any known foraging areas. Finally, a study investigating the effectiveness of acoustic deterrent devices (ADDs) (as a mitigation tool) demonstrated that the ADDs were effective in changing cetacean swimming direction and speed so that animals avoided the ensonified area (McGarry et al. 2017).

6.4.4.2 Evaluation of impacts

To inform the assessment the exposure thresholds (Table 6.8) have been combined with numerical propagation modelling to predict a sound exposure regime on marine mammals in the vicinity during the activity. Table 6.9 provides the results of the acoustic modelling, showing the horizontal distances at which the threshold is reached.

Table 6.9 - Maximum-over-depth distances (in km) to frequency-weighted SEL_{24h} based marine mammal PTS and TTS thresholds NMFS (2018) and Maximum (Rmax) horizontal distances (km) from the 2820 in^3 array to modelled maximum-over-depth $SPLL_{PK}$ thresholds based on the NOAA Technical Guidance (NMFS 2018) for marine mammals (JASCO 2020).

Threshold	Potential effects	Sound exposure threshold	Rmax distance (km)
PTS	LF-cetaceans	219 dB re 1 µPa (SPL L_{PK})	0.03
		183 dB re 1 µPa2.s (SEL_{24h})	3.52
	MF-cetaceans	230 dB re 1 µPa (SPL L_{PK})	-
		185 dB re 1 µPa2.s (SEL_{24h})	-
	HF-cetaceans	202 dB re 1 µPa (SPL L_{PK})	0.20
		155 dB re 1 µPa2.s (SEL_{24h})	0.06
TTS	LF-cetaceans	213 dB re 1 µPa (SPL L_{PK})	0.06
		168 dB re 1 µPa2.s (SEL_{24h})	62.9
	MF-cetaceans	224 dB re 1 µPa (SPL L_{PK})	-
		170 dB re 1 µPa2.s (SEL_{24h})	0.28
	HF-cetaceans	196 dB re 1 µPa (SPL L_{PK})	0.38

Threshold	Potential effects	Sound exposure threshold	Rmax distance (km)
		140 dB re 1 µPa2.s (SEL_{24h})	0.33
Behavioural Response	LF, MF and HF-cetaceans	160 dB re 1 µPa (SPL) (unweighted)	8.48

A dash (-) indicates the threshold is not reached within the limits of the modelling resolution (20 m).

Pygmy blue whales

The operational area and acquisition area both overlap with the pygmy blue whale distribution BIA and a very small edge of the migration BIA (Figure 4.11). Blue whales are classified as low frequency hearing whales.

PTS and TTS

Instantaneous PTS and TTS impact to blue whales are predicted to be constrained to within 30 m and 60 m of the seismic source, respectively. Good industry practice controls will be implemented to reduce the likelihood of this impact (see Section 6.4.12)

Cumulative PTS

Given the sound from the seismic source will only exceed the 24-hour cumulative threshold for up to 3.52 km from the vessel, and recognising the speed differential between the survey vessel and the whales, it is not credible that cumulative PTS will occur. Even if a whale and the seismic vessel were to travel within close proximity and in the same direction, the whale could only remain in the area around the vessel where sound levels were sufficient to elicit a 24-hour cumulative exposure response, for a maximum of 1 – 2 hours.

The seismic vessel is continually moving when the seismic source is powered up. Similarly, blue whales are likely to be swimming faster during their southern migration (McCauley and Jenner 2010) and therefore also moving relative to the seismic source. Blue whales typically swim at about 5 miles (8km) an hour while they are feeding and traveling, but can accelerate to more than 20 miles an hour for short bursts (NOAA 2021) A tagging study of blue whales showed that migrating individuals can travel 50 to 100 km per day (Double et al, 2012). This equates to an average swimming speed of 2-4 km/hr over a 24-hour period.. Based on this evidence and for the purpose of detailing this impact, it is reasonably assumed that blue whales in the proximity of the seismic vessel will be traveling at a mean speed of 3 km/hr. In comparison, the seismic vessel will be traveling at 4-6 knots (7-11 km/hr).

Cumulative TTS

There is a lack of data available on the effects of cumulative exposure on the behaviour of cetaceans. Therefore, for the purposes of this assessment it is conservatively assumed that whales are unlikely to avoid sound exposure levels that could induce TTS through cumulative exposure.

For similar seismic surveys ANIMAT modelling has been used to estimate more realistic exposure regimes to predict the number of individuals potentially exposed. The modelling uses peer-reviewed literature to estimate numbers of whales in the proximity of the survey area and their behaviour and accounts for vessel movement. The Woodside North-west Australia 4D Marine Seismic Survey EP (Woodside 2019) presented ANIMAT modelling to evaluate potential impacts on pygmy blue whales in proximity to the survey area. The ANIMAT modelling used acoustic detection data published by McCauley and Jenner (2010) which was adjusted for estimated population growth. This survey also overlapped the pygmy blue whale migration corridor, had similar survey line lengths and spacing and had a similar maximum distance to threshold prediction of 59.7 km for TTS SEL_{24h}. (62.9 km predicted for the Possum 3D MSS as shown in Table 6.8). The survey area was further south than the survey proposed in this EP (off Exmouth) and densities of blue whales are likely to be higher in that area than in the Possum area. The outputs of the ANIMAT modelling showed that in a 24-hr period, the number of animals that could experience TTS is 2.84. While this number of animals cannot be directly applied to this assessment, it is expected to over-estimate the number of exposed individuals in the which could experience TTS for the Possum 3D MSS. In addition, TTS injury is only a temporary reduction in hearing sensitivity from which the whales are expected to recover in hours (Southall et al. 2019). As such, no long-term effects on the health or survival of individuals is expected due to cumulative TTS.

Behaviour

As indicated in Table 6.9, any disruption to migratory movements is likely to be restricted to the approximately 8.48 km from the source, the distance that could potentially influence behavior.

Seismic sound from the acoustic array has the potential to affect only a very small portion of the pygmy blue whale known distribution and migratory corridor (Figure 4.11). The survey is not anticipated to significantly inhibit their migration movements since the survey and area ensonified only overlaps with a small proportion of their known distribution and migratory area. Depending on when the survey is undertaken pygmy blue whales could be on either their northern or southern migration.

Energetic costs

The energetic cost of avoiding the seismic source is likely to be small in the context of the greater migratory movements of pygmy blue whales migrating through the area. The radius of the behavioural effect zone is approximately 7 km (Table 6.9) therefore a whale avoiding will only alter its path by tens of kilometres at most over a migration of many thousands of kilometres (MMSA 2008). Therefore, this level of change is highly unlikely to alter the overall energy budget of whales migrating through the impact EMBA. Importantly, the seismic activity is highly unlikely to displace blue whales from their migration BIA due to the very small geographical scale of potential effects on behaviour affected relative to the very large spatial extent of the migration BIA (Figure 4.11).

Other baleen whale species (including sei and fin whales)

The impacts to other baleen whale species are likely to be similar to the detail and evaluation provided for blue whales above. As such the effects of PTS, instantaneous TTS and behavior are likely to be similar. However, since these species are likely to be less abundant (see Section 4.6.4.2), the potential number of individuals encountered and those exposed to cumulative TTS is likely to be lower.

Toothed whale species

Toothed whales are grouped with high-frequency or mid-frequency hearing range cetaceans. The effects on toothed whales are likely to be significantly less than for baleen whales due to the higher hearing frequency range and the majority of the seismic sound energy occurring at lower frequencies. Therefore, noise emissions are predicted to be outside of their hearing range frequency, and impacts are not predicted. The effects on behavior are likely to be similar to that described for other species and therefore they are expected to also avoid the sound source.

6.4.5 Impact assessment – marine fauna – reptiles

Threatened and Migratory marine turtle and sea snake species may occur in, or transit, the region. They may be exposed to sound from the seismic source when resting in the surface waters or when diving to the seabed. There are no known sea snakes or turtle nesting, inter-nesting or foraging habitat within or in close (10 km) proximity of the acquisition area. See Section 4 for further details of these receptors.

6.4.5.1 Exposure thresholds and nature of impact

The following effect thresholds (Table 6.10) have been adopted based on the best available literature. Credible sound thresholds have not been established in the literature for sea snakes, therefore the thresholds for marine turtles will be used in detailing and evaluating seismic sound risks to sea snakes. This is considered appropriate because sea snakes appear to have lower sensitivity to low frequency sound than turtles (Chapuis et al 2019).

Table 6.10 – Thresholds for acoustic effects on turtles

Hearing group	Behaviour	Impairment (NMFS (2018) & Finneran et al. (2017))			
	SPL L_{pk} (dB re 1 µPa)	PTS onset thresholds[1] (received level)		TTS onset thresholds[1] (received level)	
		Weighted SEL_{24h} (dB re 1 µPa^2·s)	SPL_{pk} (dB re 1 µPa)	Weighted SEL_{24h} (dB re 1 µPa^2·s)	SPL_{pk} (dB re 1 µPa)
Turtles	166[2] 175[3]	204	232	189	226

1. Dual metric acoustic thresholds for impulsive sounds: Use whichever results in the largest isopleth for calculating PTS onset.
2. NSF (2011);
3. McCauley et al. (2000a, 2000b); Moein et al. (1994); NSF (2011).

Little is known about injury, PTS or TTS in marine turtles due to a lack of studies being conducted that examine these physiological effects (Popper et al 2014). The thresholds developed for these effects have been developed from audiograms and are theoretical effects (Finneran et al 2017). Southall et al (2019) and NOAA (2018) define PTS as a permanent change in hearing and for the purpose of demonstrating acceptability in this EP, PTS is considered a form of injury in marine turtles. Popper et al (2014) define TTS as a temporary reduction in hearing sensitivity caused by temporary changes in hair cells.

The effects of seismic sound on sea snakes are poorly studied and there is no known literature that has examined PTS and TTS effects in sea snakes. Chapuis et al (2019) showed that a species of sea snake can hear low frequency sounds, however, have low sensitivity to sound compared to bony fish and marine turtles. For the purposes of this EP it is conservatively assumed that sea snakes could potentially experience PTS and TTS at the same thresholds and effect distances as marine turtles.

Cumulative TTS exposure is a theoretical exposure, and for a realistic evaluation of the potential for cumulative exposure to occur, animal behaviour and the moving vessel must be considered.

Changes in behaviour because of seismic sound exposure include increased swimming movement, increased flipper movement, and change in orientation of caged animals (Popper et al 2014; McCauley et al 2000). These effects are likely to be within the proximity of the seismic source detailed in Table 6.11 and only for the duration that the seismic vessel is passing by.

Some field evidence suggests that marine turtles avoid seismic sound. DeRuiter and Doukara (2012) showed a change in diving response to seismic shots which they interpreted as avoidance. There is also evidence that turtles avoid the seismic vessel (rather than just the sound) (Weir 2007). These effects are likely to be within the proximity of the seismic source detailed in Table 6.11 and only for the duration that the seismic vessel is passing by.

6.4.5.2 Evaluation of impacts

Table 6.11 details the distances at which the various effects could occur on marine reptiles without the implementation of controls to reduce or prevent these effects. The exposure thresholds have been combined with numerical propagation modelling to predict a sound exposure regime on marine reptiles in the vicinity during the activity.

Table 6.11 – Maximum predicted horizontal distances (Rmax) to PTS, TTS and behavioural response thresholds in marine turtles, for all modelled scenarios

Potential effects	Sound exposure threshold	Distance Rmax (km)
PTS instantaneous	232 (SPL L_{PK}) (dB re 1 µPa)	-
PTS 24hr cumulative	204 Weighted (SEL_{24h}) (dB re 1 $\mu Pa^2 \cdot s$)	0.06
TTS instantaneous PK (dB re 1 µPa)	226 (SPL L_{PK}) (dB re 1 µPa)	-
TTS 24hr cumulative	189 Weighted SEL24h (dB re 1 $\mu Pa^2 \cdot s$)	0.88
Behavioural response	160-175 SPL L_{pk} (dB re 1 µPa)	1.46-4.25

A dash (-) indicates the threshold is not reached within the limits of the modelling resolution (20 m).

The acquisition area is more than 50 km from the nearest BIA for any of the turtle species with the region. There are no other known foraging areas within the acquisition area. Therefore, any turtle species that occur within the acquisition area will likely be transiting and/or foraging and in open oceanic waters and present in very low numbers. The operational area does not overlap any known sensitive areas for sea snakes and the significant benthic features that sea snakes are likely to be associated with, such as Mermaid Reef and Rowley Shoals, are too distant to be affected by seismic sound. Therefore, only a few individual snakes are likely to be exposed to seismic sound in open ocean waters.

The seismic vessel is continually moving when the seismic source is powered up. Given the 24-hr cumulative zones of effect are small (60 m for PTS and 880 m for TTS) in relation to the survey area, it is almost impossible that a turtle could remain in this effect zone for sufficient time to be adversely affected. If the seismic vessel is travelling at 4-6 knots, it is likely that an individual turtle would only be within the cumulative effect zone for a few minutes.

Population level impacts to turtles due to seismic sound are highly unlikely for the following reasons:

- the survey is greater than 50 km from any known BIAs for any turtle species;
- marine reptile numbers within the deep waters of the acquisition area are expected to be very low due to a lack of foraging grounds;
- no instantaneous lethal, PTS or TTS effects are predicted;
- cumulative PTS and effects are highly unlikely to occur;
- effects on behaviour will only be temporary and within 3.6 km of the seismic source (Table 6.11); and
- impacts to foraging behaviour are highly unlikely.

6.4.6 Impact assessment – marine fauna – bony fishes and sharks

Table 6.12 summarises the types of fish identified for this assessment and their likely location within the operational area based on their biological attributes. See Section 4.6.4 for further details of these receptors.

Details of potential impacts to the biology of commercially important species are detailed in this section. The potential impacts to commercial fisheries (e.g. displacement of fishers due to the physical presence of the vessel) is dealt with in Section 6.1.

Table 6.12 – Fish and shark groups that may be present the region during the period of the Possum 3D MSS

Fish group	Likely location within operational area	Known spawning area	Hearing group category
Pelagic fish	Potentially present throughout operational area, however distribution is likely to be heterogeneous.	Several species including those of commercial significance are likely to form spawning aggregations at the Rowley Shoals. No spawning aggregations expected within the operational area.	I and II
Demersal fish species	At depth within the operational area	Likely spawn at or in close proximity to obligate habitat.	II and III
Site-attached benthic species	Present on reef habitats in waters shallower than 40 m at the Rowley Shoals (DEC 2007).	Likely spawn at or in close proximity to obligate habitat.	II and III
Elasmobranchs including whale sharks	A range of shark species are potential present across the operational area in both the pelagic and benthic environments. Overlaps with whale shark foraging BIA.	Unknown.	I

6.4.6.1 Exposure thresholds and nature of impact

Table 6.13 – Mortality/PMI, recoverably injury and TTS thresholds for fish, fish eggs, and larvae for single pulse and SEL24h modelled scenarios.

Fish hearing group	Potential impact	Sound exposure threshold
I Fish: No swim bladder (sharks and some pelagic species)	Mortality/ PMI	219 dB re 1 µPa^2·s (SEL$_{24h}$)
		213 dB re 1 µPa (SPL L$_{PK}$)
	Recoverable injury	216 dB re 1 µPa^2·s (SEL$_{24h}$)
		213 dB re 1 µPa (SPL L$_{PK}$)
	TTS	186 dB re 1 µPa2·s (SEL$_{24h}$)
II Fish: Swim bladder not involved in hearing -particle motion detection (some pelagic and benthic species)	Mortality/ PMI	210 dB re 1 µPa2·s (SEL$_{24h}$)
		207 dB re 1 µPa (SPL L$_{PK}$)
	Recoverable injury	203 dB re 1 µPa2·s (SEL$_{24h}$)
		207 dB re 1 µPa (SPL L$_{PK}$)
	TTS	186 dB re 1 µPa2·s (SEL$_{24h}$)
III Fish: Swim bladder involved in hearing – primarily pressure detection (some pelagic and benthic species)	Mortality/ PMI	207 dB re 1 µPa2·s (SEL$_{24h}$)
		207 dB re 1 µPa (SPL L$_{PK}$)
	Recoverable injury	203 dB re 1 µPa2·s (SEL$_{24h}$)
		207 dB re 1 µPa (SPL L$_{PK}$)
	TTS	186 dB re 1 µPa2·s (SEL$_{24h}$)

Mortality, recoverable injury and TTS

Exposure to very high sound levels can result in mortality as a result of rapid pressure changes that cause blood gases to come out of solution and cause gas chambers within the body to rapidly expand (Popper et al, 2014). This expansion of gases can cause damage to surrounding tissues that result in mortality, similar to the effects of barotrauma. At lower sound levels, less severe gas expansion effect can cause physiological injury from which the fish will recover (recoverable injury). The degree to which an injury is recoverable is likely to depend on external ecological factors and the individual's fitness (Popper et al 2014).

Temporary threshold shift (TTS) is a temporary change in hearing sensitivity and can occur in fish as a result of seismic sound exposure. While experiencing TTS, fish may have decreased fitness through impaired communication, prey and predator detection (Popper et al 2014). However, Popper et al (2005) reports that fish that showed TTS recovered to normal hearing levels within 18-24-hours. TTS can be induced instantaneously; however, there is no establish threshold for instantaneous TTS in fish. TTS can be induced through cumulative exposure over 24-hours.

Permanent threshold shift (PTS) does not occur in fish due to hair cells within the ear constantly being added and replaced when damaged (Popper et al 2014).

Behaviour
Behavioural responses to anthropogenic sound are generally exhibited as a startle response or avoidance of the sound source (Wardle et al 2001; Hassel et al 2004; and Carroll et al 2017). While seismic sound exposure has not been shown to affect spawning behaviour in fish, it is reasonable to assume that it may.

No thresholds have been published for anthropogenic sound effects on fish behaviour. A review of the literature by Popper et al (2014) provided qualitative rankings of high, medium and low risk of a behavioural response at distances of 10's of meters, 100's of meters, and 1,000's of meters respectively, when exposed to instantaneous seismic sound. For the purposes of the impact assessment, a conservative estimate of 10 km has been applied as the upper end of the range of distances that fish behaviour could be affected.

6.4.6.2 Evaluation of impacts

A recent review from a similar seismic survey, of the potential effects on fish for the Santos Bethany 3D MSS (Popper 2018) predicted that:

- physiological damage was highly unlikely;
- TTS levels are likely to be sufficiently low that any changes in hearing are unlikely to differ significantly from normal variations in hearing sensitivity; and
- recovery from any TTS induced by the survey is likely to occur in 24-hours or less.

The effects on fish from this survey are likely to be similar as assessed below. The effect thresholds for fish have been combined with numerical propagation modelling to predict a sound exposure regime on fish and sharks in the vicinity during the activity which aligns with the approach recommended by Hawkins & Popper (2016). Table 6.13 below details the distances at which the various effects could occur without the implementation of controls to reduce or prevent these effects.

Table 6.14 - Maximum predicted distances (Rmax) to mortality/PMI, recoverably injury and TTS thresholds for fish, fish eggs, and larvae for single pulse and SEL$_{24h}$ modelled scenarios, for water column and at the sea floor

Fish hearing group	Potential impact	Sound exposure threshold	Maximum-over-depth (MOD)	Sea floor
			Rmax (km)	Rmax (km)
I Fish: No swim bladder (sharks and some pelagic species)	Mortality/ PMI	219 dB re 1 µPa2·s (SEL$_{24h}$)	0.06	-
		213 dB re 1 µPa (SPL L_{PK})	0.06	0.046
	Recoverable injury	216 dB re 1 µPa2·s (SEL$_{24h}$)	0.06	-
		213 dB re 1 µPa (SPL L_{PK})	0.06	0.046
	TTS	186 dB re 1 µPa2·s (SEL$_{24h}$)	9.13	9.10
II Fish: Swim bladder not involved in hearing - particle motion detection (some pelagic and benthic species)	Mortality/ PMI	210 dB re 1 µPa2·s (SEL$_{24h}$)	0.06	-
		207 dB re 1 µPa (SPL L_{PK})	0.12	0.144
	Recoverable injury	203 dB re 1 µPa2·s (SEL$_{24h}$)	0.06	-
		207 dB re 1 µPa (SPL L_{PK})	0.12	0.144
	TTS	186 dB re 1 µPa2·s (SEL$_{24h}$)	9.13	9.10
III Fish: Swim bladder involved in hearing – primarily pressure detection (some pelagic and benthic species)	Mortality	207 dB re 1 µPa2·s (SEL$_{24h}$)	0.06	-
		207 dB re 1 µPa (SPL L_{PK})	0.12	-
	Recoverable injury	203 dB re 1 µPa2·s (SEL$_{24h}$)	0.06	-
		207 dB re 1 µPa (SPL L_{PK})	0.12	0.144
	TTS	186 dB re 1 µPa2·s (SEL$_{24h}$)	9.13	9.10
I, II, III All fish	Behaviour	NA, derived from Popper et al (2014)	10	10

A dash (-) indicates that the threshold was not reached.

Site-attached and mobile benthic species
The survey area does not have any significant benthic habitat features and is too deep to support coral reefs. Therefore, the survey area is unlikely to support site-attached fishes. For the same reason, larger more mobile benthic species are unlikely

to be present in significant numbers and are expected to avoid the sound source. Recoverable injury could occur up to 144 m either side of the survey line for fish which do not avoid the sound and instantaneous TTS is not predicted to occur.

While recoverable injury is theoretically possible close to the source, it is unlikely to occur because as the vessel moves along the survey line, mobile benthic species will be exposed to increasing sound levels that are likely to elicit a behavioural avoidance response before they are exposed to injurious sound levels. Since the distance at which injury is possible is only 144 m, mobile benthic species are likely to be capable of moving this distance away from the seismic source and are therefore unlikely to experience physical injury.

Mobile benthic species could theoretically experience TTS through cumulative exposure over 24 hours at up to 9.1 km from the seismic source. However, their exposure will be limited by behavioural avoidance and small-scale variability in the sound field e.g. shielding by seabed features such as dunes. TTS effects will only be temporary, and individuals are predicted to recover from this effect within 24 hrs of exposure.

The closest shallow reef habitat to the acquisition area is Mermaid Reef. The 40 m isobath around the reef is approximately 14 km from the edge of the acquisition area, which is beyond the conservative distance of 10 km identified as the maximum range for behavioural impacts to fish. The distance between the Rowley Shoals 40 m depth contour and the nearest point to the acquisition area is 26.5 km, therefore impacts to benthic fish assemblages at these locations is highly unlikely. As such, seismic sound is not expected to impact benthic or site-attached fish assemblages at ecologically important reef systems in the region.

Pelagic fish and sharks

Pelagic fish and predatory sharks could be distributed throughout the acquisition area; however, the acquisition area does not overlap any known upwelling events or oceanographic features important for pelagic fish or predatory sharks. Therefore, the densities of these species in the ensonified area are unlikely to be higher than in other oceanic waters and there is unlikely to be a significant feeding ground that would motivate fish and sharks to remain near the seismic source.

Mortality and recoverable injury are theoretically capable of occurring within 60 m to 120 m (Table 6.13) from the source; however, pelagic fish and sharks within the behavioural effect zone of the seismic source are predicted to actively avoid the sound source. Since the mortality and recoverable injury zones are only a few 10s of meters, mobile pelagic species can easily avoid injury with little consequence energetically and ecologically.

As pelagic fish are highly mobile it is unlikely that they would remain within the cumulative TTS zone long enough to be exposed to sustained levels of sound that may cause cumulative TTS. Even if they did experience TTS through cumulative exposure, they are likely to recover within 24 hrs (Popper et al 2014) with negligible ecological effects.

Based on peer-reviewed evidence, as presented above, it is predicted that behavioural responses in fish and sharks will occur, however are unlikely to occur beyond 10 kilometres of the source. Behaviour is expected to return to normal once the vessel has moved beyond the 10 km effect zone of the activity.

The southern portion of the acquisition area overlaps a foraging BIA for whale sharks. A theoretical exposure to the seismic sound over 24-hours is predicted to induce TTS in whale sharks, however the following reasoned and peer-reviewed supporting evidence sets out the grounds for which this is highly unlikely to occur during the survey. Individual whale sharks would have to remain within a range of approximately 9 km of the operating seismic source (which is also moving) for a full 24-hour period to be exposed to sound levels that could cause TTS. Since the seismic vessel moves at 4-6 knots a whale shark would have to travel in the same direction and speed as the vessel for a period up to 24-hours to induce TTS. Sanzogni et al (2015) found that whale sharks have a maximum mean swimming speed of 0.81 m/s or 1.6 knots, therefore it is impossible for a whale shark to remain within the effect zone for 24-hours while the seismic source is active. With a minimum difference in travelling speed of approximately 2.4 knots (4.5 km/h), a whale shark could not remain within the 9 km radius of the vessel for longer than around 2 hours, even if they are heading in the same direction.

Further, it is unlikely that a whale shark would enter the injurious effect area or voluntarily remain within the 9.13 km zone without responding behaviourally to avoid the sound. Behavioural avoidance is an additional mitigating factor that further reduces the potential for whale sharks to be exposed to injurious or TTS-inducing sound levels.

Behavioural avoidance of the sound source has the potential to influence foraging behaviour of the few individual whale sharks that may be present in the foraging BIA during the survey. However, these effects are likely to be very small since most of the foraging BIA will remain available for foraging activities and there are no foraging aggregation areas in the ensonified area. Furthermore, the distances at which avoidance could occur are very small in the context of the very large foraging movements of whale sharks (Reynolds et al. 2016).

Spawning

There are no known spawning grounds within the or near the acquisition area, therefore impacts to spawning are unlikely. Pelagic and benthic fish species are likely to aggregate to spawn around the reef areas of Mermaid Reef and the Rowley Shoals. These reefs are approximately 14 km from the acquisition area at the closest point, which is beyond the distance of 10 km identified as the maximum range for behavioural impacts for this assessment.

6.4.7 24-hour Impact assessment – marine fauna – avifauna

Only birds diving and foraging within the operational area are likely to be exposed to seismic sound while diving for small pelagic fishes near the sea surface. The acquisition area overlaps a very small portion of the white-tailed tropicbird breeding BIA and a very small portion of the little tern resting BIA (Figure 4.18).

6.4.7.1 Exposure thresholds and nature of impact

There is little published evidence on the effects of seismic sound on avifauna (seabirds) and no thresholds are available to detail potential impacts. The potential for adverse effects is low because the birds are unlikely to be exposed to high levels of underwater sound from the seismic source. Therefore, the following assessment is qualitative and draws on reasoned information on levels of likely exposure.

6.4.7.2 Evaluation of impacts

It is reasonable to predict that birds can avoid the seismic sound by temporarily modifying their foraging behaviour. Given the range that behavioural effects occur within a few kilometres of the source for other marine fauna, a similar small range of effect could be expected for bird foraging behaviour. Seabirds are expected to be able to continue foraging in another nearby area or resume in the same area once the vessel has passed.

The acquisition area overlaps very small portions of a little tern resting BIA and a white-tailed tropicbird breeding BIA. Terns will rest on the water surface or on emerged objects and are not likely to be exposed to disruptive levels of seismic sound while resting. If the little tern and the white-tailed tropicbird forage within the ensonified area around the seismic vessel, the seismic sound theoretically may affect their foraging through prevention of diving for prey, or through disturbing their prey. However, impacts on the birds' foraging success are unlikely for the following reasons:

- The area of the little tern resting BIA overlapped by the acquisition area (less than 5 %) is small, leaving most of the BIA available for use.
- The area of the white-tailed tropicbird BIA overlapped by the acquisition area is small (approximately 10-15 %), leaving most of the BIA available for breeding behaviours.
- Only fish in the water column within approximately 10 km of the seismic source are expected to demonstrate behavioural changes that may reduce their availability to aerial foragers.
- Effects on surface bait schools and diving birds will be much reduced due to the highly directional emissions from the seismic source which generates much lower sound energy in the horizontal plane around the vessel.
- Such small effects on foraging success are highly unlikely to influence overall energy intake of the birds.

6.4.8 Impact assessment – Protected areas

6.4.8.1 Impacts at KEFs

The acquisition area does not directly overlap any of the KEFs. The underwater sound EMBA (with outer boundary defined by the distance for underwater sound levels to fall below the cumulative 24-hour TTS exposure level for marine mammals) overlaps the following KEFs (Figure 4.4):

- Mermaid Reef and Commonwealth waters surrounding Rowley Shoals KEF
- Ancient coastline at 125 m depth KEF
- Continental slope demersal fish communities KEF.

The values for each KEF are discussed further in Section 4.4.2.

Mermaid Reef and Commonwealth waters surrounding Rowley Shoals KEF

The boundary of the acquisition area is approximately 670 m outside the KEF boundary. The main values of the KEF ecosystem are associated with the reef lagoon in less than 40 m water depth, which is approximately 14 km from the acquisition area and beyond the distance for sound to fall below effect thresholds for fish, benthic invertebrates and plankton. Therefore, sound impacts to the values of this KEF are highly unlikely. The potential pressure of sound pollution on this KEF is "*not of concern*" (DSEWPaC 2012).

The Ancient coastline at 125 m depth KEF
The acquisition area is approximately 4.5 km away from the nearest part of the ancient coastline at 125 m depth KEF boundary. The KEF is recognised for its biodiversity values in both benthic and pelagic habitats (DSEWPaC 2012). Sound levels at the KEF are modelled to be below the effect thresholds for plankton, benthic invertebrates and reptiles.

The instantaneous levels of sound received at the ancient coastline KEF are close to the threshold for fish behavioural effects when the vessel is in the southern end of the acquisition area. Fish are likely to move away from the approaching sound source. The ancient coastline opposite the southern edge of the acquisition area is mostly a wide corridor that extends away from the acquisition area. Therefore, if fish assemblages move to avoid the sound source, there is available habitat distant enough from the sound source that behaviour and cumulative effects can be avoided.

The potential pressure of sound pollution on this KEF is "*of less concern*" (DSEWPaC 2012).

Continental slope demersal fish communities KEF
The acquisition area is approximately 53 km away from the KEF boundary. The Continental Slope Demersal Fish Communities are a rich assemblage of around 500 fish species, of which 76 are endemic to the bioregion (DSEWPaC 2012a). The KEF is located well beyond the distance for sound to fall below effect thresholds for fish, benthic invertebrates and plankton and sound impacts to the values of this KEF are not credible.

The potential pressure of sound pollution on this KEF is "*not of concern*" (DAWE 2020).

6.4.8.2 Impacts on Marine Parks

The underwater sound EMBA (with outer boundary defined by the distance for underwater sound levels to fall below the cumulative 24-hour TTS for mammals) overlaps with the following Australian and state marine parks (Figure 4.2):

- Argo-Rowley Terrace Marine Park (Australian);
- Mermaid Reef Marine Park (Australian); and
- Rowley Shoals Marine Park (State).

The values for each marine park are described in the Section 4.4. This section addresses the potential impacts to the objectives set out in the relevant management plans, the IUCN principles for the Australian Marine Parks (Appendix D) and the strategic objectives of the State Marine Parks.

Argo-Rowley Terrace Marine Park (Australian)
The operational area overlaps a very small part of the south-eastern corner of the Argo-Rowley Terrace Marine Park (Section 4.4.1.1). The underwater sound EMBA overlaps two zones of the park:

- Multi use zone (IUCN VI)
- Special purpose (Trawl) (IUCN VI).

Table 6.15 details and evaluates the potential impacts of seismic sound emissions on the category VI principles and with the conservation values identified within Marine Park management plans.

Table 6.15 – Potential impacts of seismic sound emissions on category VI IUCN principles and marine park values

IUCN category VI principles	**Details and evaluation of impact**
The biological diversity and other natural values of the reserve or zone should be protected and maintained in the long term.	The natural values of this MP relevant to potential impacts from seismic sound include: Mermaid Reef and Commonwealth waters surrounding Rowley Shoals—an area of enhanced productivity and high species richness, thought to be facilitated by internal wave action generated by internal tides. See details of impacts below. The seismic activity is not anticipated to impact productivity or species richness because impacts will be limited to temporary displacement or individuals or temporary impairment of hearing sensitivity in individuals for <24-hours.
Management practices should be applied to ensure ecologically sustainable use of the reserve or zone.	Management measures for this seismic survey are identified below (Section 6.4.12). Impacts will be limited to temporary displacement or individuals or temporary impairment of hearing sensitivity in individuals for 24-hours. As such, ecological sustainable use will be maintained because the underlying ecological processes will not be impacted.
Management of the reserve or zone should contribute to regional and national development to the extent that this is consistent with these principles.	Allowing this seismic activity to be undertaken with the proposed management measures and the limited impacts as described in the impact assessment will allow regional and national development to occur in accordance with this principle.
Relevant values within the management plans for this MP	
Mermaid Reef and Commonwealth waters surrounding Rowley Shoals (high biodiversity) (KEF)	The seismic activity is not anticipated to impact productivity or species richness because impacts will be limited to temporary displacement of individuals or temporary impairment of hearing sensitivity in individuals for 24 hours.
Seafloor features – including aprons and fans, canyons, continental rise, knolls/abyssal hills and the terrace and continental slope	No effects on seafloor features are predicted.
Fishes	High species richness of the Rowley Shoals and Mermaid Reef are identified as a value of the Argo-Rowley Terrace MP. The very small portion of overlap between the acquisition area and the marine park does not contain any significant benthic features that indicate the presence of habitat for benthic fish species. However, the marine park could contain pelagic fish species that could be temporarily exposed to seismic sound. Based on the known behaviour of fish to avoid seismic sound, fish and sharks in this MP may temporarily avoid the sound source. As such, their distribution and abundances at local scales may be temporarily altered but are likely to return to pre-seismic survey levels as soon as the vessel moves beyond the behavioural effect zone.
Migratory seabirds	The acquisition area overlaps with small portions of the foraging areas for the little tern and white-tailed tropicbird. It is possible that seismic sound could influence the behaviour of their prey, however the area affected at any point in time during the survey is extremely small relative to the broader foraging area available to both these species. While little is known of the effects of seismic sound on the hearing of birds when they are below the water surface, it is logical to predict that in close proximity to the seismic source the behaviour of their prey (e.g. fish) are likely to be altered and therefore the foraging behaviour of the birds may be affected. Therefore, birds are unlikely to be diving for prey and exposed to damaging levels of sound.
Pygmy blue whale BIA	Pygmy blue whales could experience temporary changes in behaviour, minor displacement and a temporary reduction in hearing sensitivity (that is expected to recover within 24 hours) during the period of the survey as described in Section 6.4.4.2. Due to the very small overlap between the survey area and the marine park, limited marine mammals within the marine park are likely to be affected.

Mermaid Reef Marine Park

The Mermaid Reef MP is zoned as national park IUCN category II. Table 6.16 details and evaluates the potential impacts of seismic sound emissions on the category II principles and the values of the marine park.

Table 6.16 – Potential impacts of seismic sound emissions on category II IUCN principles and marine park values

IUCN category II principles	**Details and evaluation of impact**
Natural and scenic areas of national and international significance should be protected for spiritual, scientific, educational, and recreational or tourist purposes.	Seismic sound is not anticipated to directly impact on natural and scenic areas. However, seismic sound could slightly exceed recognized diver safety guidelines in a very small area (approximately a 5 km length of the 40 m depth contour) of the eastern edge of Mermaid Reef for a very short period (several days). Consultation to date noted that identified diving operations only potentially run in October and November which is outside the proposed Possum 3D MSS survey timing. Impacts to divers are discussed further in Section 6.4.10 and management measures for divers are detailed below in Section 6.4.12. The recreational and tourism values of the park will recover after the survey vessel has moved on from the area closest to the reef
Representative examples of physiographic regions, biotic communities, genetic resources and native species should be perpetuated in as natural a state as possible to provide ecological stability and diversity.	The activity is too distant from most receptors in the MP to impact biotic communities, genetic resources and native species. Impacts from seismic sound to this MP will be limited to possible temporarily reduced hearing sensitivity in some migrating cetaceans. As such, the biotic communities, genetic resources and native species should be perpetuated in as natural a state as possible and will provide ecological stability and diversity
Visitor use should be managed for inspirational, educational, cultural and recreational purposes at a level that will maintain the reserve or zone in a natural or near-natural state.	The activity will not enter the MP and the activity does not constitute visitation.
Management should seek to ensure that exploitation or occupation inconsistent with these principles does not occur.	The survey does not represent occupation or exploitation of the marine park. As detailed for the other principles, the seismic survey will be managed so that biotic communities are ecological sustainable.
Respect should be maintained for the ecological, geomorphologic, sacred and aesthetic attributes for which the reserve or zone was assigned to this category.	By maintaining ecological attributes of the reserve, the proposed seismic activity is respecting the zoning assigned to the reserve.
The needs of Indigenous people should be taken into account, including subsistence resource use, to the extent that they do not conflict with these principles.	The seismic activity is not predicted to impact on subsistence resource use of indigenous people.
The aspirations of traditional owners of land within the reserve or zone, their continuing land management practices, the protection and maintenance of cultural heritage and the benefit the traditional owners derive from enterprises, established in the reserve or zone, consistent with these principles should be recognised and taken into account.	The seismic activity is not predicted to impact on the cultural heritage or the benefits to traditional owners.
Relevant biodiversity values within the management plans for this MP	
Corals	The thresholds for impact to corals will not been reached for the seismic source used in this survey therefore impacts to corals are not predicted.
Fishes	Fishes within the Mermaid Reef MP could be exposed to noise levels capable of changing their behaviour or inducing cumulative TTS – if they are located at the shortest distance between the acquisition area and the park boundary. However, since pelagic species are highly mobile it is unlikely that they would remain within the cumulative TTS zone long enough to experience cumulative TTS. Furthermore, most of the marine park will be unaffected by sound levels that could impact fish, therefore. Impacts on pelagic fish populations in the marine park are highly unlikely with impacts predicted to be limited to temporary changes in behaviour.
Invertebrates (other than corals)	The seismic activity is not expected to impact on this value because: • the impacts to crustaceans are not lethal, do not impact behavior and are unlikely to have population level consequences • sound levels capable of causing mortality or increased stress levels in molluscs are not predicted to reach the Mermaid Reef MP. The behaviour of molluscs, potentially squid and cuttlefish within these MPs could be temporarily influenced

IUCN category II principles	Details and evaluation of impact
	through inducing a startle response for period that is likely less than the duration of the survey. Lasting or population level impacts to molluscs within the MPs are highly unlikely.
Marine mammals	Levels of sound capable of causing injury such as instantaneous and cumulative PTS, instantaneous TTS, or changes in behaviour are not predicted to enter the Mermaid Reef MP. However, cumulative TTS exposure could occur for low frequency hearing baleen whale species. For blue whales ANIMAT modelling suggests the number of individuals exposed is likely to be low. Furthermore, Southall et al (2019) suggest this will be a temporary hearing impairment with recovery in hearing likely within 24 hrs. Management controls and a risk assessment are presented below in Section 6.4.12.
Marine turtles	The sound levels reaching the park are predicted to be below any effect thresholds for marine turtles.
Avifauna	Sound levels capable of affecting prey for seabirds are unlikely to enter the Mermaid Reef MP given the acquisition area is ~7 km a from the park boundaries. At this distance avifauna prey is unlikely to be affected, as detailed in the fish and invertebrate impact assessment sections.

Rowley Shoals Marine Park

Rowley Shoals MP is managed by the Western Australian government. Table 6.17 details and evaluates the potential impacts of seismic sound emissions on the strategic objectives listed under the marine park management plan.

Table 6.17 – Potential impacts of seismic sound emissions on the strategic objectives of Rowley Shoals MP management plan

Strategic objectives	Details and evaluation of impact
Conservation • to maintain the marine biodiversity of the MP; • to maintain ecological integrity (i.e. key ecosystem structure and function);	The activity is too distant from most receptors in the MP to impact biotic communities, genetic resources and native species. Impacts from seismic sound to this MP will be limited to temporary reduced hearing sensitivity in some migrating cetaceans. Therefore, the marine biodiversity and ecological integrity are unlikely to be impacted.
Science and Education • to promote education, nature appreciation (through recreation and tourism opportunities) and scientific research in the MP.	The seismic activity is not anticipated to prevent or impact on science and education of the MP and potential interference with research activities by CSIRO and AIMS will be managed by SIMOPS planning.
Public Participation • to promote community involvement in the management of the MP.	The seismic activity is not anticipated to prevent or impact on public participation of the MP
Recreational Uses • to facilitate, manage, and, where appropriate, assist in the management of recreational activities within an equitable and ecologically sustainable framework; and	The seismic activity is not anticipated to prevent or impact on recreational uses of the MP, noting potential impacts to divers discussed above.
Commercial Uses • to facilitate, manage, and, where appropriate, assist in the management of commercial activities in the MP within an equitable and ecologically sustainable framework.	The seismic survey will not affect other commercial activities in the MP.
Relevant values within the management plans for this MP	
Intertidal and subtidal coral reef communities	The thresholds for impact to corals will not been reached for seismic source used in this survey therefore impacts are not predicted.
Invertebrates (other than corals)	The seismic activity is not expected to impact on this value because: - the impacts to crustaceans are not lethal, do not impact behavior and are unlikely to have population level consequences - sound levels capable of causing mortality or increased stress levels in molluscs are not predicted to reach the Mermaid Reef MP. The behaviour of molluscs, potentially squid and cuttlefish within these MPs could be temporarily influenced through

Strategic objectives	Details and evaluation of impact
	inducing a startle response for period that is likely less than the duration of the survey. Population level impacts to molluscs within the MPs are highly unlikely.
Finfish	Pelagic fish, sharks and site-attached fish in the Rowley Shoals MP are not predicted to be affected by seismic sound as they are too distant from the sound source.
Turtles	The park boundary is 21.6 km from the acquisition area, therefore sound levels are predicted to be below any effect thresholds for marine turtles in the MP.
Seabirds	Sound levels capable of affecting prey for seabirds are unlikely to enter the Rowley Shoals MP given the acquisition area is 21.6 km from the park boundaries. At this distance avifauna prey is not predicted to be affected.
Cetaceans	Levels of sound capable of causing injuries such as instantaneous and cumulative PTS, instantaneous TTS, or changes in behaviour are not predicted to reach the Rowley Shoals MP. However, cumulative TTS exposure could occur for low frequency hearing baleen whale species. For blue whales ANIMAT modelling suggests the number of individuals exposed is likely to be low. Furthermore, Southall et al (2019) suggest this will be a temporary hearing impairment with recovery in hearing likely within 24 hrs. Management controls and a risk assessment are presented below in Section 6.4.12.

6.4.9 Impact assessment – Commercial fisheries

The Mackerel Managed Fishery and North West Slope Trawl Fishery are the only historically active (recorded catch within the last 5 years) fisheries within or adjacent to (within 10 km of) the acquisition area. For the purposes of the impact assessment on finfish, a 10 km buffer (the approximate distance at which cumulative TTS could occur) has been added around acquisition area and laid over the actively fished areas to assess the potential area within each fishery where fish behaviour (potentially including catchability) may be affected.

Mackerel Managed Fishery

The acquisition area and the area where sound levels may exceed the behavioural threshold for fish (10 km range), do not overlap the actively fished areas of the MMF (Figure 4.20). Fishers from the MMF are generally active in waters shallower than 70 m (WAFIC 2019). Initial fisheries catch and effort data recorded between 2014-2019 sourced from DPIRD on 28/10/2019 identified one 2018 record of fishing effort in approximately 400m of water within the acquisition area, which is considered unusual as the depth of the acquisition area is outside the usual actively fished area for this fishery (via consultation with WAFIC and DPIRD, 2020). Subsequent fisheries catch and effort data recorded between 2018-2020 sourced from DPIRD on 19/07/2021 shows no reference to the one 2018 record of fishing effort which has been removed from the list.

It is theoretically possible that Spanish mackerel, the target species of this fishery, could occur in the acquisition area, but as described in the fish impact assessment for pelagic fish (Section 6.4.6), these highly mobile, pelagic fish are likely to avoid the sound source and not experience mortality, injury or instantaneous TTS.

If Spanish mackerel are present within approximately 9 km of the seismic source, some individuals could develop TTS through cumulative exposure. However, this relies on the fish remaining within 9 km of the vessel for the full 24 hours and if they did, it would only cause a reduction in hearing sensitivity that is recoverable in 18-24-hours (Popper et al 2005). The Mackerel Managed Fishery spawning period is outside the survey acquisition timing and is highly unlikely to be impacted by the Possum 3D seismic activity.

North West Slope Trawl Fishery

The acquisition area overlaps 2.33 % of the total area of the North West Slope Trawl Fishery (NWSTF) and evidence suggests that most of the permitted area of the fishery is actively fished (ABARES 2018). Based on the impact assessment conducted on crustaceans (above) it is possible that scampi (the target species of the NWSTF) within the acquisition area could experience statocyst damage as a result of seismic sound exposure, but this is likely to be recoverable after moulting as has been recorded for other decapod crustaceans (Day *et al* 2019). The evidence from experiments conducted on other crustacean species suggests sub-lethal effects on adults, behavioural effects or impacts on embryos on berried females and the larvae that subsequently hatch are unlikely (Day *et al* 2016). (See impact assessment for crustaceans in Section 6.4.3.2 for the reasoned and scientifically supported evidence which has been used as the basis of this assessment). Furthermore, scampi are known to burrow in soft seabed substrate which may make them less vulnerable to increased underwater sound levels (Bell *et al* 2006).

Any effects to stocks in the 2.33% of the fishery are unlikely to be permanent (Day *et al* 2019). The best available scientific evidence shows that seismic sound exposure did not change catch rates of prawns in much shallower waters (Andriguetto-

Filho *et al* 2005). Furthermore, a review of all the available scientific evidence found exposure to seismic sound did not affect catch rates in invertebrates (Carroll et al 2017), nor did a Before-After-Control-Impact study on the catch rates of snow crabs exposed to seismic sound (Morris et al 2018) . Based on this evidence it is reasonably predicted that the Possum 3D survey is unlikely to affect the sustainability of the stock and overall catch rates of scampi in the North West Slope Trawl fishery.

6.4.10 Impact assessment – Tourism and recreation

Tourism and recreation activities which may be impacted by seismic sound are diving (snorkelling and SCUBA) and fishing.

The Rowley Shoals support low level of fishing effort, primarily due to their isolation from major population centres. Given the distance of the seismic vessel from the shallow reefs around the shoals, no interference with recreational fishing is predicted. Impacts on the fish are addressed in Section 6.4.6.

The peak diving season is in October and November due to weather conditions outside these months. Several charter boat operators run expeditions to the shoals during these months. Impacts to recreational divers are assessed below.

Diving exposure threshold

The Diving Medical Advisory Committee (DMAC) advises on commercial diving safety management and has released information on safe diving distance from seismic survey operations. DMAC notes that there is limited understanding of the effects of seismic pressure waves on divers, and that the multiple factors involved make it difficult to determine a safe or tolerable distance for diving operations (DMAC 12 Rev. 2.1 – 2020).

Evidence based on effects of underwater sound emissions on both military and recreational divers suggests that sound levels below 145 dB re 1 µPa (SPL; L_P) within a frequency range between 100 and 500 Hz is safe for recreational divers and swimmers (Ainslie 2008 and Parvin 2005).

Evaluation of impacts to divers

The exposure threshold has been combined with numerical propagation modelling to predict a sound exposure regime at the nearest potential dive location to the survey acquisition area. Few recreational divers dive deeper than 40 m and this is taken as the realistic limit of diving activity on the shoals.

The 40 m depth contour at Mermaid Reef nearest the acquisition area has been identified as the nearest potential dive location and is considered representative of the greatest underwater sound impacts on divers. When the seismic vessel is at its closest point to the 40 m depth contour (Site 3 in Appendix C), the modelled sound level of 147.4 dB re 1 µPa (SPL; L_P) at this location slightly exceeds the recommended safety threshold of 145 dB re 1 µPa (SPL; L_P). Sound levels reaching the representative 40 m dive site from the two adjacent sites modelled (Sites 1 and 2) did not exceed the threshold, indicating it would be a transient exceedance.

The modelling showed that as the sound reaches the steeply rising reef edge its energy decreases dramatically. The leeward sides of the reef are predicted to be exposed to significantly lower sound levels and most of the reef will be exposed to lower than the threshold value throughout the survey. The area on the north-west side of Mermaid Reef that is predicted to be exposed to sound above the recreational diver sound threshold is highly localised and would only be exposed to sound at this level for a short time.

The sound exposure to the rest of the Rowley Shoals remains well below the diver safety threshold during the entire survey.

Some audible sound levels will likely be present around the waters of the Rowley Shoals, including Mermaid Reef, during the seismic activity. However, sound levels experienced during diving are unlikely to cause discomfort or prevent diving activities.

6.4.11 Additive impacts

6.4.11.1 Multiple surveys

Previous and potentially concurrent seismic surveys have been derived from NOPSEMA's website and are listed in Table 4.11.

Additive impacts from previous seismic surveys in the same areas can occur when the timing between surveys is less than the recovery rate of any predicted impacts to receptors. Since the last completed survey was approximately one year prior to the Possum MSS and there is no overlap in the acquisition or operational area, additive effects are not anticipated.

It is difficult to predict which surveys will occur concurrently since the other surveys have operational windows that extend beyond the Possum 3D MSS and acquisition timing will depend on vessel availability. At the time of writing this EP there has been a significant downturn in the petroleum industry associated with the COVID-19 pandemic which could affect the exploration activities for some years. Therefore, many of the planned seismic activities may be cancelled or delayed which will further reduce the potential for concurrent surveys. This may particularly apply for surveys planned as multiclient acquisition.

It is not good industry practice to acquire seismic concurrently due to the impact on the quality of the data obtained. If a survey does operate concurrently with an adjacent survey, impacts may result from slightly increased sound levels of approximately 6 dB SPL in the far field where the sound waves converge (Hass 2013). Because the sound levels have already attenuated to lower levels in the far field a 6 dB SPL increase in sound is unlikely to have an impact. For example, if a separation distance of 40 km is maintained between vessels the sound waves will likely intercept at 20 km where the sound level has dropped to approximately 150 dB SPL. Therefore, it is expected that an increase to 156 dB SPL will have little to no effect on environmental receptors because this is below the known effect thresholds.

6.4.11.2 Reacquisition

Reacquisition of particular seismic lines and/or part lines (overlaps) may be required to obtain seismic coverage to acceptable industry standard. Reacquisition and overlaps have the potential to re-expose benthic receptors (invertebrates and fish) within the acquisition area. However, the exposure of benthic fish is unlikely to be significant because the survey area is devoid of suitable habitat. However, if present mobile benthic species are only likely to exposed to levels that induce TTS or behavioural response which is recoverable within 24 hours of initial exposure.

For benthic invertebrates there is the potential for reacquisition or overlap lines to transect over previously exposed individuals. The results from Day et al (2016) which have been used to support the impact assessment of crustaceans assessed multiple exposure regimes. The effects during reacquisition are not anticipated to be greater than the conservative assessment of impacts provided in that work. Furthermore, reacquisition overlapping of previously surveyed locations is typically only conducted over short segments of individual survey lines where previously acquired data is considered of insufficient quality. Therefore, any additional impacts from reacquisition is expected to be minor.

6.4.12 Seismic sound risk assessment

Nature and Scale of Impacts and Risks
Refer to the above Section 6.4.2 to Section 6.4.10
Good Industry Practice
EPBC Policy Statement 2.1 Interaction between offshore seismic exploration and whales Part A: Standard Management Measures. (EPS 4.5): • Implementation of 500 m shutdown, 2 km low power and 3 km observation zones (for seismic surveys where received sound exposure level for each shot will exceed 160 dB re 1µPa2·s, for 95 % of seismic shots at 1 km range). • Do not program seismic surveys in areas where and when whales are likely to be breeding, calving, resting or feeding. • Implement procedures for: o Pre start-up observation o Soft start o Start-up delays o Operations o Stop work o Night-time and low visibility.
DMAC 12 Safe Diving Distance from Seismic Surveying Operations. (DMAC 2020): (EPS 4.4) 1. Where possible, plans should be made to avoid overlapping seismic and diving activities. Where this is not possible, the activities should be prioritised and a simultaneous operations (SIMOPS) plan developed. 2. Where diving and seismic activity are scheduled to occur within a distance of 45 km, it would be good practice for all parties to be made aware of the planned activity where practicable. This should include clients/operators, diving and seismic contractors. 3. Where diving and seismic activity will occur within a distance of 30 km a joint risk assessment should be conducted, between the clients/operators involved and the seismic and diving contractors in advance of any simultaneous operations. The risk assessment should consider ramp-up trials as well as other risk control measures e.g. reduction in source sizes, changes to firing intervals, timeshare/prioritisation etc. Seismic operators should consider whether a source output modelling study should be undertaken to predict sound pressure levels at diving locations. If so, these sound pressure levels should be considered together with other relevant factors in the risk assessment. 4. The maintenance of effective communication and co-operation between the seismic vessel and the diving vessel is essential. If the risk assessment generates a requirement for a ramp up trial, it should define the start point or location at which the trial commences

taking into account the planned movement of the vessel and an appropriate predetermined communication plan between seismic party manager and diving supervisor.

5. The minimum safe distance, as determined from the risk assessment or testing outlined above, should not be compromised by either party.
6. There should be regular effective communication between the seismic vessel and diving vessel so that those in control of seismic and diving operations are aware of each other's work programmes .A communications check should be conducted between vessels at a pre-defined regular frequency in order to reduce the chance of an unknown communications failure.
7. Should any member of the diving team in the water suddenly experience discomfort, the seismic source should be turned off immediately or the bell run terminated if a request is made to do so. The SIMOPS plan should include contingency arrangements for this situation.
8. Following the risk assessment and any ramp-up trials local factors may change. This combined with individual diver susceptibility may produce the need for further risk assessment and a management of change process.
9. The health impact of exposure to noise in the underwater environment is difficult to assess. A diver's exposure should be terminated if the noise level:
    a. interferes with diver communications;
    b. is considered to exceed acceptable noise exposure levels;
    c. induces discomfort; or
    d. places the diver at risk in any other way.
10. Diving operations may continue if none of these criteria for terminating diving operations are present, including diving within 30 km (18.6 miles) of seismic surveying operations
11. Diver reports suggest that communications problems may often provide the earliest and most reliable/objective indication that the underwater noise from a seismic source has reached an unacceptable level. It is therefore strongly emphasised that the seismic source must be turned off immediately or the bell run terminated if the noise level compromises communications between the diver(s) and diving supervisor. In order to conduct diving operations safely there must always be good communications between the divers in the water and the supervisor in dive control.
12. When simultaneous operations are conducted, the diving contractor should generate and submit a short online Report of Simultaneous Seismic and Diving Operations at www.dmac-diving.org/data. DMAC will periodically review the data gathered from such reports.

Organisations which provide consent for seismic operations may wish to take into account the potential impact of seismic activity on divers and consider whether a requirement for monitoring the area for new diving activity is appropriate.

Diving contractors and clients/operators should seek to ensure they are aware of planned or consented seismic operations using all reasonable means.

Environmental Impact Assessment

Potential Consequence	**Rank**	**Likelihood Discussion**	**Rank**	**Residual Risk**
Plankton communities				
Lethal impacts are predicted to occur in the water column at up to 120 m from the source, with a radius of this zone exposed as the vessel moves along the sail line. However, zooplankton population dynamics are characterised by natural rapid expansion, crashes and recovery due to the nature of their life history traits. Based on realistic thresholds by Popper et al (2014) the recovery of local zooplankton populations is likely to occur well within three days. As such, the worst credible impact is temporary and localised to the survey area.	[A] Minor	The minor impacts described are likely to occur.	[4] Likely	[10] Tolerable
Benthic communities				
Impacts on benthic invertebrates have been assessed (see Section 6.6.3). The worst credible impact to crustaceans is physical damage (non-lethal, recoverable) to individuals within 344 m of the seismic vessel (based on threshold for lobsters). Scampi will be less exposed due to burrowing habit. With respect to molluscs: • Mortality in benthic molluscs as a result of seismic sound exposure is unlikely to be significantly greater than natural levels of mortality • The stress response that molluscs may undergo when exposed to seismic sound is not expected to increase mortality levels beyond natural levels	[A] Minor	The minor impacts described are likely to occur. A featureless, sandy-mud seabed with sparse sessile organisms is likely to be the dominant substrate within the operational area.	[4] Likely	[10] Tolerable

• Behavioural effects will be temporary and will possibly reduce over time due to habituation. No impacts are expected to corals.				
Marine Fauna – mammals				
For the purpose of this risk assessment the credible worst case impacts to mammals are those to pygmy blue whales, due to their hearing sensitivity and higher likelihood of presence due to a nearby migration BIA. Instantaneous PTS and TTS injury to blue whales within the immediate area (30 m and 60 m respectively) of the seismic source is predicted (with no controls in place). Some temporary effects on hearing sensitivity through cumulative TTS exposure is possible, however the number of individuals is likely to be small. TTS is not anticipated to have long term health or survival consequences and the effects on the energetics of individuals are likely to be minor. The consequence rank is based on the risk of PTS and TTS.	[C] Serious	With the implementation of the good practice controls (EPBC Policy Statement 2.1) this impact is unlikely.	[2] Unlikely	[8] Tolerable
Marine Fauna – reptiles				
For the purpose of this risk assessment, the credible worst case impacts to reptiles are those to turtles, Any turtles that occur within the acquisition area will likely be transiting and/or foraging and in open oceanic waters will likely be at very low densities. Instantaneous physical impacts to turtles are not predicted, with cumulative PTS and TTS ranges predicted in the immediate area only (60 m and 880 m respectively). Effects on behaviour will only be temporary and within 3.6 km from the seismic source. The consequence rank has been based on the risk of physical injury to marine turtles.	[B] Moderate	The seismic vessel is continually moving when the seismic source is powered up. Given the 24-hour cumulative zones of effect are small (60 m for PTS and 880 m for TTS) in relation to the survey area, it is highly unlikely that a turtle could remain this effect zone for sufficient time to elicit a cumulative effect. If the seismic vessel is travelling at 4-6 knots a turtle, even moving in the same direction as the seismic vessel, would only be within the cumulative effect zone for a few minutes.	[2] Unlikely	[5] Acceptable
Marine Fauna – bony fish and sharks				
For mobile benthic fish recoverable injury could occur up to 144 m either side of the survey line for fish which do not avoid the sound. Instantaneous TTS is not predicted to occur. For pelagic fish, mortality and recoverable injury are theoretically capable of occurring within 60 m to 120 m (Table 6.13) from the source; however, pelagic fish and sharks within the behavioural effect zone of the seismic source are predicted to actively avoid the sound source. Pelagic fish are highly mobile it is unlikely that they would remain within the cumulative TTS zone long enough to be exposed to sustained levels of sound that may cause cumulative TTS. Even if they did experience TTS through cumulative exposure, they are likely to recover within 24 hrs (Popper et al 2014) with negligible ecological effects. It is predicted that behavioural responses in fish and sharks will occur, however are unlikely to occur beyond 10 kilometres of the source. There are no known spawning grounds within or near the acquisition area, therefore impacts to spawning are considered unlikely. The sound source has the potential to impact individual whale sharks that may be present in the foraging BIA during the survey. However, these effects are minimised since most of the foraging BIA will remain available for foraging activities and there are no foraging aggregation areas in the ensonified area. The consequence rating is based on the potential for mortality and recoverable injury of whale shark.	[C] Serious	With the implementation of the good practice controls (EPBC Policy Statement 2.1), specifically the implementation of a soft start procedure, this impact is unlikely.	[2] Unlikely	[8] Tolerable

Marine Fauna – avifauna				[3] Acceptable
The acquisition area overlaps a very small portion of the white-tailed tropicbird breeding BIA and a very small portion of the little tern resting BIA. Only birds diving and foraging within the operational area would be exposed to seismic sound while diving for small pelagic fishes near the sea surface, or affected by changes in prey distribution. It is considered reasonable that birds may avoid the seismic sound and physical impact is considered not credible. Seismic sound theoretically has the ability affect the tropicbird foraging through avoidance of diving for prey or through disturbing their prey. Only the area around the seismic source (approximately 10 km) at any one time is expected to influence fish behaviour and therefore potentially influence the availability of their prey source. As such, at any moment in time the affects to potential foraging sources is extremely small. Further, the area of the BIA overlapped with the acquisition area (approximately 10-15%) is small, leaving most of the BIA available for foraging.	[A] Minor	A minor impact on avifauna behaviour is considered unlikely.	[2] Unlikely	
Protected areas				[10] Tolerable
The main values of the closest KEF ecosystem are associated with reef lagoons in less than 40 m water depth, which are approximately 14 km from the acquisition area and beyond the distance for sound to fall below effect thresholds for fish, benthic invertebrates and plankton. As detailed in Section 6.4.8, the key values with potential to be impacted at marine parks are: *Fishes within the Mermaid Reef MP:* could be exposed to noise levels capable of changing their behaviour or inducing cumulative TTS – if they are located at the shortest distance between the acquisition area and the park boundary. However, since pelagic species are highly mobile it is unlikely that they would remain within the cumulative TTS zone long enough to experience cumulative TTS. Most of the marine park will not reach sound levels that could impact fish, therefore further reducing the potential impacts to pelagic fish in the marine park. Impacts on pelagic fish populations in the marine park are highly unlikely with impacts predicted to be limited to temporary changes in behaviour. *Mammals within the Argo-Rowley Terrace Marine Park (Pygmy blue whales are a value), Mermaid Reef Marine Park and Rowley Shoals Marine Park:* could experience temporary changes in behaviour, minor displacement and a temporary reduction in hearing sensitivity (that is expected to recover within 24 hours) during the period of the survey. Effects on marine mammals within the marine park are likely to be negligible.	[A] Minor	The behavioural and cumulative TTS impacts described are conservatively considered likely to occur.	[4] Likely	
Commercial Fisheries				[3] Acceptable
As detailed in Section 6.4.9 the worst credible impact to a commercial fishery would be a temporary reduction in stock levels within a very small percentage of a fishery. Any impacts will be temporal and local in nature, and only impact a very small part of the NWSTF.	[A] Minor	The MMF is highly unlikely to be impacted by the Possum 3D seismic activity. The Possum 3D survey is unlikely to affect the overall catch rates of scampi in the North West Slope Trawl fishery.	[2] Unlikely	

Tourism and Recreation				
The only credible impacts to tourism and recreation is in relation to divers. When the seismic vessel is at its closest point to potential diving locations (north-west of Mermaid Reef), the modelled sound level of 147.4 dB re 1 µPa (SPL; LP) at this location slightly exceeds the recommended safety threshold of 145 dB re 1 µPa (SPL; LP). Sound levels reaching the representative sites from the two adjacent seismic sites modelled did not exceed the threshold, indicating it would be a transient exceedance. The area predicted to be exposed to sound above the recreational diver sound threshold is highly localised and would only be exposed to sound at this level for a short time.	[B] Moderate	With the implementation of the good practice controls (DMAC 12 Safe Diving Distance from Seismic Surveying Operations Rev 2.1), impact to diver safety are determined to have a likelihood of Rare.	[1] Rare	[2] Acceptable

Risk Type		**Overall Residual Risk**
Type B Risk	Risk is determined to be Type B as: • the residual risk is Tolerable or greater • there has been stakeholder feedback concerning the potential impact of anthropogenic sound due to the seismic array Although the activity and risk are well understood, and good practice control measures are well defined, there has been stakeholder feedback concerning the potential impact of the presence of anthropogenic sound due to the seismic array. Searcher has undertaken additional risk assessment and cost/benefit analysis to identify further control measures to those identified as 'Good Practice' above.	Tolerable

Environmental Performance Outcomes (EPOs) relating to this aspect include:

EPO 1 No long term or permanent impacts to plankton communities as a result of the activity

EPO 2 No permanent change in benthic communities as a result of the activity.

EPO 3 No physical injury (PTS or TTS), mortality or disturbance during peak breeding or migration period to EPBC Act listed (marine fauna) species due to noise associated with the operation of vessels and seismic sources and Seismic acquisition is consistent with the Recovery Plans for EPBC listed marine species.

EPO 5 No impact on values of marine protected areas not inconsistent with the management principles and objectives of the marine park or other protected area.

EPO 7 No impact on values of marine protected areas not inconsistent with the management principles and objectives of the marine park or other protected area.

EPO 11 No health impacts on divers or recreational activities due to seismic sound.

The Control Measures are consistent with Good Industry Practice summarised above, additional Control Measures considered for this aspect are shown below with Environmental Performance Standards (EPSs) and Measurement Criteria for the EPOs described in Section 9, Table 9-2.

Evaluation of Additional Control Measures (Detailed ALARP Evaluation)					
Control Measure	**Type**	**Environmental Benefit**	**Cost (% of project)**	**Implemented**	**Cost benefit analysis**
Do not conduct Possum MSS	Elimination	Prevents all impacts to marine fauna.	>10%	Not adopted	There is minimal environmental benefit from this control given the predicted negligible impacts to marine fauna and other marine users. Titleholders are required by NOPTA to acquire seismic data within specified time frames. Data is required to meet business objectives. The cost of this control measure is grossly disproportionate to the environmental benefits.
Conducting the survey during daylight hours only	Elimination	Minimisation of effects to marine mammals and turtles due to increased ability to detect and implement controls.	>10%	Not adopted	Minimal environmental benefit would be gained as effects are already low. This control would effectively double the cost of the survey and render it financially unviable. Therefore, the cost is grossly disproportionate to the benefit gained.
Equipment specification and procedures: Minimum practical source size selected to acquire survey data and meet the geophysical objectives of the survey. (EPS 4.1)	Engineering	Minimisation of effects to marine fauna.	<1%	Adopted	Utilisation of smallest practical seismic source to minimise underwater sound emissions and potential impacts to marine fauna.
Application of EPBC Policy Statement 2.1 Part A: Standard Management Measures to whale sharks – with 500m shutdown zone. (EPS 4.6)	Administrative	Significantly reduces likelihood of mortality and recoverable injury to whale sharks as a result of seismic sound emissions.	5-10%	Adopted	Aligns with management actions for whale shark management / recovery plans and conservation advice. 500 m shutdown zone give a suitable buffer to the predicted mortality and recoverable injury zone of up to 120 m.
Application of EPBC Policy Statement 2.1 Part B: Up to two MFO's, trained to an internationally recognised standard, will be on board with one MFO on watch at all times during daylight hours of seismic acquisition.(EPS 4.7)	Administrative	Visual detection of marine fauna in proximity to seismic source.	<1%	Adopted	Although the acquisition area is not considered to be located within an area of moderate to high likelihood of encountering whales, the operational area does overlap part of the pygmy blue whale migration BIA and so inclusion of an MFO, trained to an internationally recognised standard, is considered conservative. Consistent with Part B of EPBC Policy Statement 2.1, an MFO will be on board the seismic vessel and on duty during daylight hours of survey.
Application of EPBC Policy Statement 2.1 Part B: Passive Acoustic Monitoring (PAM).	Engineering / Isolation	Detection of cetaceans at night-time, but limited use due to expected low population densities in the area.	2-5%	Not adopted	Although PAM can be used to supplement visual observations made by MFOs, the method is dependent upon animals vocalising. Costs for engaging a trained PAM operator for the survey are approximately US$640,000. The additional cost of having a qualified PAM operator and equipment on board for the duration of the survey when few or no detections are expected was determined to outweigh

					any limited additional benefit that PAM might provide, particularly given the proposed soft-start, night-time and low visibility procedures. Given that the operational area does not overlap any critical habitat (i.e. feeding, breeding, calving areas) or a constricted migratory pathway for cetaceans, and the limited detections expected from the use of PAM, the cost of this option is considered to outweigh the limited potential for any further reduction to an already low level of risk.
Application of EPBC Policy Statement 2.1 Part B: Spotter vessel / aircraft.	Engineering / Isolation	Visual detection of marine mammals over greater ranges from the seismic source	5-10%	Not adopted	The use of a dedicated spotter vessel/plane would add considerable cost to the survey and would add to the overall environmental footprint of the survey (e.g. through physical presence, emissions and discharges etc.). Lack of availability of aircraft capable of long-range, long duration flights from the nearest viable airport (Karratha) is also a major consideration. Low numbers of marine mammals are expected to be encountered in the operational area. Given the uncertain benefits and viability of spotter planes/vessels and the added environmental footprint, the cost associated with engaging a dedicated spotter vessel or plane plus the added safety risks to personnel are considered disproportionate to the minimal environmental benefit of identifying marine mammals ahead of the survey vessel.
Application of EPBC Policy Statement 2.1 Part B: Adaptive management – During pygmy blue whale migration period (September to December, April to July), if three blue whale-instigated power-down or shut-down situations, or seven or more confirmed blue whale sightings, occur during a 24 hour period (commencing from the time of the first whale instigated shut-down or sighting), seismic acquisition will not be undertaken during the subsequent night-time. Seismic acquisition will not resume at night-time until there has been a 24-hour period of seismic acquisition during which no power-downs / shutdowns have	Isolation	Minimisation of effects on pygmy blue whales	1-3%	Adopted	Further reduces the low likelihood of impacts to pygmy blue whales if timing for the survey overlaps with the likely presence of this species in the region and addresses uncertainty in movements through the area.

occurred for pygmy blue whales. (EPS 4.8)					
Shut down zone for foraging seabirds near the seismic source.	Elimination	Elimination/minimisation of effects to seabirds	1-3%	Not adopted	There is already very low likelihood of birds foraging near the operating seismic source, there is a very low risk they could be directly impacted, and the potential impacts on their prey distribution (through effects on behaviour) is very small relative to their available foraging area. In addition, shut-downs for seabirds would be impracticable to implement and place a disproportionate amount of effort on MFOs and crew potentially adding to delays in the survey duration. Therefore, the cost of implementing this control is predicted to be grossly disproportionate to the environmental benefit gained.
Phasing of the survey to avoid pygmy blue whale and whale shark migration period. (EPS 4.9)	Elimination	Avoids the effects of survey on whales and whale sharks	>10%	Partially adopted (survey Dec – Jul)	The migration period for whale sharks is Jul-Nov and for blue whales is Apr-July (north)and Sept-Dec (south). The most appropriate acquisition window, considering environmental sensitivities (including pygmy blue whale migration periods), weather conditions and allowing a sufficient window to enable successful engagement of a seismic vessel, is December to July and hence there could be a partial overlap of MSS with migration periods. The survey is only expected to take approximately 70 days. Therefore, if the acquisition period does overlap with the migration periods, it will only be a small portion of the migration periods. Further, only a small portion of the pygmy blue whale migration corridor and the whale shark foraging BIA will receive sound levels above TTS levels. Restricting the MSS schedule to completely avoid these migration periods will significantly increase vessel contracting fees and place logistical constraints (e.g. weather and vessel availability) that jeopardise the viability of the survey.
Commercial Fishery Adjustment: Payment of adjustment to commercial fishers for evidence-based loss of catch, displacement and Fishing gear loss or damage. (EPS 1.21)	Administrative	'Adjustment' arrangement for commercial fishery licence holders affected by the activity to reduce potential commercial impacts.	>10%	Adopted	Searcher is a member of the Collaborative Seismic Environment Plan (CSEP) consortium that underpins the NERA Commercial Fishing Industry Adjustment Protocol. As such, as negotiated with commercial fishing peak industry bodies, including AFMA, WAFIC and the Northern Territory Seafood Council. The CSEP Adjustment Protocol details an evidence-based process for commercial fishers to make a claim for loss of catch, displacement or gear damage within an Adjustment Area, a copy of which is available on the NERA website (NERA 2021)
Searcher will engage with proponents identified as having potential concurrent seismic activities prior to commencing the Possum 3D MSS and develop a concurrent operations	Administrative	Reduce cumulative effects of underwater sound emissions from the seismic source.	<0.5%	Adopted	Environmental benefit outweighs additional cost.

plan for any concurrent surveys identified within 60 km of the acquisition area.(EPS 4.2)					
A minimum separation distance of 40 km will be maintained between the Possum 3D MSS survey vessel and other operating seismic sources. (EPS 4.3)	Isolation	Elimination/minimisation of cumulative effects of underwater sound emissions from the seismic source	2-5%	Adopted	Environmental benefit outweighs additional cost.
100 m 'turtle pause' when a turtle is within 100 m of the active source (EPS 4.10)	Administrative/Isolation	Avoid effects of survey on turtles	<0.5%	Adopted	Reduces impact to turtles. Benefit outweighs additional cost.

Residual Risk Following the Application of Additional Controls	
In addition to implementing all 'Good Practice' management measures in accordance with regulations and industry guidelines, Searcher has also identified additional measures to manage the discharge of anthropogenic sound due to the seismic array. Given the good practice and additional controls that have been proposed, the likelihood of impacts occurring is further reduced, however some minor impacts (behavioural or short lived) are still likely to occur. Therefore, the overall risk rating remains Tolerable.	**Tolerable**

ALARP Justification

Given the decision context is 'Type B', and:

- Searcher has a high degree of certainty of the effectiveness of well-established control measures to ensure the level of impact to the environment from the discharge of anthropogenic sound due to the seismic array is ALARP;
- All relevant 'Good Practice' control measures have been adopted by Searcher to manage the potential impacts and risks associated with the discharge of anthropogenic sound due to the seismic array to ALARP;
- Searcher has committed to convey the 'Good Practice' control measures to vessel operators to ensure they are aware of their obligations;

Searcher considers that the environmental impacts and risks associated with the discharge of anthropogenic sound from the seismic array are managed to ALARP.

Demonstration of Acceptability

Acceptable Level Criteria (General)	***Statement of how the acceptance criteria has been met***
1. The environmental impact or risk is deemed to be ALARP.	Risks and impacts have been reduced to ALARP as demonstrated above.
2. Principles of ESD not compromised and relevant requirements for environmental approvals (EPBC Act Part 3, Division 1) met.	The best practice control measures to be implemented in this EP will prevent irreversible individual and ecological damage. Any environmental effects will be temporary. Therefore, biological diversity and ecological health will be maintained.
3. The management of the activity is consistent with a plan of management for a Marine Park and/or a recovery plan for a threatened species.	Blue whales: This EP has assessed the potential impacts to Blue and Sei whales. Through the application of the proposed controls, death or injury to these whales is highly unlikely. There may be localised and temporary displacement of individuals within their known foraging areas but they are not expected to be displaced from their foraging BIA. Any reduction in hearing sensitivity is expected to be small and temporary (24 hrs) and no population level impacts are predicted. Therefore, the objective of minimising anthropogenic threats has been achieved. Fin whales: Through the application of the proposed controls, death or injury to these whales is highly unlikely. Any reduction in hearing sensitivity is expected to be small and temporary (24 hrs) and no population level impacts are predicted. Therefore, the objective of ensuring ongoing recovery has been achieved. Sei whales: Through the application of the proposed controls, death or injury to these whales is highly unlikely. Any reduction in hearing sensitivity is expected to be small and temporary (24 hrs) and no population level impacts are predicted. Therefore, the objective of population recovery and protection from threats has been demonstrated. Whale sharks: The behavioural response to avoid the sound source and controls implemented to significantly reduce injury are consistent with the objective of facilitating recovery of whale sharks. Marine turtles: The survey area does not overlap with any biologically important areas for marine turtles. Controls will be implemented to reduce the likelihood of injury and death as a result of seismic sound. As a result, the recovery objective demonstrably minimising the anthropogenic threat of sound will be achieved. Consistency with the Rowley shoals, Mermaid Reef and Argo Rowley marine park management plans.
4. Legislation and Other Requirements	The evaluation of impacts and the controls implemented in this EP demonstrate the activity is consistent with the legislation and requirements

	listed below. See the evaluation of impacts and ALARP sections of this EP for demonstration of how these criteria have been met. • EPBC Policy statement 2.1 • Blue, Fin and Sei Whale Recovery Plan 2005-2010. • Conservation Advice Balaenoptera borealis sei whale 2015. • Conservation Management Plan for the Blue Whale (2015 – 2025) A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999. • Recovery Plan for Marine Turtles in Australia 2017. • Commonwealth management plans for the Argo-Rowley Terrace Marine Park (MP) (Australian) and Mermaid Reef MP (Australian) • State management plan for the Rowley Shoals MP (State) • OPGGS Act: residual risks reduced to ALARP • Safe Diving Distance from Seismic Surveying Operations. (DMAC 12 Rev. 2.1 2020)
5. Internal Context – Searcher	The systems, procedures and environmental outcomes demonstrated in this EP are consistent with Searcher's corporate environmental policy, culture, company standards and procedures.
6. External Context – Stakeholder objects and claims addressed	Additional controls have been evaluated and adopted for the following Stakeholder concerns: Stakeholder raised concern regarding fish spawning, as there is no aggregated fish spawning in OA this has been addressed Stakeholders concerns regarding impacts to fish behaviour and stock for key indicator species including the NWSTF resource have been addressed to ALARP (see section 6.4.9 and Table 8.1). Searcher have adopted additional control measures regarding the reduction of survey area including relevant buffer zones, timing, spatial and temporal design, stakeholder notification and payment of adjustment to commercial fishers for evidence-based loss of catch, displacement and Fishing gear loss or damage. Searcher will continue to consult regarding the NWSTF licence holders, including specifically stakeholder ID130's, concerns on displacement from fishing grounds. Stakeholders concerns regarding strict no recreational fishing from survey vessels have been addressed. Stakeholders raised concerns regarding possible simultaneous operations Searcher will plan to avoid overlapping seismic activity or this will be addressed with a simultaneous operations plan (SIMOPS)
Receptor Specific Criteria	***Comparison with the predicted level of impact***
Plankton Searcher considers it unacceptable for there to be long term or permanent impacts to plankton communities as a result of the activity.	Any impacts to plankton are predicted to occur within a few 10s of metres from the source and recovery to pre-impact levels is expected within a few days.
Benthic Communities Searcher considers it unacceptable for there to be a permanent change in benthic communities as a result of the activity.	Minor effects to benthic crustaceans, molluscs and other invertebrates. Impacts to molluscs are likely to be within natural rates of mortality. Impacts to crustacean statocysts are not anticipated to result in mortality or population level effects. Corals are not expected to receive any level of impact.
Marine Fauna Searcher considers it unacceptable to have a significant impact on an EPBC listed (marine fauna) species or other marine fauna species.	Mammals: Controls will significantly reduce risk of death or injury. Temporary reduction in hearing sensitivity and effects on behaviour are highly unlikely to inhibit population recovery. Reptiles: The survey area does not overlap with any biologically important areas for marine turtles or sea snakes. Controls will be implemented to significantly reduce the likelihood of injury and death due to seismic sound.

	Fish and Sharks: Impacts to fish and sharks is predicted to be limited to some temporary displacement and changes in behaviour during the survey.
Protected areas Searcher considers it unacceptable to have impacts on values of marine protected areas not inconsistent with the management principles and objectives of the marine park or other protected area.	The evaluation provided in Section 6.5.8 demonstrates the impacts to marine park values are not inconsistent with the management principles and objectives of the marine park.
Commercial fisheries Searcher considers limiting disturbance displacement of commercial fisheries to the caution zone around the seismic survey vessel to represent an acceptable level of disruption to commercial fishers. It is unacceptable to have long-term effects on stock, spawning or fishing activities due to the activity.	Impacts to commercial fish and invertebrates are predicted to be limited to temporary changes in behaviour, some temporary displacement, and damage to statocysts in crustaceans. No long-term effects on stock, spawning or fishing activities are predicted.
Tourism and recreation Searcher considers limiting displacement of tourism and recreation activities to the mutually agreed area during SIMOPS planning to be an acceptable level of disruption to tourism and recreation. No health impacts on divers or recreational activities from seismic sound are acceptable.	Sound levels will be below thresholds for impacts to divers at locations used for diving.
Acceptable level decision	
All general and receptor specific criteria have been met and the impacts and risks are determined to be of an acceptable level.	

6.5 ATMOSPHERIC EMISSIONS

Nature and Scale of Impacts and Risks
Fuel combustion during seismic acquisition will result in the atmospheric emission of Greenhouse gases (GHG) (such as CO_2, CH_4 and N_2O) and non- GHGs such as NO_X and SO_X. During the activity emissions will be generated from the combustion of approximately 50 m^3/day of hydrocarbons (MGO on the survey vessel and MGO/MDO on the support vessels) used to power vessel engines, generators and mobile or fixed equipment. There is also the possibility that an incinerator is intermittently in use on a vessel to burn wastes. Incineration of oily sludges is not expected to generate any significant atmospheric emissions, due to the infrequent nature of the activity and the small volumes of material being burnt during each disposal episode. Accidental releases and fugitive emissions of ozone depleting substances (ODSs) are not expected to occur during the activity. Refrigeration systems containing ODS typically do not require frequent maintenance and follow well established practices to prevent accidental release of ODS. The short-term nature of the survey activity reduces the potential for maintenance being required. Combustion emissions can lead to a reduction in local air quality. The only receptor determined at risk is marine avifauna. The contribution of GHG as a result of vessel hydrocarbon combustion is estimated at around 2,900 tons of CO_2 equivalent, which is a negligible contribution to Australia's emissions (i.e. <0.0005 % of the 558.3 million-ton CO_2 equivalent in 2018 (Climate Council 2019). The remainder of this risk assessment therefore focusses on impacts and risks related to changes to local air quality and the potential to impact marine avifauna. **Marine fauna** *Avifauna* Two avifauna BIA overlap the operational area – the white-tailed tropic bird breeding BIA and little tern resting BIA on Bedwell Islet (approximately 29 km from the operational area boundary). Foraging adults of other species are likely to occur in the area, including the red-tailed tropicbird which also breeds on Bedwell Islet. Shorebirds may cross the region during migration. Potential impact on avifauna would be the localised reduction in air quality for the duration of the survey (<70 days).
Good Industry Practice
Protection of the Sea (Prevention of Pollution from Ships) Act 1983, Part IIID – prevention of air pollution Division 2 -paragraph 26FEG(1)(b) a person commits an offence if the persons engage in conduct that results in fuel oil with sulphur content of more than the prescribed limit being used on board a ship a fuel, and the person is reckless or negligent as to causing that result. (EPS 5.4)
Marine Order 97 (Marine pollution prevention — air pollution) 2013 (Note – as applicable to vessel class and engine size): Division 2: Certificates: For subsection 130(3) of the Navigation Act (which enables the regulations to provide that specified kinds of vessels are required to have specified pollution certificates), a vessel must have the following certificates (EPS 5.1): (a) an Engine International Air Pollution Prevention (EIAPP) certificate for each marine diesel engine installed on the vessel; (b) an international air pollution prevention (IAPP) certificate;

(c) an International Energy Efficiency (IEE) certificate.

Division 4: Incineration on board vessels:

(1) A person must not incinerate any matter on board a vessel if incineration of the matter is prohibited (either absolutely or in a specified circumstance or a specified way) by regulation 16 of Annex VI. (EPS 5.3)

(2) A person must not incinerate any matter on board a vessel in an incinerator that does not comply with regulation 16 of Annex VI. (EPS 5.2)

(3) Subsections (1) and (2) do not apply to incineration of any matter in an incinerator for which AMSA has allowed exclusion from subparagraph 6.1 of regulation 16 of Annex VI.

Division 6: Energy efficiency- ship energy efficiency management plan (Note – as applicable to vessel class): (EPS 5.6)

For subsection 26FEW(3) of the Pollution Prevention Act, a SEEMP must contain the information required by *2016 Guidelines for the development of a ship energy efficiency management plan*, adopted by IMO resolution MEPC.282(70) and as amended from time to time.

Division 7: Matters prescribed for by the Pollution Prevention Act:

(1) For paragraph 26FEG(1)(b) of the Pollution Prevention Act, the prescribed limit is 0.50% m/m. (EPS 5.4)

2016 Guidelines for the development of a ship energy efficiency management plan (IMO 2016) (Note – as applicable to vessel size) including: (EPS 5.6)

- careful planning and execution of voyages
- speed optimisation
- optimised shaft power
- optimise ship handling
- waste heat recovery
- improved fleet management
- improved cargo handling
- energy management

Seismic and support vessel engines maintained as per manufacturer's specification. (EPS 5.5)

Environmental Impact Assessment

Potential Consequence	Rank	Likelihood Discussion	Rank	Residual Risk
Marine fauna				
The survey location is remote from sensitive receptors in an open-ocean environment where there will be rapid dispersion of atmospheric emissions, with two BIA overlapping the operational area and avifauna transiting and resting on the surface the operational area. The decrease in local air quality will be temporary (maximum 70 days of survey operation), localised and recoverable, and the contribution to global GHG levels is insignificant.	[A] Minor	The vessel will be in the operational area for up to 70 days and will burn fuel for operations, however with GIP in place the likelihood of atmospheric emissions having an effect on the environment is Unlikely.	[2] Unlikely	[3] Acceptable

Risk Type		Overall Residual Risk
Type A Risk	Risk is determined to be Type A as: • the activity and risk are well understood, with little uncertainty • good practice control measures are well defined • there has been no stakeholder feedback concerning the potential impact of atmospheric emissions. Given the application of 'Good Practice' control measures, the activity is relatively well understood, the predicted residual risk is well understood and there is no significant stakeholder interest the basis of ALARP has been made on a 'Type A' decision context.	Acceptable

Environmental Performance Outcomes (EPOs) relating to this aspect include:

EPO 15 No unplanned objects, emissions or discharges to sea or air.

The Control Measures are consistent with Good Industry Practice summarised above with Environmental Performance Standards (EPSs) and Measurement Criteria for the EPOs described in Section 9, Table 9-2.

ALARP Justification

Given the decision context is 'Type A', and:

- Searcher has a high degree of certainty of effectiveness of well-established control measures to ensure the predicted level of impact of the atmospheric emissions from the survey vessels is equal to or lower than the acceptable level;
- All good practice control measures have been adopted by Searcher to manage the potential impacts and risks associated with the atmospheric emissions from the survey vessels; and
- There has been no stakeholder feedback concerning the potential impact of atmospheric emissions from the survey vessels

Searcher consider that all potential environmental impacts and risks associated with atmospheric emissions due to the survey are managed to ALARP.

Demonstration of Acceptability	
Acceptable Level Criteria (General)	***Statement of how the acceptance criteria has been met***
1. The environmental impact or risk is deemed to be ALARP.	The residual risks associated with atmospheric emissions due to the survey is ALARP, as detailed above.
2. Principles of ESD not compromised and relevant requirements for environmental approvals (EPBC Act Part 3, Division 1) met.	There is no threat of serious or irreversible environmental damage to any matters of national environmental significance associated with atmospheric emissions. There is no significant threat to biodiversity and ecological integrity associated with atmospheric emissions. There is no serious threat to the quality of the environment available to future generation associated with atmospheric emissions to the environment.
3. The management of the activity is consistent with a plan of management for a Marine Park and/or a recovery plan for a threatened species.	Atmospheric emissions due to routine survey operations does not pose any risk to threatened species or protected areas, including those covered by the below recovery plans and guidelines: • Marine Bioregional Plan for the North West Marine Region (DSEWPaC 2012a), • Recovery Plan for Marine Turtles in Australia, • Blue, Fin and Sei Whale Recovery Plan 2005-2010, • Conservation Advice *Balaenoptera borealis* sei whale 2015, • Conservation Management Plan for the Blue Whale (2015) – A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999, • Conservation Advice *Balaenoptera physalus* fin whale 2015, • Humpback Whale recovery Plan 2005-2010 • Conservation Advice *Megaptera novaeangliae* humpback whale 2015.
4. Legislation and Other Requirements.	The legislative and other requirements will be met via the effective implementation of control measures: • Protection of the Sea (Prevention of Pollution from Ships) Act 1983, Part IIID – prevention of air pollution • Marine Order 97 (Marine pollution prevention — air pollution) 2013
5. Internal Context – Searcher.	There are no internal Searcher requirements.
6. External Context – Stakeholder objects and claims addressed.	No stakeholder objections or claims were raised relating to atmospheric emissions.
Acceptable level decision	
All general criteria have been met and the impacts and risks are determined to be of an acceptable level.	

6.6 DISCHARGE OF SEWAGE, GREYWATER AND PUTRESCIBLE WASTE

Nature and Scale of Impacts and Risks
The use of ablution, laundry and galley facilities by crew will result in the generation of sewage, greywater and putrescible waste, which are commonly discharged to the marine environment at or close to the sea surface. The maximum number of personnel on board the three vessels at any time totals 134 POB. Discharge of sewage and grey water from each vessel can be estimated at 5 m^3 per person per day, and putrescible waste at a maximum of 2 kg per person per day (NERA 2017). The composition of sewage, greywater and putrescible waste may include: • physical particulates such as solids composed of floating, settleable, colloidal and dissolved matter, • chemicals including nutrients (e.g. ammonia, nitrite) organics (e.g. oil and greases, endocrine disrupting compounds) and inorganics (e.g. hydrogen sulphide, surfactants etc) • biological pathogens such as bacteria, viruses, parasites etc • food wastes The discharge of sewage, greywater and putrescible waste may cause a localised and temporary increase in nutrient concentrations (eutrophication) resulting in biological oxygen demand and reduction in water quality (turbidity) in the location of the discharge over the short term (70-day MSS) from the three vessels. Woodside (2010) monitored sewage discharges and found that a 10 m^3 discharge over 24 hours from a stationary source in shallow water will reduce to approximately 1% of its original concentration within 50 m of the discharge location. Additional monitoring at 100 and 200 m downstream at five water depths demonstrated that the discharge is rapidly diluted, or nutrients are metabolised, with no elevation in water quality parameters recorded above background levels. NERA examined modelling of large-scale sewage treatment plants and compared predicted dilutions with a reference case for a 400 POB fixed facility and concluded 150 m^3/day discharge would not exceed a 500 m mixing zone boundary (NERA 2017). Given the mobile

nature of the vessels and the mixing provided by vessel motion, this impact scale could be expected to be reduced for the Possum 3D MSS.

Given the location of the survey (approximately 28 km from the nearest land at Cunningham Islet, Rowley Shoals, and 210 km from Broome on the mainland), there are no socio-economic receptors that could be impacted by the discharge of sewage, greywater and putrescible wastes and hence they will not be discussed further. Open ocean waters result in rapid mixing of surface and near surface water, so nutrients will not accumulate in the water column or lead to eutrophication. As such, the receptors with the greatest potential to be impacted by the sewage, greywater and putrescible waste are those in the immediate vicinity of the discharge. E.g. primary productivity and plankton communities. The operational area overlaps the Multiple Use Zone of the Argo-Rowley Terrace Australian MP, however water quality is not identified as a value in the management plan for that park.

Plankton communities
Planktonic abundances are likely to be low and are characterised by high species diversity but relatively low endemicity within the operational area. In favourable conditions (e.g. high nutrient levels) plankton communities can experience a rapid increase. Upon return to background nutrient levels the community will then collapse or return to previous conditions within tens to hundreds of meters from the discharge location (Parnell 2003).

Good Industry Practice

Waste Management Procedures are in place and implemented during the survey in accordance with the following legislative requirements:
Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (The Pollution Prevention Act) Division 2:
Discharge of sewage is permitted when:

- the sewage has been comminuted and disinfected using a system approved in accordance with the regulations, or orders made pursuant to the regulations, giving effect to paragraph 1.2 of Regulation 9 of Annex IV to the Convention—the discharge is made when the ship is at a distance of not less than 3 nautical miles from the nearest land; or (EPS 6.1)
- the discharge is made when the ship is at a distance of not less than 12 nautical miles from the nearest land (EPS 6.1)
- where the sewage has been stored in holding tanks, or originates from spaces containing living animals—the sewage is not discharged instantaneously but is discharged at a prescribed rate when the ship is proceeding en route at a speed of not less than 4 knots (EPS 6.2)

Marine Order 96 (Marine pollution prevention — sewage) 2018:
Division 2 (Systems, equipment etc required by Annex IV): (EPS 6.1/EPS 6.3)

- A vessel to which Annex IV applies and section 4.2 of the 2012 Guidelines does not apply must be equipped with:
  (a) a sewage treatment plant approved by an issuing body, that complies with:
  (i) regulation 9 of Annex IV; and
  (ii) for a system installed on a vessel after 31 December 2015 — the 2012 Guidelines other than section 4.2; and
  (iii) for a system installed on a vessel after 31 December 2009 and before 1 January 2016 — the Revised guidelines on implementation of effluent standards and performance tests for sewage treatment plants, as adopted by IMO Resolution MEPC.159(55) on 13 October 2006; and
  (iv) for a system installed on a vessel before 1 January 2010 — the International effluent standards for sewage treatment plants and the Guidelines for performance tests for sewage treatment plants with respect to effluent standards, each as adopted by IMO Resolution MEPC.2(VI) on 3 December 1976; or
  (b) a sewage comminuting and disinfecting system approved by an issuing body, that complies with Regulation 9 of Annex IV; or
  (c) a holding tank approved by an issuing body, that complies with Regulation 9 of Annex IV.

Division 3 (Certificates):

- a vessel to which Annex IV applies must have an ISPP certificate (EPS 6.1)

Division 6 (Matters prescribed by the Pollution Prevention Act):

- For paragraphs 26BC(4)(b), 26BCC(6)(d) and 26D(6)(c) of the Pollution Prevention Act, the discharge rate is:
  (a) over any period up to 24 hours — not more than Drmax m^3 per hour; and
  (b) in any 1 hour during that period — not more than 1.2 × Drmax m^3.
  Drmax = 0.00926 × B × D × V
  where:
  B = breadth in metres.
  D = draft in metres.
  V = the ship's average speed in knots over the period.

Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (The Pollution Prevention Act) Part IIC, subsection 26FA(6):

- If a prescribed operation or prescribed occurrence is carried out or occurs in, or in relation to, a ship, the master of the ship must make, without delay, appropriate entries in accordance with subsection (8) in the ship's garbage record book, or cause appropriate entries in accordance with that subsection to be made, as soon as is practicable in the circumstances, in that book. (EPS 6.4)

Discharge of garbage is permitted when:
(b) the discharge occurs when the ship is proceeding en route and is as far as practicable from the nearest land

(c) the garbage is food wastes
(d) in the case of food wastes that have been passed through a comminuter or grinder so that the wastes are capable of passing through a screen with no opening greater than 25 millimetres
(i) if the discharge occurs when the ship is not alongside, or within 500 metres of, a fixed or floating platform—the discharge occurs when the ship is at a distance of not less than 3 nautical miles from the nearest land; or
(ii) if the discharge occurs when the ship is alongside, or within 500 metres of, a fixed or floating platform—the discharge occurs when the ship is at a distance of not less than 12 nautical miles from the nearest land;
(e) in the case of all other food wastes:
(i) the discharge occurs when the ship is at a distance of not less than 12 nautical miles from the nearest land; and
(ii) the discharge occurs when the ship is not alongside, or within 500 metres of, a fixed or floating platform.

Marine Order 95 (Marine pollution prevention — garbage) 2018, Division 3:
For subsection 26FA(6) of the Pollution Prevention Act, each of the following operations or occurrences is prescribed:
(a) discharge of garbage to a reception facility ashore or to another ship;
(c) discharge of garbage into the sea in accordance with:
(i) regulation 4, 5 or 6 of Annex V; or
(ii) Chapter 5 of Part II-A of the Polar Code;
(d) accidental or other exceptional discharge or loss of garbage into the sea, including the matters mentioned in regulation 7 of Annex V.

Sewage treatment plant is in good working order. (EPS 6.5)

Vessels of 12 m length or over display placards notifying passengers and crew of the disposal requirements, including for food waste. (EPS 6.6)

Environmental Impact Assessment

Potential Consequence	Rank	Likelihood Discussion	Rank	Residual Risk
Plankton communities				
Given the vessels are generally moving faster than 4 knots during acquisition, the vessel movement and mixing motion of the thrusters are expected to assist in localised dilution and discharges are expected to be rapidly mixed into the receiving environment and diluted. The predicted consequence to the primary productivity and plankton communities is localised population increases that is resolved within days.	[A] Minor	The vessel will be in the operational area for up to 70 days and will discharge wastes during operations, however with GIP in place the likelihood of discharges having an effect on the primary productivity and plankton communities is Possible.	[3] Possible	[6] Acceptable

Risk Type		**Overall Residual Risk**
Type A Risk	Risk is determined to be Type A as: • the activity and risk are well understood, with little uncertainty • good practice control measures are well defined • there has been no stakeholder feedback concerning the potential impact of discharge of sewage, greywater and putrescible waste Given the application of 'Good Practice' control measures, the activity is relatively well understood, the predicted residual risk is well understood and there is no significant stakeholder interest the basis of ALARP has been made on a 'Type A' decision context.	Acceptable

Environmental Performance Outcomes (EPOs) relating to this aspect include:
EPO 15 No unplanned objects, emissions or discharges to sea or air.
The Control Measures are consistent with Good Industry Practice described above with Environmental Performance Standards (EPSs) and Measurement Criteria for the EPOs described in Section 9, Table 9-1.

ALARP Justification

Given the decision context is 'Type A', and:

- Searcher has a high degree of certainty of effectiveness of well-established control measures to ensure the predicted level of impact of the discharge of sewage, greywater and food waste due to the survey is equal to or lower than the acceptable level;
- All good practice control measures have been adopted by Searcher to manage the potential impacts and risks associated with the discharge of sewage, greywater and food waste due to the survey to ALARP and
- There has been no stakeholder feedback concerning the discharge of sewage, greywater and food waste due to the survey

Searcher consider that all potential environmental impacts and risks associated with the discharge of sewage, greywater and food waste due to the survey are managed to ALARP.

Demonstration of Acceptability	
Acceptable Level Criteria (General)	***Statement of how the acceptance criteria has been met***
1. The environmental impact or risk is deemed to be ALARP.	The residual risks associated with the discharge of sewage, greywater and food waste due to the survey is ALARP as detailed above.
2. Principles of ESD not compromised and relevant requirements for environmental approvals (EPBC Act Part 3, Division 1) met.	There is no threat of serious or irreversible environmental damage to any matters of national environmental significance associated with the discharge of sewage, greywater and food waste due to the survey. There is no significant threat to biodiversity and ecological integrity associated with the discharge of sewage, greywater and food waste due to the survey. There is no serious threat to the quality of the environment available to future generation associated with the discharge of sewage, greywater and food waste due to the survey to the environment.
3. The management of the activity is consistent with a plan of management for a Marine Park and/or a recovery plan for a threatened species.	The discharge of sewage, greywater and food waste does not pose any impact to marine parks so no management plans are applied.
4. Legislation and Other Requirements.	The legislative and other requirements will be met via the effective implementation of control measures: • Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (The Pollution Prevention Act) Division 2, • Marine Order 96 (Marine pollution prevention — sewage) 2018, • Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (The Pollution Prevention Act) Part IIC, subsection 26FA(6), • Marine Order 95 (Marine pollution prevention — garbage) 2018, Division 3.
5. Internal Context – Searcher.	There are no internal Searcher requirements.
6. External Context – Stakeholder objects and claims addressed.	No stakeholder objections or claims were raised relating to the discharge of sewage, greywater and food waste due to the survey.
Acceptable level decision	
All general criteria have been met and the impacts and risks are determined to be of an acceptable level.	

6.7 DISCHARGE OF DECK DRAINAGE AND BILGE WATER

Nature and Scale of Impacts and Risks

The normal operations of the survey vessels will cause the generation of deck drainage and bilge water, which are commonly discharged to the marine environment at or close to the sea surface. Bilge tanks contain wastewater and small volumes of oils from machinery spaces or minor spills, detergents, solvents and other chemicals, and deck drainage originates from variable water discharges of rainfall, spray and green water, and deck activities such as cleaning/wash-down which could contain residues from spills or leaks of chemicals to deck. The composition of deck drainage and bilge water may include:

- water
- oil
- detergents
- solvents
- chemicals
- particles.

Bilge water is typically generated at 0.01–13 m^3 per day (EMSA 2016). Bilge water is routinely treated using an oily water separator. If not treated prior to discharge, there would be potential for a negligible reduction in water quality in the location of the discharge over the short term (70 day MSS) from the three vessels.

Given the location of the survey, there are no socio-economic receptors that could be impacts by the discharge of deck drainage and bilge water and hence they will not be discussed further. Open ocean waters result in rapid mixing of surface and near surface water, so nutrients will not accumulate in the water column. As such, the sensitive receptors with the greatest potential to be impacted by deck drainage and bilge water are those in the immediate vicinity of the discharge. The operational area overlaps the Multiple Use Zone of the Argo-Rowley Terrace Australian MP, however water quality is not identified as a value in the management plan for that park.

Plankton communities

Planktonic abundances are likely to be low and are characterised by high species diversity but relatively low endemicity within the operational area. In less than favourable conditions (e.g. reduction in water quality) plankton communities can experience a decrease. Upon return to background water quality levels the community will then recover due to rapid local recruitment.

Good Industry Practice

Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (The Pollution Prevention Act):

Discharge of oil or oily mixtures is permitted when: (EPS 7.1) • the oily mixture is processed using oil filtering equipment meeting the requirements under regulations made for the purposes of section 130 of the Navigation Act 2012 • the oil content of the effluent without dilution does not exceed 15 parts in 1,000,000 parts Marine Order 91 (Marine pollution prevention — oil) 2014, specifically: Division 3: Certificates issued under the Navigation Act (EPS 7.1) For subsection 130(3) of the Navigation Act (which enables the regulations to provide that specified kinds of vessels are required to have specified pollution certificates), a vessel mentioned in regulation 7.1 of Annex I must have an IOPP certificate. Part 30: Oil record book (a) a ship must carry an oil record book (EPS 7.4)
Marine Order 94 (Marine pollution prevention — packaged harmful substances) 2014 Division 2 If a vessel has on board harmful substances in packaged form, the owner of the vessel must comply with regulations 2 to 5 of Annex III (of MARPOL) (EPS 7.7) Division 3 (EPS 7.5) For paragraph 26AB(6)(a) of the Pollution Prevention Act, the substance may be washed overboard only if the master: (a) has considered the physical, chemical and biological properties of the substance; and (b) reasonably considers that washing overboard is the most appropriate manner of disposal; and (c) has authorised the washing overboard (Note Annex III of MARPOL regulates the safe sea transportation of harmful substances in packaged form, including the safe stowage of harmful substances.) (EPS 7.7)
Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (The Pollution Prevention Act): Discharge of garbage is permitted when: (EPS 7.6) • the garbage is cleaning agents or additives contained in deck wash water or other external surfaces wash water • the cleaning agents or additives are not prescribed cleaning agents or additives • the garbage is cleaning agents or additives contained in cargo hold wash water and the cleaning agents or additives are not prescribed cleaning agents or additive Marine Order 95 (Marine pollution prevention — garbage) 2018 (EPS 7.7) • prescribed cleaning agents or additives are identified as a harmful substance according to the criteria in the Appendix to Annex III (of MARPOL); or contains a component that is carcinogenic, mutagenic or reprotoxic
Oily water separator is in good working order. (EPS 7.2)
Oily water meter is operational and calibrated.(EPS 7.3)
Deck spills are cleaned up in accordance with the vessel SOPEP. (EPS 7.8)
Environmental Impact Assessment

Potential Consequence	**Rank**	**Likelihood Discussion**	**Rank**	**Residual Risk**
Plankton communities				
Given the vessels are generally moving faster than 4 knots during acquisition, the vessel movement and mixing motion of the thrusters are expected to assist in localised dilution. Discharges are expected to be rapidly mixed into the receiving environment and diluted. The predicted consequence to the primary productivity and plankton communities is localised population increases that is resolved within days.	[A] Minor	The vessel will be in the operational area for up to 70 days and will discharge wastes during operations, however with GIP in place the likelihood of discharges having an effect on the primary productivity and plankton communities is Possible.	[3] Possible	[6] Acceptable

Risk Type		**Overall Residual Risk**
Type A Risk	Risk is determined to be Type A as: • the activity and risk are well understood, with little uncertainty • good practice control measures are well defined • there has been no stakeholder feedback concerning the potential impact of the discharge of deck drainage and bilge water Given the application of 'Good Practice' control measures, the activity is relatively well understood, the predicted residual risk is well understood and there is no significant stakeholder interest the basis of ALARP has been made on a 'Type A' decision context.	Acceptable

Environmental Performance Outcomes (EPOs) relating to this aspect include:

EPO 15 No unplanned objects, emissions or discharges to sea or air.

The Control Measures are in accordance with Good Industry Practice outlined above with Environmental Performance Standards (EPSs) and Measurement Criteria for this EPO described in Section 9, Table 9-2.

ALARP Justification

Given the decision context is 'Type A', and:

- Searcher has a high degree of certainty of effectiveness of well-established control measures to ensure the predicted level of impact of the discharge of deck drainage and bilge water due to the survey is equal to or lower than the acceptable level;
- All good practice control measures have been adopted by Searcher to manage the potential impacts and risks associated with the discharge of deck drainage and bilge water; and
- There has been no stakeholder feedback concerning the discharge of deck drainage and bilge water due to the survey

Searcher consider that all potential environmental impacts and risks associated with the discharge of deck drainage and bilge water due to the survey are managed to ALARP.

Demonstration of Acceptability

Acceptable Level Criteria (General)	***Statement of how the acceptance criteria has been met***
1. The environmental impact or risk is deemed to be ALARP.	The residual risks associated with the discharge of deck drainage and bilge water due to the survey are ALARP as detailed above.
2. Principles of ESD not compromised and relevant requirements for environmental approvals (EPBC Act Part 3, Division 1) met.	There is no threat of serious or irreversible environmental damage to any matters of national environmental significance associated with the discharge of deck drainage and bilge water due to the survey. There is no significant threat to biodiversity and ecological integrity associated with the discharge of deck drainage and bilge water due to the survey. There is no serious threat to the quality of the environment available to future generation associated with the discharge of deck drainage and bilge water due to the survey to the environment.
3. The management of the activity is consistent with a plan of management for a Marine Park and/or a recovery plan for a threatened species.	The discharge of deck drainage and bilge water does not pose any impact to marine parks so no management plans are applied.
4. Legislation and Other Requirements.	The legislative and other requirements will be met via the effective implementation of control measures: • Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (The Pollution Prevention Act) • Marine Order 91 (Marine pollution prevention — oil) 2014, Part 30: Oil record book • Marine Order 94 (Marine pollution prevention — packaged harmful substances) 2014 Division 3 • Marine Order 95 (Marine pollution prevention — garbage) 2018.
5. Internal Context – Searcher.	There are no internal Searcher requirements.
6. External Context – Stakeholder objects and claims addressed.	No stakeholder objections or claims were raised relating to the discharge of deck drainage and bilge water due to the survey.

Acceptable level decision

All general criteria have been met and the impacts and risks are determined to be of an acceptable level.

6.8 DISCHARGE OF COOLING WATER AND DESALINATION BRINE

Nature and Scale of Impacts and Risks

The normal operations of the survey and support vessels will cause the generation of cooling water and desalination brine, which are commonly discharged to the marine environment at or close to the sea surface.

Sea water is often used as a heat exchange medium for cooling machinery engines and other equipment. Sea water is drawn up from the ocean, de-oxygenated, sterilised, circulated as coolant then discharged to the ocean 20-30°C warmer than the ambient water temperature. After discharge, the heated water plume will be rapidly dispersed and diluted through turbulent diffusion, convection in water, flow of fluids of variable density, evaporation, radiation and convection in the air (IPPC 2001). Modelling for the Stybarrow Development for a discharge of 100,000 m^3/day of cooling water at 25°C above ambient sea water temperature showed the likelihood of surface water temperature exceeding ambient temperature by >2 °C was reduced to about 1% within 60 m–85 m of the discharge point (BHP Billiton 2004). Given the vessels will discharge much smaller volumes and will be continually on the move, the discharge stream is expected to reach background temperatures in a shorter distance from the discharge.

Brine wastewater may be produced by vessels' desalination processes required to supply freshwater for drinking, showers, cooking etc. The brine has an elevated salinity approximately 10–20% more than ambient sea water. Changes in salinity can affect the ecophysiology of marine organisms. Early larval stages tend to be more susceptible to salinity changes (Neuparth, Costa & Costa 2002). Some marine species are able to tolerate short-term salinity changes up to 30% (Walker & McComb 1990). Populations are expected to rapidly recover from any impacts once the activity ceases (or vessel moves on) as they are naturally characterised by high population turnover rates and rapid population increases (Villarino, Watson & Chust 2018). Fish larvae assemblages are expected to be widespread and any localised decrease in abundance likely to fall within natural levels of variation in population sizes.

Given the location of the survey, there are no socio-economic receptors that could be impacted by the discharge of cooling water and desalination brine and hence they will not be discussed further. Open ocean waters result in rapid mixing of surface and near surface water, so increased salinity and temperatures are expected to dissipate quickly. As such, the receptors with the greatest potential to be impacted by cooling water and desalination brine are those in the immediate vicinity of the discharge point (e.g. primary productivity and plankton communities). The operational area overlaps the Multiple Use Zone of the Argo-Rowley Terrace Australian MP, however water quality is not identified as a value in the management plan for that park.

Plankton communities

Planktonic abundances are likely to be low and are characterised by high species diversity but relatively low endemicity within the operational area. In less than favourable conditions (e.g. reduction in water quality) plankton communities can experience a decrease. Upon return to background water quality levels the community will then recover due to rapid local recruitment.

Good Industry Practice

Desalination plant and cooling water systems should be maintained in accordance with manufacturer specifications or preventative maintenance system so as to remain in good working order. (EPS 8.1)

Environmental Impact Assessment

Potential Consequence	Rank	Likelihood Discussion	Rank	Residual Risk
Plankton communities				
Given the vessels are generally moving faster than 4 knots during acquisition, the vessel movement and mixing motion of the thrusters are expected to assist in localised dilution and discharges are expected to be rapidly mixed into the receiving environment and diluted. The predicted consequence to the primary productivity and plankton communities is localised population increases that is resolved in less than days.	[A] Minor	The vessel will be in the operational area for up to 70 days and will discharge wastes during operations, however with GIP in place the likelihood of discharges having an effect on at a minor level the primary productivity and plankton communities is Possible.	[3] Possible	[6] Acceptable

Risk Type		Overall Residual Risk
Type A Risk	Risk is determined to be Type A as: • the activity and risk are well understood, with little uncertainty • there has been no stakeholder feedback concerning the potential impact of the discharge of cooling water and desalination brine Given the activity is relatively well understood, the predicted residual risk is well understood and there is no significant stakeholder interest the basis of ALARP has been made on a 'Type A' decision context.	Acceptable

Environmental Performance Outcomes (EPOs) relating to this aspect include:

EPO 15 No unplanned objects, emissions or discharges to sea or air.

Control Measures are consistent with Good Industry Practice with Environmental Performance Standards (EPSs) and Measurement Criteria for this EPO described in Section 9, Table 9-2.

ALARP Justification

Given the decision context is 'Type A', and:

- There has been no stakeholder feedback concerning the discharge of cooling water and desalination brine due to the survey

Searcher consider that all potential environmental impacts and risks associated with the discharge of cooling water and desalination brine due to the survey are managed to ALARP.

Demonstration of Acceptability

Acceptable Level Criteria (General)	*Statement of how the acceptance criteria has been met*
1. The environmental impact or risk is deemed to be ALARP,	The residual risks associated with the discharge of cooling water and desalination brine due to the survey is as demonstrated above.
2. Principles of ESD not compromised and relevant requirements for environmental approvals (EPBC Act Part 3, Division 1) met	There is no threat of serious or irreversible environmental damage to any matters of national environmental significance associated with the discharge of cooling water and desalination brine due to the survey.

	There is no significant threat to biodiversity and ecological integrity associated with the discharge of cooling water and desalination brine due to the survey. There is no serious threat to the quality of the environment available to future generation associated with the discharge of cooling water and desalination brine due to the survey to the environment.
3. The management of the activity is consistent with a plan of management for a Marine Park and/or a recovery plan for a threatened species	The discharge of cooling water and desalination brine does not pose any impact to marine parks so no management plans are applied.
4. Legislation and Other Requirements	There are no legislative requirements to be met regarding the discharge of cooling water or desalination brine for the duration of the survey.
5. Internal Context – Searcher	There are no internal Searcher requirements.
6. External Context – Stakeholder objects and claims addressed	No stakeholder objections or claims were raised relating to the discharge of cooling water and desalination brine due to the survey.
Acceptable level decision	
All general criteria have been met and the impacts and risks are determined to be of an acceptable level.	

6.9 DROPPED OBJECTS AND SOLID WASTE

Nature and Scale of Impacts and Risks

This section considers the potential for the loss of survey equipment including overboard (i.e. seismic streamers), solid non-biodegradable waste, and other vessel items.

In the unlikely event of loss of a seismic streamer, the potential environmental effects will be limited to physical impacts on benthic communities arising from the streamer and associated equipment sinking to the seabed. Seismic streamers are fitted with pressure-activated, self-inflating buoys that are designed to bring the equipment to the surface if lost accidentally during a survey. As the equipment sinks and passes a certain water depth, buoys inflate to surface the equipment where it can be retrieved by the seismic and/or support vessels. Recovery of streamers is standard industry practice and undertaken where safe and practicable to do so, which removes the ongoing risk of faunal entanglement.

Other solid non-biodegradable waste which may be blown overboard or lost overboard in rough ocean conditions include paper and cardboard, wooden pallets, scrap steel, metal, aluminium, glass, plastics and ropes. Hazardous wastes include hydrocarbon contaminated materials (e.g., oily rags, oil filters, hydraulic oils), batteries, empty paint cans, cleaning products, aerosol cans, and fluorescent tubes.

With respect to windblown material, while volumes may be small, materials such as plastic, rags and packaging may impact marine fauna through ingestion, entanglement etc, resulting in mortality. Floating or suspended waste such as plastics etc. could be widely dispersed by local currents/winds, with potential to result in (individual) fauna mortality or injury through ingestion or entanglement.

Solid hazardous waste dropped overboard (e.g. paint cans containing paint residue, batteries) would be expected to settle on the seabed. Over time, hazardous materials may leach into the seabed and surrounds, with the substrate becoming toxic and unsuitable for colonisation by benthic biota. Accidental dropped objects and solid wastes would be considered to occur as isolated incidents, as such no cumulative impacts have been assessed.

Benthic communities

Much of the NWMR's outer mid-shelf is covered by relatively featureless, sandy-mud seabed with sparse sessile organisms that is likely to be the dominant substrate within the operational area. Dropped objects that fall to the ocean floor may result in localised physical disturbance of the substrate, benthic habitats and communities. Over time, hazardous materials may leach into the seabed and surrounds, with the substrate becoming toxic and unsuitable for colonisation by benthic biota.

Marine Fauna

The *Marine Bioregional Plan for the North West Marine Region* (DSEWPaC 2012a) describes the threats from marine debris to marine life, especially turtles and cetaceans. The *Recovery Plan for Marine Turtles in Australia 2017-2027* (DoEE 2017) and *Conservation Plan for Blue Whales* (DoE 2015a) require the prevention, removal and mitigation of debris under the EPBC Act *Threat Abatement Plan (*TAP*) for Marine Debris on Vertebrate Marine Life*. For the purposes of the TAP, harmful marine debris refers to all plastics and other types of debris from domestic or international sources that may cause harm to vertebrate marine wildlife. This includes land-sourced waste and garbage (such as bags, bottles, ropes, fibreglass, piping, insulation, paints and adhesives), abandoned fishing gear from recreational and commercial fisheries (e.g. strapping bands, synthetic ropes, derelict fishing nets, floats, hooks, fishing line and wire trace), and ship-sourced, solid, nonbiodegradable floating materials disposed of at sea (e.g. fibreglass, insulation). It does not include debris that is not harmful to marine wildlife such as floating wooden objects and metal objects which do not cause entanglement and are unable to be ingested. Plastics are notable particularly for their durability and cigarette butts for their ability to leach toxic compounds.

Cetaceans

<table>
<tr><td colspan="6">The timing and location of surveys within the operational area may coincide with sensitive periods, such as the pygmy blue whale and whale shark migrations. The deepest waters of the operational area are approximately 566 m and given that the pygmy blue whale migratory pathway is centred on the 500 m contour, individuals are likely to be encountered within the operational area. The occurrence of humpback whales in the operational area is expected to be temporary and low. Sei and fin whales may be present in the deep, offshore waters of the operational area. However, it is unlikely that they will be present in significant numbers. Cetaceans are at risk from entanglement in dropped objects. Entanglement would not occur in dropped and unrecovered streamers (due to the unlikely event of failed recovery systems) as the streamers would sink to the sea floor, however entanglement in dropped ropes in the water column could cause injury or death to individuals as they may be unable to forage or breathe.

Marine Reptiles
Marine turtles are at risk from entanglement and ingestion of, dropped objects. Entanglement could occur with dropped and unrecovered tail buoys in addition to entanglement in dropped objects (ropes), which could cause injury or death to individuals as they may be unable to forage or breathe. Marine turtles could also ingest harmful plastic dropped objects (e.g. bags), which can lead to intestinal blockages and starvation. As the operational area does not overlap any recognised turtle BIA or habitat critical, it is highly unlikely that significant numbers of marine turtles will occur, and their occurrence is expected to be rare and infrequent.

Avifauna
Avifauna is at risk from entanglement in, and ingestion of, dropped objects. Entanglement could occur with dropped objects (e.g. ropes, bags), which could cause injury or death to individuals as they may be unable to forage or breathe. Avifauna could also ingest harmful plastic dropped objects (e.g. bags, plastic pieces), which can lead to intestinal blockages and starvation. Several species of avifauna may be encountered, including both the red- and white-tailed tropicbird, since breeding pairs are known to occur at the Rowley Shoals.</td></tr>
<tr><td colspan="6">Good Industry Practice</td></tr>
<tr><td colspan="6">Use of solid streamers, rather than fluid-filled streamers. (EPS 9.1)</td></tr>
<tr><td colspan="6">Redundant attachment points of the streamer to the seismic vessel. (EPS 9.2)</td></tr>
<tr><td colspan="6">Secure storage of equipment and waste on-board, e.g. all deck bins have lids which can be closed or nets fitted. (EPS 9.3)</td></tr>
<tr><td colspan="6">Automatic Streamer Recovery Devices (SRD) attached to streamers will be set to the shallowest depth feasible for the operational requirements of the streamers. (EPS 9.4)</td></tr>
<tr><td colspan="6">Environmental Impact Assessment</td></tr>
<tr><td>Potential Consequence</td><td>Rank</td><td>Likelihood Discussion</td><td>Rank</td><td colspan="2">Residual Risk</td></tr>
<tr><td colspan="4">Marine Fauna</td><td colspan="2" rowspan="2">[4] Acceptable</td></tr>
<tr><td>The worst-case impact from a single event of windblown material on marine fauna has been assessed as injury or death to a single individual due to the ingestion of windblown plastic (marine reptiles and avifauna), or entanglement in unrecovered lost floating streamers or ropes (cetaceans) there are no predicted population level effects.</td><td>[C] Serious</td><td>The likelihood of windblown waste blowing overboard is Unlikely, however the likelihood of marine reptile ingesting the plastic blown overboard from a vessel is Rare. Recovery of dropped objects is standard industry practice and undertaken where safe and practicable to do so, which removes the ongoing risk of faunal entanglement.</td><td>[1] Rare</td></tr>
<tr><td colspan="4">Benthic communities</td><td colspan="2" rowspan="2">[2] Acceptable</td></tr>
<tr><td>The worst-case impact from solid waste dropped overboard to benthic communities would be highly localised physical disturbance or hazardous substances leaching into benthic substrates that takes months to recover.</td><td>[B] Moderate</td><td>The survey will not operate in water depth <100 m. In the absence of shallow waters (<30 m depth) or emergent features within the operational area, the risk of significant impacts resulting from equipment dragging or loss is considered to be low.</td><td>[1] Rare</td></tr>
<tr><td colspan="4">Risk Type</td><td colspan="2">Overall Residual Risk</td></tr>
<tr><td>Type A Risk</td><td colspan="3">Risk is determined to be Type A as:
the activity and risk are well understood, with little uncertainty
good practice control measures are well defined
there has been no stakeholder feedback concerning the potential impact of dropped objects and solid waste
Searcher considers that all potential environmental impacts and risks associated with dropped objects and solid waste due to the survey are managed to ALARP.</td><td colspan="2">Acceptable</td></tr>
<tr><td colspan="6">Environmental Performance Outcomes (EPOs) relating to this aspect include:
EPO 15 No unplanned objects, emissions or discharges to sea or air.
Control Measures are consistent with Good Industry Practice with Environmental Performance Standards (EPSs) and Measurement Criteria for this EPO described in Section 9, Table 9-2.</td></tr>
<tr><td colspan="6">ALARP Justification</td></tr>
<tr><td colspan="6">Given the decision context is ‘Type A’, and:</td></tr>
</table>

• Searcher has a high degree of certainty of effectiveness of well-established control measures to ensure the predicted level of impact of dropped objects and solid waste due to the survey is equal to or lower than the acceptable level; • All good practice control measures have been adopted by Searcher to manage the potential impacts and risks associated with dropped objects and solid waste; and • There has been no stakeholder feedback concerning dropped objects and solid waste due to the survey Searcher consider that all potential environmental impacts and risks associated with dropped objects and solid waste due to the survey are managed to ALARP.	
Demonstration of Acceptability	
Acceptable Level Criteria (General)	***Statement of how the acceptance criteria has been met***
1. The environmental impact or risk is deemed to be ALARP.	The residual risks associated with the risk of dropped objects or solid waste from the survey are ALARP as detailed above.
2. Principles of ESD not compromised and relevant requirements for environmental approvals (EPBC Act Part 3, Division 1) met.	There is no threat of serious or irreversible environmental damage to any matters of national environmental significance associated with dropped objects and solid waste due to the survey. There is no significant threat to biodiversity and ecological integrity associated with dropped objects and solid waste due to the survey. There is no serious threat to the quality of the environment available to future generation associated with dropped objects and solid waste due to the survey to the environment.
3. The management of the activity is consistent with a plan of management for a Marine Park and/or a recovery plan for a threatened species.	Ingestion of dropped objects (i.e. plastics) is considered in the below recovery and management plans: • Marine Bioregional Plan for the North West Marine Region (DSEWPaC 2012a), • Recovery Plan for Marine Turtles in Australia 2017-2027 (DoEE 2017) • Conservation Plan for Blue Whales (DoE 2015a). Effective implementation of the control measures will ensure management of the activity in line with the above recovery and management plans.
4. Legislation and Other Requirements.	The legislative and other requirements will be met via the effective implementation of control measures: • Protection of the Sea (Prevention of Pollution from Ships) Act 1983 Part IIC, subsection 26FA(6) • Marine Order 95 (Marine pollution prevention — garbage) 2018, Division 3.
5. Internal Context – Searcher.	Consistent with Searcher's Environmental Policy.
6. External Context – Stakeholder objects and claims addressed.	No stakeholder objections or claims were raised relating to dropped objects and solid waste due to the survey.
Acceptable level decision	
All general criteria have been met and the impacts and risks are determined to be of an acceptable level.	

6.10 MARINE HYDROCARBON SPILLS

There is potential for marine hydrocarbon spills to occur during the Possum 3D MSS and the following spill scenarios have been considered:

- surface release of MDO from breach of vessel fuel tank; and
- surface release of MDO during bunkering / refuelling incident.

The risk assessment below has focussed on the worst credible spill, being a breach of a vessel fuel tank, however, control measures have been identified for the management of refuelling spills.

Should a vessel collision result in fuel discharges (such as MDO or MGO) to ocean, there is potential to impact the marine environment through reduction in water quality and exposure of hydrocarbons to fauna and habitats. Should a surface spill or entrained/dissolved hydrocarbon contact shallow waters or emergent features adjacent to the operational area, then a range of benthic habitats and communities would be at risk of adverse exposure. Commercial fishing, tourism and shipping activities in the area would also be impacted from a major diesel spill.

6.10.1 Hydrocarbon spill trajectory modelling

To assess the potential magnitude and scale of impacts from underwater noise produced during the seismic survey, RPS Ocean Science Technology (RPS, 2020) was commissioned to perform a quantitative spill risk assessment of the worst credible spill, as detailed in the sections below.

6.10.1.1 Worst case credible hydrocarbon spill

Given that the water depths in the operational area are 118 m to 566 m, with an absence of any shallow water or emergent features, and the presence of the support vessel, it is not considered credible for the survey or support vessels to ground within or immediately adjacent to the operational area. There remains a remote possibility of a collision between the survey vessel and third-party vessel or the support vessels during occasions when both vessels are manoeuvring close to each other.

The worst-case credible discharge (WCCD) is represented by an instantaneous release of 321 m^3 of MGO to the surface. This volume represents the largest single tank volume of survey vessels being considered for the Possum 3D MSS. Searcher has committed to not using HFO to power vessels in this survey. Volumes are considered conservative as they assume the tanks are full, all contents lost and no mitigation.

Modelling was performed for the release of hydrocarbon from a single site within the survey area that was identified as presenting the greatest risk of exposure to sensitive receptors i.e. the Rowley Shoals, based on distance and prevailing current patterns. This site was 10 km to the east of Mermaid Reef. Year-round operations were considered.

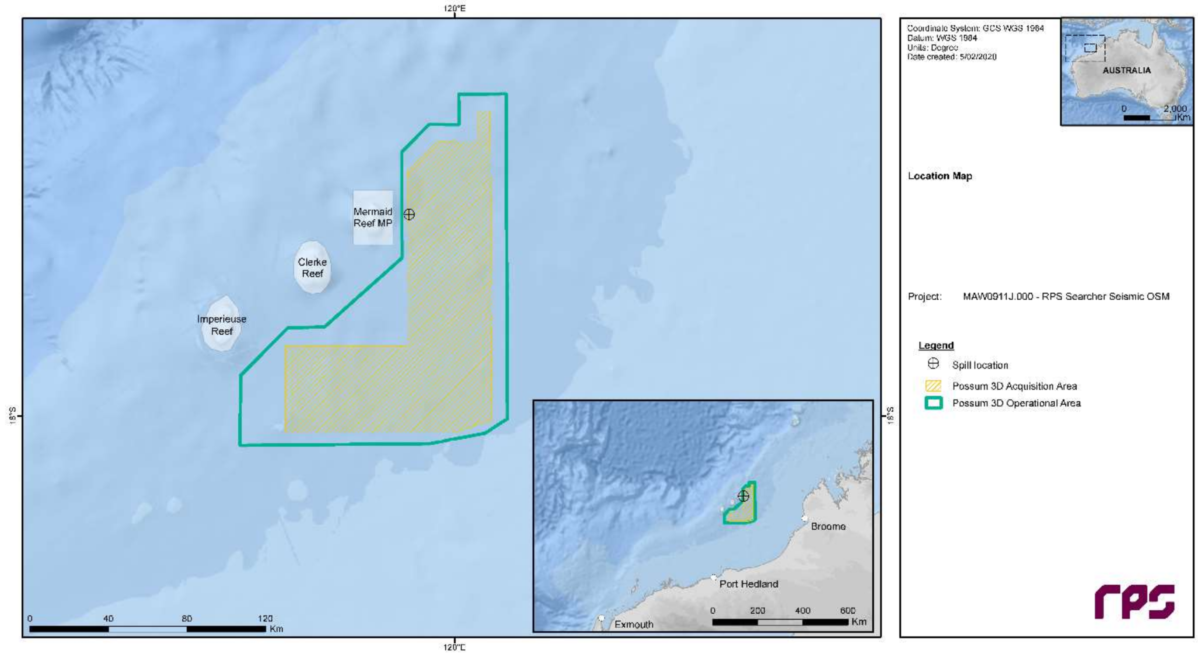


Figure 6.2 – Modelled hydrocarbon release site (indicated by the circle enclosing a cross)

6.10.1.2 Spill event probability

The Australian Transport Safety Bureau's marine safety database (ATSB 2020) states there are no recorded instances of collisions, grounding or sinking of a seismic vessel or its support vessels in Australian waters in at least the last 30 years.

6.10.1.3 Hydrocarbon properties and weathering behaviour

MGO has a density of 0.829 g/cm^3 at 25°C and viscosity of 4cP at 25°C. MGO comprises approximately 6% volatiles (C4 to C10) which should evaporate within the first 12 hours. A further 35% semi volatiles (C11 to C15) should evaporate within the first 24 hours and 54% low volatiles (C16 to C20) should evaporate over several days to a few weeks. Residual components heavier than C20 (accounting for approximately 5%) may persist for longer before biodegradation. Aromatics with a boiling point below 380°C account for 3%. This component will be subject to both evaporation (especially of more volatile BTEX constituents) and dissolution.

Modelling considered weathering of a surface MGO spill subject to a constant 5 knots wind and variable 14-19 knot wind, 27°C water temperature and 25°C air temperature. Under constant 5 knots, approximately 41% of the oil volume would evaporate within 12 hours, with most of this component evaporating within several hours. Under the variable-wind case, significant entrainment of MGO into the water column is indicated. Within approximately 24 hours, around 72% of the oil mass is forecast to have entrained and 24% to have evaporated. Only a small proportion of the oil (<1%) is forecasted to be floating on the water surface after the first few hours.

The higher rates of entrainment of oil into the water column are forecasted to increase the proportion that undergoes decay. For the higher, variable-wind case, degradation was calculated at the approximate rate of 2.4% per day with an accumulated total of ~16% after 7 days, in comparison to a rate of ~0.2% per day and an accumulated total of 1.3% after 7 days in the low-wind case. This indicates that the remaining hydrocarbons would decay over time scales of several weeks. Dispersion of oil droplets will be a further significant process that reduces concentrations of entrained MGO.

6.10.1.4 Hydrocarbon exposure thresholds

The following thresholds consider the hydrocarbon state, published sensitivities of biota contacted and the duration of receptor contact. The exposure thresholds are based primarily on the values defined in NOPSEMA Bulletin #1 Oil Spill Modelling (NOPSEMA 2019a).

Table 6.18 Summary of applied thresholds

Form	Exposure value		Justification	Reference
Floating Oil Concentration (g/m^2)	Low	1	Approximates range of socio-economic effects and establishes planning area for scientific monitoring. Represents the practical limit of observing an oil sheen in the ocean. Considered below levels which would cause environmental harm and is more indicative of areas perceived to be affected due to its visibility on the sea-surface.	NOPSEMA (2019a)
	Moderate	10	Approximates lower limit for harmful exposures to birds and marine mammals Conservative minimum oil thickness at which ecological impacts (e.g. to birds through ingestion from preening of contaminated feathers, or the loss of the thermal protection of their feathers) could occur	NOPSEMA (2019a), French-McCay, (2009) Koops et al., (2004)
	High	50	Approximates surface oil slick and informs response planning This value is the estimated minimum floating hydrocarbon threshold for containment and recovery and informs response planning.	NOPSEMA (2019a)
Shoreline Oil Concentration (g/m^2)	Low	10	Predicts potential for some socio-economic impact. Represents the area visibly contacted by the spill	NOPSEMA (2019a)
	Moderate	100	Loading predicts area likely to require clean-up effort. Represents the minimum oil thickness at which potential lethal ecological impacts (e.g. to intertidal invertebrates) may occur.	NOPSEMA (2019a), French et al., (1996), French-McCay, (2009)
	High	1,000	Loading predicts area likely to require intensive clean-up effort	NOPSEMA (2019a)
Entrained Oil Concentration (ppb)	Low	10	Establishes the planning area for scientific monitoring based on potential for exceedance of water quality triggers.	NOPSEMA (2019a), ANZECC & ARMCANZ, (2000)
	High	100	The 100-ppb threshold is considered conservative in terms of potential for toxic effects leading to mortality for sensitive mature individuals and early life stages of species. This threshold has been defined to indicate a potential zone of acute exposure, which is more meaningful over shorter exposure durations.	NOPSEMA (2019a), ANZECC & ARMCANZ, (2000)
	Very high	500	Particularly relevant for short duration (acute) exposure to organisms or fixed habitats affected by the dynamically varying oil plume.	ANZECC & ARMCANZ, (2000)
Dissolved Aromatic Hydrocarbon Concentration (ppb)	Low	10	Establishes the planning area for scientific monitoring based on potential for exceedance of water quality triggers.	NOPSEMA (2019a)
	Moderate	50	Potential toxic effects, particularly sublethal effects to sensitive species.	NOPSEMA (2019a)
	High	400	Approximates toxic effects including lethal effects to sensitive species.	NOPSEMA (2019a)

6.10.1.5 Spill Modelling Methodology

The spill modelling was carried out using a purpose-developed oil spill trajectory and fates model, SIMAP (Spill Impact Mapping and Assessment Program). This model is designed to simulate the transport and weathering processes that affect the outcomes of hydrocarbon spills to the sea, accounting for the specific oil type, spill scenario, and prevailing wind and current patterns.

The stochastic model within SIMAP performs many simulations for a given spill site, randomly varying the spill time for each simulation. The model uses the spill time to select sequences of current and wind data from a long time-series of wind and current data for the area. Hence, the transport and weathering of each slick will be subject to a different sequence of wind and current conditions. The minimum time to shoreline and the maximum potential concentration estimates indicate the worst potential outcome of the modelled spill scenario for each section of shoreline. However, the average over the replicates presents an average of the potential outcomes, in terms of oil that could strand.

Noting the grid resolution of 0.4 km, for sensitive receptors with shorelines <100 m, it is not possible to resolve down to scale of these individual receptors, e.g. Clerke Reef (Rowley Shoals MP) where the area of shoreline above high tide is smaller than the grid resolution. This is a conservative approach to estimating risks to shorelines and may over-predict length of shoreline oiled.

The modelling did not consider any remediation of the spill (e.g. the use of dispersant).

6.10.1.6 Spill Modelling results

The full results of modelling 100 replicate spills across a year can be found in the RPS Oil Spill Modelling report (Appendix H). While a single spill location was selected as the worst case, concentration contours and probability contours can be transposed throughout the operational area with similar, albeit approximate, results. The same or slightly lower probabilities and concentrations are forecast for Clerke and Imperieuse Reef, compared to those predicted for Mermaid Reef, should the spill occur at the closest point of the operational area to the east of these features, due to the slightly increased distance of the operational area from these features.

A spill towards the east of the operational area is not predicted to impact the shallow coastal areas off mainland Australia due to the distance offshore.

A summary of the main findings follows.

1. **Current patterns**: Variable around the site. The location is subject to both tidal currents, which flow to the south-east on the flood and north-west on the ebb and reverse over time-scales of six hours, and ocean drift-currents that vary in direction in a more complex manner and can persist for longer time-scales. Drift currents may flow towards the south-west during all months of the year.
2. **Wind conditions**: Variable, with seasonal trends. The wind most frequently blows from the western sector during the summer months and from the eastern sector during the winter months. Wind speeds frequently exceed speeds that would generate breaking surface waves that would result in entrainment of MGO.
3. **Floating oil:** Concentrations at ≥ 1 g/m^2 could potentially occur up to 148 km from the spill site, reducing to 84 km for ≥ 10 g/m^2, 32 km for ≥ 50 g/m^2 and 19 km for ≥ 100 g/m^2. Highest probabilities of contact with floating oil at ≥ 10 $g/\ m^2$ were calculated for Mermaid Reef Marine Park (5 %) and Mermaid Reef and Commonwealth waters surrounding Rowley Shoals KEF (13 %). This is the probability that such oil concentrations would contact the water surface over those receptor areas. Floating oil at the 10 g/m^2 threshold is predicted to potentially arrive at Mermaid Reef Marine Park and Mermaid Reef and Commonwealth waters surrounding Rowley Shoals Key Ecological Feature receptors within 1 hour after a spill commencement.

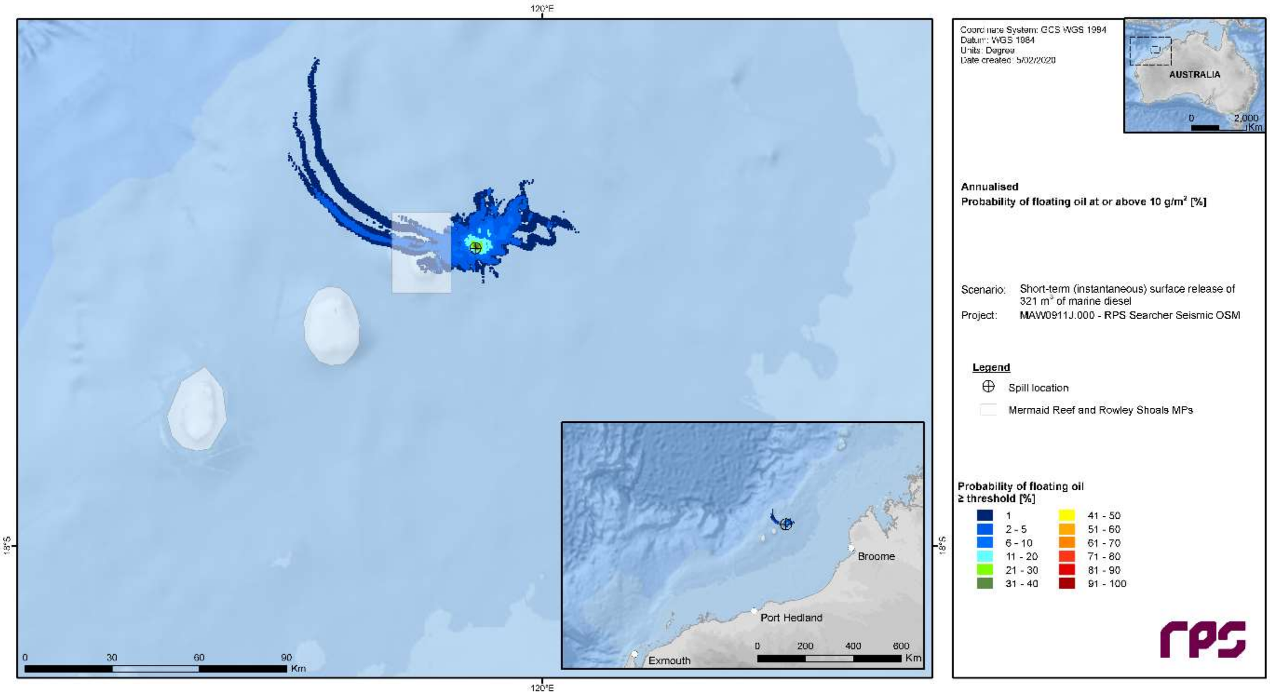


Figure 6.3 – Predicted annualised floating oil concentrations ≥10 g/m^2 resulting from an instantaneous release of MGO during seismic survey operations near Rowley Shoals

4. **Shoreline oil:** A low probability of contact (< 1 %) with any shoreline is indicated for floating oil concentrations ≥ 1 g/m^2. However, some potential for accumulation of oil that arrives at lower concentrations is indicated on some shorelines including emergent sandy cays within the Mermaid Reef and Cunningham and Bedwell Islets.
5. **Entrained oil**: Concentrations > 10 ppb could occur up to 441 km from the spill site. The effect distance could extend to 280 km at > 100 ppb and 120 km at > 500 ppb. Cross-sectional transects of maximum entrained oil concentrations in the vicinity of the release site indicate that entrained oil concentrations > 100 ppb are not likely to occur at depths greater than ~20 m BMSL. The water depth in the operational area is 118 m – 566 m.

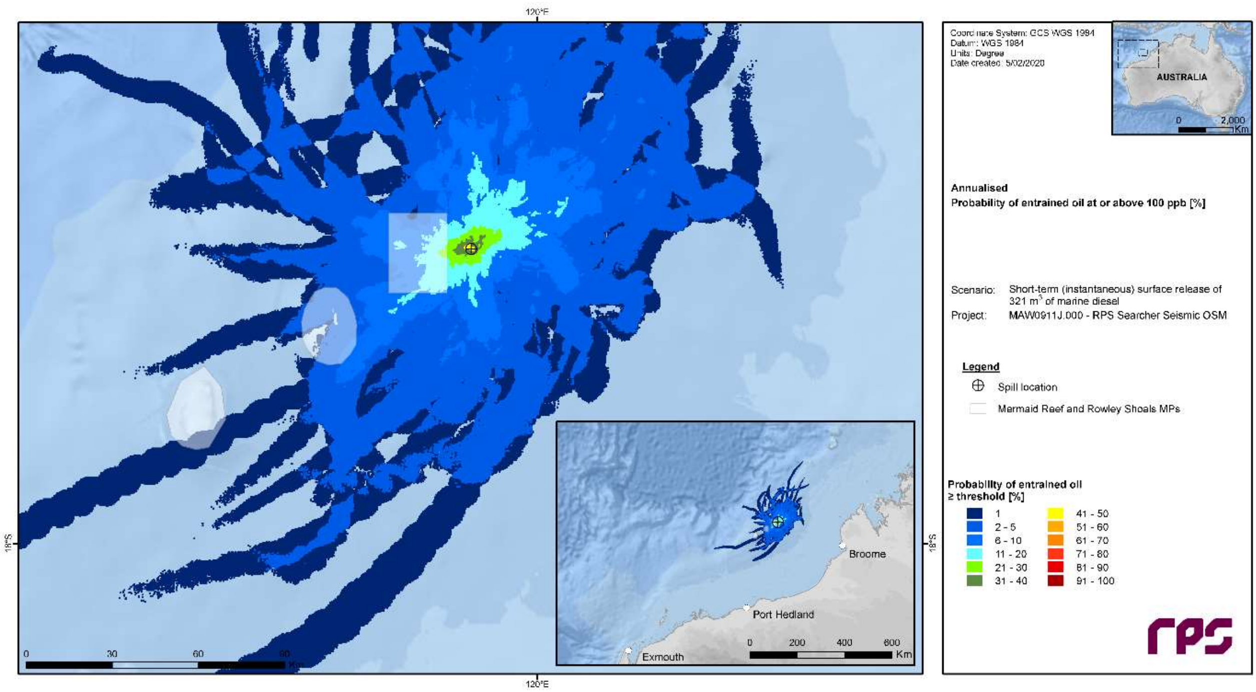


Figure 6.4 – Predicted annualised entrained oil concentrations ≥100 ppb resulting from an instantaneous release of MGO during seismic survey operations near Rowley Shoals

6. **Dissolved aromatic hydrocarbons:** Concentrations ≥ 10 ppb are calculated to occur up to 215 km from the spill site, with the potential contact zone decreasing exponentially as the threshold concentration is raised. Mermaid Reef Marine Park is calculated to have a worst-case dissolved aromatic hydrocarbon concentration of 258 ppb. Cross-sectional transects of maximum dissolved aromatic hydrocarbon concentrations in the vicinity of the release site indicate that dissolved aromatic hydrocarbon concentrations at ≥ 50 ppb should not reach depths greater than ~40 m BMSL. The operational area is in water depths of 118 -566 m.

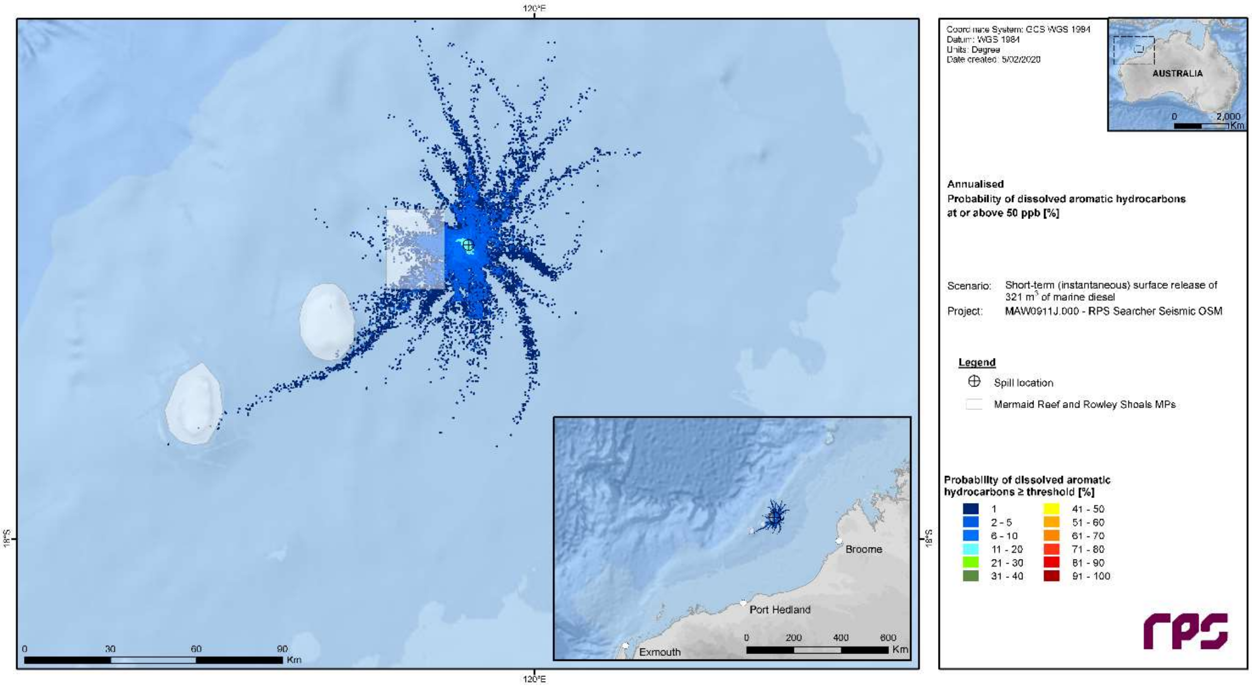


Figure 6.5 – Predicted annualised dissolved aromatic hydrocarbon concentrations ≥ 50 ppb resulting from an instantaneous release of MGO during seismic survey operations near Rowley Shoals

6.10.1.7 Nature of impact

The table below provides the potential exposure pathway of hydrocarbons to sensitive receptors within the Possum 3D MSS EMBA.

Table 6.19 - Potential exposure pathway of hydrocarbons to sensitive receptors within the Possum 3D MSS EMBA

Receptor and EP reference	Presence in oil spill EMBA	Physical exposure		Chemical exposure	
		Physical pathway	Potential impact	Chemical pathway	Potential impact
Plankton communities (Section 4.6.1)	Low planktonic abundances with high species diversity and relatively low endemicity. The spill EMBA timing and location could overlap with spawning of some fish species given the year-round spawning of some species and overlap in peak spawning periods of others (Table 4.9). Multispecies, synchronous spawning of scleractinian corals occur at (Rowley Shoals)	Coating of adults, eggs and larvae	Mortality, impaired growth	Ingestion, external contact and absorption across exposed skin and cellular membranes, uptake of dissolved aromatic hydrocarbons across cellular membranes, reduced capacity for oxygen exchange.	Mortality, cell damage, reduced metabolic capacity, reduced immune response, disease, reduced growth, reduced reproductive output, reduced egg/larval success, growth abnormalities.

Receptor and EP reference	**Presence in oil spill EMBA**	**Physical exposure**		**Chemical exposure**	
		Physical pathway	**Potential impact**	**Chemical pathway**	**Potential impact**
Benthic communities – algae and seagrass (Section 4.6.2.2)	Over 120 species of macroalgae and seagrasses are reported on the Rowley Shoals, Scott Reef, and Seringapatam Reef. Compared to the NW coast of the mainland, the diversity is markedly lower. Significant stands of seagrass *Thalassia hemprichii* occurs in patches within the lagoon on Mermaid Reef.	Coating of leaves/ thalli reduces light availability and gas exchange. Degree of coating depends on the energy and tidal reach of the shoreline, receptor type and MGO weathering.	Bleaching/blackening of leaves, defoliation, reduced growth	External contact by oil and absorption across cellular membranes.	Mortality, bleaching or blackening of leaves, defoliation, disease susceptibility, reduced growth and reproductive output, reduced seed/ propagule viability.
Benthic communities -coral reefs and shoals (Section 4.6.2.3)	Extensive coral systems in three atolls – the Clerke, Mermaid and Imperieuse Reefs of the Rowley Shoals system are adjacent to the operational area. Ranging widely within the EMBA are also Scott Reef and the Glomar Shoals. Coral communities, including patch or fringing reefs occur in shallow water, sub tidal environments of the NWMR, as well as around intertidal areas adjacent to islands and other emergent features. Mermaid Reef consists of a reef flat 500–800 m wide that delves into shallow back-reefs that are rich in coral diversity. The Rowley Shoals exhibit a greater proportion of living corals and crustose coralline algae than others within the NWMR network.	Coating of polyps, shading resulting in reduction on light availability. Degree of coating dependent on metocean conditions, MGO dilution, if corals are emergent at all and continual weathering of the MGO.	Bleaching. Increased mucus production. Reduced growth.	External contact by oil and absorption across cellular membranes.	Mortality, cell damage, reduced metabolic capacity, reduced immune response, disease/ bleaching susceptibility, reduced growth, reduced egg/larval success, growth abnormalities.
Shoreline habitats – Rocky shorelines (Section 4.6.3)	The Rowley Shoals are a hotspot for biodiversity in the NWMR. The Shoals comprise of three atolls – the Clerke, Mermaid and Imperieuse Reefs. Clerke and Imperieuse Reef have emergent land – both surrounded by rocky habitats.	Degree of oil coating is dependent on energy of the shoreline area, the type of rock formation and continued MGO biodegradation.	Impacts to resident flora and fauna, as per 'marine fauna' sections.	Absorption via cellular membranes and soft tissue, ingestion, irritation on contact and inhalation. Impacts to rocky habitats as per flora and fauna sections within this table.	Impacts to sessile flora and fauna (including invertebrates) where relevant for the habitat type, as per below.

Receptor and EP reference	Presence in oil spill EMBA	Physical exposure		Chemical exposure	
		Physical pathway	**Potential impact**	**Chemical pathway**	**Potential impact**
Shoreline habitats – Sandy shorelines (Section 4.6.3)	The sandy beach habitats and shorelines potentially at risk from surface MGO slicks and / or entrained MDO are on Bedwell Islet (Clerke Reef), Cunningham Island and the emergent sand cays at the northern tip of Mermaid Reef, which shift with tidal influences.	Shoreline loading and water movement allow MGO residue to filter into sediments, biodegrade on the surface or remobilise into surf zone. Degree of loading depends on energy and tidal reach of the shoreline, the type of the sandy shore and continued MGO weathering.	Indirect impacts to nesting and foraging habitats for birds and turtles. Direct coating and toxicity impacts to infauna.	Absorption via cellular membranes and soft tissue, ingestion, irritation/burning on contact and inhalation.	Indirect impacts to nesting and foraging habitats for birds and turtles. Direct impacts (mortality) to infauna through toxic effects and smothering.
Protected areas (Section 4.4)	Modelling predicts oil may enter the waters of some of the listed MPs and KEFs. Depending on weather conditions, within 24 hours around 41 % of the mass on the surface will evaporate and another 54 % within a few days leaving only a small proportion (<5 %) of persistent components. The entrained oil dilutes and degrades slowly over several weeks potentially resurfacing if wind and waves abate.	*Different for each value of the MPs and KEFs*			
Marine Fauna – Cetaceans (Section 4.6.4.2)	30 listed species of cetaceans may occur within the EMBA. Of these, the blue whale is listed as Endangered and the humpback whale, sei and fin are listed as Vulnerable. Parts of the extensive distribution BIA and migration BIA and a small portion of foraging BIA for pygmy blue whales at Scott Reef overlaps comparatively small parts of the EMBA. The migration BIA for humpbacks intersects the EMBA.	Being smooth, thick-skinned and hairless, whales and dolphins' skins are not expected to be sensitive to the physical effects of oiling (Geraci 1990, O'Shea & Aguilar 2001).	Soft tissues, eye and skin irritation, digestive system damage (especially for baleen whales).	Inhalation of toxic volatiles, ingestion, external contact and absorption across exposed skin and membranes.	Acute or chronic exposure poses greater toxicological risks, changes in behaviour and reduced breeding success, inflammation of the mucous membranes, lung congestion, liver disorders, neurological damage.

Receptor and EP reference	Presence in oil spill EMBA	Physical exposure		Chemical exposure	
		Physical pathway	**Potential impact**	**Chemical pathway**	**Potential impact**
Marine Fauna - marine reptiles (Section 4.6.4.3)	20 Listed sea snakes and six marine turtle species may occur within the EMBA. The green, hawksbill and flatback turtles (Vulnerable and Migratory); and loggerhead and leatherback turtles (Endangered and Migratory) may be in the EMBA and the Olive Ridley Turtle (Endangered, habitat critical that may occur within the EMBA). Figure 4.15 shows the edge of the marine turtle habitat critical falls on the northern tip of the EMBA around Scott Reef. Under certain conditions, the southern boundary of the EMBA may reach the edge of the inter-nesting buffer for flatback turtles.	All life phases vulnerable (eggs, hatchling, juveniles, adults at sea and shore) Ingestion (including tar balls) and vapour inhalation, especially prior to diving.	Eye and skin irritation/damage, gut impaction. Hatchlings coated with oil residue may have reduced mobility (more vulnerable to predation) and toxicity impacts.	Inhalation, ingestion, external contact and absorption across exposed skin and membranes.	Mortality, cell damage, secondary infections, reduced metabolic capacity, reduced immune response, disease susceptibility, reduced growth, reduced reproductive output, growth abnormalities, behavioural disruption.
Marine Fauna – sharks and rays, fishes (Section 4.6.4.4 and 4.6.4.5)	13 listed species of sawfish, sharks and rays may occur in the EMBA. 40 species of threatened fish may occur in the EMBA – comprising pipefish and seahorses.	Coating of adults, eggs and larvae can reduce mobility and capacity for oxygen exchange.	Mortality, oxygen debt, starvation, dehydration, increased predation, behavioural disruption.	Ingestion, external contact and absorption across exposed skin and cellular membranes, uptake of dissolved aromatic hydrocarbons across cellular membranes (e.g. gills).	Mortality, cell damage, flesh taint, reduced metabolic capacity, reduced immune response, disease susceptibility, reduced growth and egg/larval success, growth abnormalities, behavioural disruption.
Marine Fauna - avifauna (Section 4.6.4.6)	46 listed species of shore and seabirds may occur in the EMBA, some of which are migratory and wetland species. Bedwell and Cunningham Islets: • BIA (resting) for the little tern, • BIA (breeding) for the white-tailed tropicbird, • breeding colony of red-tailed tropic birds.	Direct contact with surface hydrocarbons – smothering, excessive preening, ingestion of hydrocarbons (preening and prey).	Feather and skin irritation, toxicity, loss of thermal insulation (hypothermia) and buoyancy. Diverting time away from other behaviours leading to starvation and dehydration.	Ingestion during feeding or preening. External contact and absorption across exposed skin and membranes.	Mortality, cell damage, secondary infections, reduced metabolic capacity, reduced immune response, disease, reduced growth and reproductive output, growth abnormalities, behavioural disruption.
Commercial Fisheries (Section 4.7.1)	Of the 16 fisheries identified as authorised to operate in the operational area and EMBA, only 2 are historically active in the immediate surrounds i.e. within the operational area – the Mackerel Managed Fishery and North West Slope Trawl Fishery.	Oiling equipment such as nets, traps and lines. Temporary exclusion zones.	Contamination of equipment. Potential loss of income.	N/A	N/A
Commercial Shipping (Section 4.7.2)	Major shipping routes through the EMBA are associated with the Ports of Dampier and Hedland, with less traffic to the Port of Broome. Typically include freighters, tankers,	Oiling of vessels. Temporary exclusion zones.	Contamination of vessels. Minor re-routing.	N/A	N/A

Receptor and EP reference	Presence in oil spill EMBA	Physical exposure		Chemical exposure	
		Physical pathway	Potential impact	Chemical pathway	Potential impact
	domestic support and supply, construction barges/ dredge, survey and commercial fishing vessels.				
Tourism and Recreation (Section 4.7.3)	The Rowley Shoals Marine Park and Mermaid Reef Marine Park has limited visitation due to the distance offshore. Activities are nature-based tourism, (including diving) and recreational fishing, primarily by charter vessels.	Oiling of vessels. Reduced aesthetics. Temporary exclusion zones.	Aesthetic impacts. Health impacts (swimming, SCUBA diving). Contamination of equipment. Potential loss of income.	N/A	N/A
Petroleum exploration and production (Section 4.7.4)	Sixteen petroleum titles are held in the EMBA with no facilities close to a potential spill source (i.e. operational area). Other seismic vessels may be in the EMBA.	Oiling of vessels. Temporary exclusion zones.	Contamination of vessels.	N/A	N/A
Research activities (Section 4.7.6)	Long term research oceanographic mooring deployed within the EMBA.	Oiling of vessels. Temporary exclusion zones.	Contamination of vessels and equipment.	N/A	N/A

6.10.2 Hydrocarbon spill risk assessment

Nature and Scale of Impacts and Risks
The nature and scale assessment has considered the consequence ranking and likelihood category determined for the worst-case spill scenario (location, oil type, volume and environmental conditions) as modelled. The sensitive receptors that may be impacted by a worst case hydrocarbon spill are shoreline habitats, marine fauna, plankton & benthic communities . Other receptors that are likely to be impacted are the protected areas where the spill may enter the waters of listed MPs and KEFs, and fish species targeted by commercial fisheries. For details refer to Table 6.19.
Good Industry Practice -Regulatory Requirements
Navigation Act 2012 specifically Chapter 6 Part 6 Division 5, which establishes the Australian Hydrographic Office to collect, compile and collate hydrographic data and maintain and disseminate hydrographic and other nautical information and nautical publications of maritime safety/navigation procedures which include Notices to Mariners. (EPS 1.2/EPS 1.3/EPS 1.4/EPS 1.5)
Notification of activity details to relevant stakeholders four weeks prior to the survey commencing, containing specific information of the survey vessels, planned tracks and contact information, including the AHO with details (survey location, timing) four weeks prior to mobilisation and following demobilisation for issue of Notice to Mariners (EPS 1.2/EPS 1.3/EPS 1.4/EPS 1.5)
Marine Orders Part 30: Prevention of Collisions 2016, Section 9 – Requirements of International Regulations: (EPS 1.7) • The measures required by the International Regulations in the navigation, management and working of a vessel for the prevention of collisions must be observed in the operation of a vessel. • The lights and signals required by the International Regulations must be provided and used on a vessel.
AIS tracking device installed on survey vessels and operational to aid identification by other vessels.(EPS 1.6)
Marine Notice 21/2013: Sound navigational practices, including: • using a variety of navigational aids • not relying solely on any Global Navigation Satellite System for navigation, particularly when navigation can also be conducted visually and/or by radar
MARPOL 73/78, Annex I (Prevention of pollution by oil) as administered under Marine Order 91 (Marine pollution prevention – oil): all vessels of 400 gross tonnage and above to carry on board a shipboard oil pollution emergency plan that includes: (EPS 10.2) • the procedure to be followed by the person in charge of the ship to report an oil pollution incident, (Article 8 and Protocol I of the present Convention) • the contact list of authorities or persons to be notified in the event of an oil pollution incident • a detailed description of the action to be taken immediately by persons on board to reduce or control the discharge of oil following the incident • the procedures and point of contact on the ship for coordinating shipboard action with national and local authorities in combating the pollution

The OPGGSA 2006 and associated Regulations 2009 require the preparation of an OPEP and supporting OSMP that contain all information necessary to respond to a hydrocarbon spill to the marine environment and to support ongoing response by the statutory Control Agency. The Possum MSS specific OPEP and supporting OSMP are provided in Appendix I to cover planning for any spill to ocean.				
The OPEP includes an Oil Spill Monitoring Plan to be implemented in the event of a Level 2 spill.(EPS 10.5/EPS 10.3/EPS 1.4)				
Up to two support vessels used throughout the activity for seismic acquisition operations throughout the activity.(EPS 1.16)				
Regulation 37, MARPOL Annex I requires all ships ≥ 400 gross tonnage carry an approved Shipboard Oil Pollution Emergency Plan (SOPEP). Article 3 of the International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990, also requires such a plan for certain ships. (EPS 10.2)				
All refuelling of the survey vessels will be carried out in accordance vessel refuelling and bunkering procedures which will require: (EPS 10.1) • Constant surveillance, communication protocols and daylight refuelling. • Dry-break couplings and non-return valves on fuel transfer hoses that are to be maintained regularly.				
Environmental Impact Assessment				
Potential Consequence	**Rank**	**Likelihood Discussion**	**Rank**	**Residual Risk**
Plankton communities				[6] Acceptable
Zooplankton and fish/coral larvae may be impacted by MGO on the sea surface as well as dissolved and entrained in the water column. Depending on weather conditions, within 24 hours around 41 % of the oil mass on the surface will evaporate and another 54 % within a few days leaving only a small proportion (<5 %) of persistent components. Under variable wind/sea states, about 72% can entrain into the water column, the toxicity of the dissolved and entrained portions rapidly decreasing with distance and time. Mass coral spawning occurs in March and April each year while the timing of fish spawning varies, occurring at different periods throughout the year and across different locations. The overall consequence is assessed as Minor (short term impact – days to weeks).	[A] Minor	It is possible that some fish spawning may overlap within the wider EMBA, however there are no known spawning aggregations for key or indicator species for commercial fisheries historically active within 10 km of the acquisition area further spawning may occur at a different times/locations so not all spawning would be affected by a single spill. The likelihood of a WCCD occurring and resulting in Minor impacts to a spawning event at population levels is Unlikely. Plankton mortality in the immediate area of a WCCD is possible but with negligible population effects in the context of the natural turnover rates and variability.	[3] Possible	
Benthic communities				

Sparse seagrasses and macroalgae occurs within the subtidal coral reefs but are not described as major habitat types at the Rowley Shoals or Mermaid Reef. Corals and seagrasses close to the surface on emerging reefs close to the shoreline or periodically exposed at spring low tides at Rowley Shoals could be exposed to surface oils within an hour of the WCCD occurring. Depending on weather conditions, within 24 hours around 41 % of the mass on the surface will evaporate and another 54 % within a few days leaving only a small proportion (<5 %) of persistent components, so impacts such as light barriers preventing photosynthesis or toxic significant impacts from coating are not likely. Below 3-4 m, overlying waters separate coral colonies from surface slicks, but these corals may be exposed to entrained hydrocarbons introduced into the water column by wave action on surface slicks (NOAA 2010). Impacts to corals will depend on species' tolerance, exposure concentrations and duration of exposure with impacts potentially ranging from no observable injury through to complete or partial mortality of the colony (NOAA 2010). Cross-sectional transects of maximum entrained oil concentrations in the vicinity of the release site indicate that entrained oil concentrations > 100 ppb are not likely to occur at depths greater than ~20 m BMSL. Cross-sectional transects of maximum dissolved aromatic hydrocarbon concentrations in the vicinity of the release site indicate that dissolved aromatic hydrocarbon concentrations at ≥ 50 ppb should not reach depths greater than ~40 m BMSL. As such, away from the Rowley Shoals, benthic habitats are for the most part too deep for impacts from entrained or dissolved hydrocarbons (operational area is 118 – 566 m water depth). Given the slow growing characteristics of coral (worst case), the consequence is conservatively assessed as major (long term impact – 2 to 10 years).	[D] Major	The WCCD modelling forecasts a 5 % probability of exposure to concentrations above 10 g/m^2 for the Mermaid Reef Marine Park and 13% for KEF – Mermaid Reef and Commonwealth waters surrounding the Rowley Shoals. Modelling predicts a 24 % probability that patches of shallow habitats around the Mermaid Marine Park will be exposed to entrained oil >100 ppb (and 12 % probability for the Argo-Rowley Shoal Terrace MP). The probability of exposure to entrained and dissolved hydrocarbons is highly unlikely for the deep-water habitats e.g. of the operational area. As such the overall likelihood of a WCCD occurring and resulting in 'major' long-term damage to a significant stand of seagrass, algae or coral is Rare.	[1] Rare	[7] Tolerable
Shoreline habitats				
Modelling predicts surface oil and shoreline oil at Mermaid Reef (and by approximation at Clerke Reef and Imperiuse Reef) exposed to floating or shorelines oil >10 g/m^2 within approximately 5 hrs in the WCCD. Depending on weather conditions, within 24 hours around 41 % of the mass on the surface will evaporate and another 54 % within a few days, leaving a small proportion (<5 %) of persistent components. MDO tends to penetrate porous sediments quickly but waves can quickly flush rocks and sandy shores i.e. those habitats for polychaetes, molluscs, marine crustaceans, semi-terrestrial crustaceans, insects, nesting turtles and breeding and foraging seabirds. The scale of impacts is limited to those exposed beaches and rocks of sheltered bays. The duration of exposure (and restitution) is forecast as short term (<1 year), hence the consequence to the physical environment or behaviours of protected species is Moderate.	[B] Moderate	The likelihood of Mermaid Reef, Clerke Reef and Imperiuse Reef exposed to floating or shorelines oil >10 g/m^2 is approximately <5 %. Impacts vary with degree of submergence, energy of the waves and weathered state. The likelihood of a WCCD occurring and resulting in impacts above a Moderate for both sandy shores and rocky habitats is Unlikely.	[2] Unlikely	[5] Acceptable

Protected areas				

• Mermaid Reef MP: Key values – pristine character and coral reefs, enhanced productivity and high species richness.
• Rowley Shoals MP: Key values – migratory pelagic species foraging area for endangered marine turtle, and nesting, resting and foraging area for various seabirds.
• Argo-Rowley Terrace MP: key values – habitat for migratory pelagic species, foraging area for endangered marine turtles and listed migratory seabirds, nesting, resting and foraging area for listed seabirds, migratory BIA for pygmy blue whales, communities and habitats of the deeper (220->5000 m) offshore waters of the region and seafloor features e.g. canyon, the terrace, continental slope and two KEFS:
  • The canyons linking the Argo Abyssal Plain with the Scott Plateau KEF
  • Mermaid Reef and the Commonwealth waters surrounding Rowley Shoals KEF.
• Ancient coastline at 125 m depth contour KEF values: higher diversity and enhanced species richness, migrating humpback whales, enhanced productivity.
• Continental Slope Demersal Fish Communities KEF values: rich assemblage of ~500 fish species and high endemicity in 225–1,000 m water depth.
The modelling suggests under certain conditions an MGO spill may enter the waters of some of the listed MPs and KEFs. Depending on weather conditions, within 24 hours around 41 % of the mass on the surface will evaporate and another 54 % within a few days leaving only a small proportion (<5 %) of persistent components. The entrained oil dilutes and degrades slowly over several weeks potentially resurfacing if wind and waves abate. The potential impacts of surface slicks and entrained oil will not have significant consequences for sensitivities and values that are below the surface and in deep water (as described below).
The consequence is ranked Moderate i.e. minor impacts on physical environment or behaviour of protected species with restitution forecast within a year.
	[B] Moderate	WCCD modelling predicts the following probability that oil concentrations might occur at <u>some part</u> of the boundary of these receptor areas:
		Mermaid Reef MP: surface oil – 1 % probability of exposure to ≥ 100 g/m^2; 5% at ≥ 10 g/m^2. Entrained oil: 24% probability of exposure to >100 ppb.
		Argo-Rowley Terrace MP: surface oil <1 % probability of exposure to ≥ 100 g/m^2; 2 % at ≥ 10 g/m^2. Entrained oil -12% >100 ppb.
		KEFS: Mermaid Reef and Commonwealth waters surrounding Rowley Shoals: surface oil 13 % probability of exposure at ≥ 10 g/m^2 and 4 % at ≥ 100 g/m^2. Entrained oil: 41% >100 ppb.
		All other KEFs are <1% probability of exposure to surface oil at ≥ 10 g/m^2 and entrained oil <2 % probability >100 ppb.
		Overall, given the likelihood of a WCCD occurring and given the above probabilities, and the short-term exposure, the likelihood of impacts to protected areas above a Moderate is Unlikely.
			[2] Unlikely	[5] Acceptable

Marine Fauna – cetaceans				
Within 12 hours after the WCCD, 41 % of the oil volume is expected to evaporate under calm conditions. Approximately 24 hours after the spill, around 72 % of the oil mass could entrain. Only a small proportion of the oil (<1 %) is forecasted to be floating on the water surface after the first few hours. The maximum predicted extent of surface hydrocarbons greater than 10 g/m^2 is approximately 84 km from the release site. This may overlap parts of the migration BIA for the pygmy blue whale and humpback. Dolphins are likely transient visitors and anecdotally may avoid a spill. Baleen whales, which may skim or gulp at or near the surface, are more likely to ingest surface hydrocarbons than toothed whales and hydrocarbons may foul the baleen fibres. Weathered oil residues (~5 % of MGO) may persist for longer periods. Entrained oil >100 ppb and dissolved aromatics >50 ppb aromatic extend as far as 280 km and 122 km from the spill respectively (albeit not in continuous cover but diluting and degrading over distance and time. However, there is no evidence of extensive feeding activity taking place during migrations. Humpback whales migrating north at the start of the northbound season may be exposed to surface MGO slicks. A low number of transient individuals may be present within the area affected by a spill As the operational area overlaps a small portion of the known distribution BIA and migration BIA for pygmy blue whales, it is unlikely that significant numbers of whales would be exposed to surface diesel slicks in the event of a MGO spill within the very short timeframe (<1 % of the oil is forecasted to be floating on the water surface after the first few hours). Marine mammals are highly mobile, and anecdotal evidence indicates whales and dolphins may be able to detect and avoid surface slicks. Significant mortalities affecting population numbers are considered unlikely given the overall low species density within the operational area and impacts to populations are expected to be recoverable. However, given the long restitution time for cetaceans and injury or death of more than one protected species results conservatively in a consequence ranking of Major.	[D] Major	While a small part of the whales BIA will be exposed to surface oils >10 g/m^2, the probability of any part of the BIA being exposed to entrained oil >100 ppb is 49 % and dissolved oil >50 ppb is 22 %. Affected areas are a small percentage of the whales entire BIA and the EMBA does not contain any critical habitats (e.g. calving, nursing, resting, breeding, feeding area, narrow restricted migratory pathways) for any cetacean species. Therefore, potential impacts of surface slicks and entrained oil on these species are considered to be Low. The likelihood of a WCCD occurring at the time of a migration or concentrated presence of cetaceans in the immediate area of a spill whilst there are hydrocarbon concentrations high enough to result in a major impact (death) to more than one protected species, is Rare.	[1] Rare	[7] Tolerable
Marine Fauna -marine reptiles				
Depending on weather conditions, within 24 hours around 41 % of the mass on the surface will evaporate and another 54 % of surface oil within a few days leaving only a small proportion on the surface and about 72 % of the mass may entrain. Twelve protected species of sea snakes may occur within or adjacent to the operational area. Given the noted absence of sea snakes from the adjacent Rowley Shoals (Edgar et al 2017), it is unlikely that large numbers of sea snakes will be encountered within the operational area, and any occurrence will likely be rare and infrequent. Sea snakes may experience sub-lethal impacts from coating, inhalation of vapours and ingestion and in extreme cases, mortality. However, as sea snakes are unlikely to occur in abundance in the deep waters of the Possum operational area, the potential impacts on population levels from surface slicks are considered negligible. Only inter-nesting buffer BIA are noted for flatbacks, green and hawksbill turtles within the outer extremities of the EMBA. There is a small overlap of the eastern outer extent of the EMBA with flatback, green and loggerhead foraging BIA. However, injury or death of protected species individuals results conservatively in a consequence ranking of Serious.	[C] Serious	There is a <1% probability of any turtle BIA being exposed to surface oil >10 g/m$^{2.}$ While the impacts of marine turtles encountering a surface slick can be severe, only low numbers are expected to occur. Hatchlings are unlikely to be impacted given the separation distances between the Possum 3D MSS operational area and turtle nesting sites in the region. As such, the likelihood of a WCCD occurring and turtles being exposed to adverse concentrations resulting in impacts above Serious is Rare	[1] Rare	[4] Acceptable

Marine Fauna – rays and sharks, fish				
The PMST report lists 40 species of syngnathids that 'may occur' in the EMBA. Ten Listed species of sharks and rays potentially occur in the Possum operational area, some of which (e.g. sawfish and Northern River shark species) are unlikely to be present. Whale sharks often filter feed on dense aggregations of prey close to the sea surface (Colman 1997) potentially ingesting oil directly (Campagna *et al.* 2011). Part of the Whale shark's extensive Foraging BIA falls within the EMBA. However, based on the low population abundance and unknown and irregular movements of whale sharks within the operational area, it is unlikely that a large number would contact surface MGO slicks. Fish (especially demersal) and sharks generally have little contact with the sea surface. Depending on weather conditions, within 24 hours around 41% of the spill mass on the surface will evaporate and another 54% within a few days, leaving a small proportion on the surface and about 72% entrained. Although entrained hydrocarbons can have negative impacts on sharks, rays and fish, considering the small volume of entrained hydrocarbons potentially encountered, ever dilution and biodegradation over time and space, the impact on fish populations is considered low. Areas protected due to high diversity and abundance such as the Continental Slope Demersal Fish Community KEF is too distant and too deep for exposure to high concentrations above impact thresholds for entrained and dissolved hydrocarbons. Overall, impacts to local population levels of fish, rays and sharks is moderate (short term impacts – <1 year).	[B] Moderate	Part of the Whale Shark BIA and Continental Slope Demersal Fish Community KEF have a <1% probability to exposure above impact thresholds for surface hydrocarbons. Part of the Whale Shark BIA and Continental Slope Demersal Fish Community KEF have <3 and <2 % probability respectively of exposure to entrained hydrocarbons more than 100 ppb. Both have <1 % probability of exposure to dissolved hydrocarbons concentrations >50 ppb. Given the low likelihood of occurrence of the WCCD and the low probability of the WCCD resulting of exposure above impact concentrations for, it is unlikely local populations would be impacted at a Moderate level.	[2] Unlikely	[5] Acceptable
Marine Fauna – avifauna				
Bedwell Islet and Cunningham Islet are listed as breeding BIA for the white-tailed tropicbird and breeding and resting BIA for the little tern. The southern outer extremities of the EMBA may overlap small parts of the roseate tern breeding and resting BIAs as well as lesser frigatebird and brown booby breeding BIAs. Contact with surface MGO >10 g/m^2 could occur for in-water seabirds for a distance of 84 km potentially impacting diving birds and rafting flocks. Contact with entrained oil >100 ppb could occur up to 280 km from the site and contaminated prey could be ingested by seabirds and shorebirds. Note – the spill contours are not continuous but patchy. The worst credible consequence is conservatively assessed as Serious (recoverable impact to multiple individuals or death of an individual of a protected species) with recovery to the species in 1-2 years.	[C] Serious	A low probability of contact (< 1 %) with any shoreline is indicated for floating oil concentrations ≥ 1 g/m^2. However, some potential for accumulation of oil that arrives at lower concentrations is indicated on some shorelines including emergent land within the Mermaid Reef MP and various seabirds BIA. After 92 hours <1 m^3 (average maximum 0.3 g/m^2) of MGO could accumulate at the outer State water boundary at Clerke Reef. Thus, the likelihood is Rare of a WCCD spill occurring and of birds foraging and nesting on Bedwell and Cunningham Islets and being exposed to shoreline or surface MGO that resulted in the injury or death of an individual of a protected species.	[2] Unlikely	[8] Tolerable

Commercial Fisheries				
The EMBA overlaps several commercial fisheries licence areas but only two are historically active in the immediate vicinity of the Operational area – the MMF and NWSTF. MGO entrained and dissolved in the water column and surface oil can have toxic effects on fish and fish spawn (see above), reducing catch rates and rendering fish unsafe for consumption. There may be both direct (e.g. oiling of nets, traps and lines) and indirect impacts (e.g. public perception of tainted catch, exclusion zones) on these fisheries. The spread of key commercial fish spawning periods throughout the year indicates that there are no specific periods of higher sensitivity with respect to fish spawning. Temporary exclusion zones within the area of a spill or spill response activities can directly restrict access for fishers resulting in potential temporary financial losses. Longer term perceptions of tainted stock may have a longer duration (months). The consequence is assessed as Moderate (recovery time <1 year).	[B] Moderate	WCCD modelling predicts a 49 % probability of contact by dissolved aromatic hydrocarbon concentrations at ≥ 100 ppb for part of NWSTF, Southern Bluefin Tuna Fishery, Western Skipjack Fishery, Western Tuna and Billfish Fishery licence areas, with decreasing concentrations over time and space. Given the active effort by fishers in the immediate vicinity is reported to be low and largely limited to two fisheries, and their licence areas beyond the EMBA is extensive, the likelihood of a large number of fishers being exposed to a spill with a duration long enough to result in losses > 1 year is Unlikely.	[2] Unlikely	[5] Acceptable
Commercial Shipping				
Vessels passing through a spill may experience light oiling of short duration Depending on weather conditions, within 24 hours around 41 % of the mass on the surface will evaporate and another 54 % within a few days, leaving a small proportion (<5 %) of persistent components. No impacts to ports and only minor re-routing to avoid exclusion zones is forecast. No impacts from entrained or dissolved oils are forecast. The consequence is conservatively assessed as minor (temporary impact – days to weeks).	[A] Minor	While vessel traffic may be moderate to high, the likelihood of a WCCD occurring and of the spill resulting in impacts beyond re-routing (due to exclusion zones) for a few days is Rare.	[1] Rare	[1] Acceptable
Tourism and Recreation				
Low levels of tourism and recreational fishing may occur around the Rowley Shoals during the survey. Modelling forecasts a light oiling of short duration. Depending on weather conditions, within 24 hours around 41 % of the mass on the surface will evaporate and another 54 % within a few days, leaving a small proportion (<5 %) of persistent components. Exclusion zones surrounding spills may reduce aesthetics and access for recreational fishing and snorkelling/diving on emergent and intertidal reefs such as Clerke and Mermaid Reefs. Effects of entrained oil on fish may impact recreational fishing. Exposure of entrained oil to coral, fish, intertidal and submerged reefs and emergent sandy cays (all discussed above) may impact snorkelling and diving activities. The consequence is conservatively assessed as moderate (short term impact – < 1 year).	[B] Moderate	There is no recreational fishing permitted within the Mermaid Reef Marine Park, and limited fishing permitted within the Rowley Shoals Marine Park. Given the likelihood of a WCCD in the first instance is unlikely, the likelihood of a spill coinciding with the limited tourist season (typically Sept-December) and affecting the limited number of tourist operators is Unlikely.	[2] Unlikely	[5] Acceptable
Petroleum exploration and production				
Vessels passing through a spill may experience light oiling. No impacts to facilities, no significant re-routing and no equipment damage from light oiling is forecast. The consequence is conservatively assessed as Minor (temporary impact – days to weeks).	[A] Minor	The likelihood of a WCCD occurring and the spill resulting in more than a light oiling or minor re-routing for a short duration is Rare	[1] Rare	[1] Acceptable
Research Activities				
Vessels at the Rowley shoals or passing through a spill may experience light oiling. No equipment damage from light oiling is forecast but surveys may be impacted (e.g. monitoring water quality). Swimming/diving in Rowley Shoals may be excluded temporarily. The consequence is conservatively assessed as moderate (short term impact < 1 year).	[B] Moderate	The potential for light oiling is of short duration. The likelihood of a spill in the first instance, and the likelihood of a spill impacting beyond reduced water quality for a few days to weeks is Unlikely	[2] Unlikely	[5] Acceptable

Risk Type		**Overall Residual Risk**
Type B Risk	Risk is determined to be Type B for a WCCD as:	Tolerable

	• Although the activity and risk are amenable to assessment using well established methods, there is still some uncertainty and are numerous variables. Searcher has undertaken additional quantitative risk assessment (i.e. spill modelling) Searcher has undertaken additional risk assessment and cost/benefit analysis to identify further control measures to those identified as 'Good Practice' above.	

Environmental Performance Outcomes (EPOs) relating to this aspect include:
EPO 16 No long-term environmental impact to identified sensitive receptors in the event of an unplanned hydrocarbon spill to sea. The Control Measures considered for this aspect are shown below with Environmental Performance Standards (EPSs) and Measurement Criteria for the EPOs described in Section 9, Table 9-1.

Evaluation of Additional Control Measures (Detailed ALARP Evaluation)					
Control Measure	***Type***	***Benefit***	***Cost (% of project)***	***Implemented***	***Rationale***
Stakeholder consultation: Stakeholders actively operating in or near the operational area will be kept informed of daily survey activities through 24-hour look-ahead communication. (EPS 1.5)	Administrative	Minimise potential negative interactions with other vessels.	<0.5%	Adopted	Ongoing notification of activities during the survey will allow stakeholders to plan activities around the survey and avoid negative interactions. Benefit outweighs cost.
Support Vessel Procedure : Up to two support vessels used throughout the activity to manage vessel interactions and maintain communications with commercial shipping in the survey area, assist in the recovery of lost streamers and warning the survey vessel of in-water hazards 24/7. In case of emergency one support vessel will be capable of taking survey vessel under tow with all equipment deployed (to keep survey vessel and in-water equipment under control and in forward motion). A dedicated support vessel with tow capabilities will always remain with the survey vessel when within 20km of Mermaid Reef or other marine park.(EPS 1.16)	Administrative	Warning other vessels that may not be aware of the presence of the seismic vessel, minimises the risk of negative interactions. Identification of in water hazards allows the seismic vessel to avoid damage.	<5% of project cost	Adopted	Warning errant or unaware vessels of the seismic vessel presence and pre-identification of in water hazards will allow avoidance actions to be undertaken in a timely manner. Benefit outweighs cost.
Navigation equipment and procedures: AIS tracking device and Automatic Radar Plotting Aid (ARPA) installed on survey vessels and operating to aid identification by other vessels, including vessel speed, heading and virtual outer tail buoy locations to cover the extent of the seismic array. (EPS 1.6)	Engineer	Minimise potential negative interactions with other vessels.	<0.5%	Adopted	Navigation equipment that enables other marine users to track and avoid the survey vessel including vessel speed, heading and virtual outer tail buoy locations to cover the extent of the seismic array. Benefit outweighs cost.
Use of alternative fuels	Substitute	Some fuels have less persistent environmental characteristics	N/A	Not adopted	No known robust, cost effective commercially available alternative fuel or power systems.
Using MDO/MGO rather than HFO (EPS10.6)	Substitute	HFO is more persistent in the environment	HFO is cheaper than MGO/MDO	Adopted	Possum MSS will not use HFO as vessel fuel to reduce impact the environment in case of spill.
Seismic acquisition only during daylight hours	Substitute	Better visibility by day	Doubles operating cost	Not adopted	Substantial additional cost – doubling of survey duration and cost. Searcher would be unable to meet seismic data delivery requirements of clients. Extended program duration results in increased impacts from planned activities such

Evaluation of Additional Control Measures (Detailed ALARP Evaluation)					
Control Measure	***Type***	***Benefit***	***Cost (% of project)***	***Implemented***	***Rationale***
					as routine discharges and physical presence in shipping lanes. Adequate procedures and equipment in place (required electronic navigation, communications, lighting etc) to allow visibility at night.
Use of survey /support vessels with smaller fuel tank sizes	Substitute	Less fuel oil in tanks that could be spilled	Potential for delays in contracting vessels leading to delays in survey	Not adopted	In addition to additional risks to the survey schedules, more expensive vessels may be contracted. More frequent at sea refuelling would introduce additional risk of hydrocarbon spills. Adequate procedures and equipment in place to accommodate large tank vessels.
Seismic survey only occurs outside areas with substantial vessel traffic	Substitute	Lower probability of vessel collision outside key fishing grounds and busy shipping routes	N/A. Program objectives not met	Not adopted	This would create large gaps in survey data coverage. Large amounts of infill acquisition required. Very substantial additional costs in filling these gaps.

Residual Risk Following the Application of Additional Controls	
All 'Good Practice' management measures will be implemented in accordance with regulations and industry guidelines, Given the additional controls that have been proposed (such as the communications protocols and not using HFO), the likelihood of a spill occurring and the likelihood of the impacts eventuating is further reduced. However, the potential consequence remains the same (worst case for any receptor – Major) and the likelihood category reduces to Rare. Therefore, the overall risk ranking is Tolerable.	Tolerable

ALARP Justification

Given the decision context is 'Type B', and:

- An operational NEBA would be undertaken prior to implementing spill response activities (see OPEP, Appendix G).
- Should a spill occur, Searcher are able to monitor the effectiveness of the proposed control measures via the implementation of the OPEP and OSMP (see Appendix I)
- All relevant 'Good Practice' control measures, have been adopted by Searcher to manage the potential impacts and risks associated with collision and spill prevention to ALARP
- Searcher has committed to convey the 'Good Practice' control measures to vessel operators to ensure they are aware of their obligations
- There have been no objections or claims raised by relevant person(s).

Searcher considers all potential environmental impacts and risks associated with collision prevention and response are managed to ALARP.

Demonstration of Acceptability

Acceptable Level Criteria (General)	***Statement of how the acceptance criteria has been met***
1. The environmental impact or risk is deemed to be ALARP.	The residual risks associated with the risk of unplanned marine hydrocarbon spills from the survey are ALARP as detailed above.
2. Principles of ESD not compromised and relevant requirements for environmental approvals (EPBC Act Part 3, Division 1) met	An accidental WCCD comprising an MGO/MDO spill from the survey or support vessel does not pose: • a threat of serious or irreversible environmental damage any matters of national environmental significance • a significant threat to biodiversity and ecological integrity • a serious threat to the quality of the environment available to future generations
3. The management of the activity is consistent with a plan of management for a Marine Park and/or a recovery plan for a threatened species	The accidental release of diesel from a vessel collision resulting in fuel tank rupture within the operational area poses a low probability of impact to protected areas, therefore, there are no relevant management plans. The North-west Marine Parks Network Management Plan 2018 identifies marine pollution, including oil spills, as detrimental to marine life and a pressure on the region and allows oil spill response to be undertaken in all zones of MP's in the North-West network when aligned with a current accepted EP and when DNP is notified. Minimising chemical discharge is an action identified by the Recovery Plan for Marine Turtles in Australia 2017-2027. This requires that best practice industrial management is implemented to minimise impacts to marine turtle health and habitats. The accidental release of MGO due to a vessel collision is not planned by Searcher, but the application of industry 'Good Practice' guidelines will be applied to manage the potential for the event to occur and response undertaken.
4. Legislation and Other Requirements	Searcher confirm that all relevant legislative requirements have been addressed, including: • The OPGGSA 2006 and associated Regulations 2009 • MARPOL 73/78, Annex I (Prevention of pollution by oil) and Marine Order 91 (Marine pollution prevention – oil) • STCW Convention • Marine Notice 21/2013: Sound navigational practices • Navigation Act 2012 (including Marine Orders) and Regulations for Preventing Collisions at Sea 1972 (COLREGS) • Marine Order 21 (Safety of navigation and emergency procedures) • Marine Order 27 (Safety of Navigation and Radio Equipment) • Marine Order 28 (Operations standards and procedures) • Marine Order 30 (Prevention of collisions) • Marine Order 59 (Offshore industry vessel operations)
5. Internal Context – Searcher	Consistent with Searcher's Environmental Policy, company standards and procedures including Emergency response procedures.

6. External Context – Stakeholder objects and claims addressed	There have been no objections or claims raised by relevant stakeholders in relation to the accidental release of MGO from the seismic or support vessels.
Acceptable Level of Impact – Receptor Specific Criteria	NA. Searcher does not consider it acceptable for an emergency condition to occur, including an unplanned hydrocarbon spill.

6.11 EMERGENCY RESPONSE – OILED FAUNA

Nature and Scale of Impacts and Risks

As detailed in Section 6.10, a preliminary NEBA/SIMA has been documented in the Possum 3D MSS OPEP and concludes that an oiled wildlife response may be appropriate for Level 2 spills when oiled wildlife are discovered and safely accessible. Response may include pre-emptive capture or hazing of birds on shorelines, along with collection for rehabilitation. The preliminary NEBA/SIMA indicates an oiled wildlife response is unlikely to be effective for marine mammals and reptiles.

Hazards to marine fauna associated with oiled wildlife response stem from fauna handling during collection following oiling for rehabilitation purposes.

Within the spill EMBA, protected marine fauna that may be collected for rehabilitation in the event of an unplanned oil spill include seabirds nesting on the Rowley Shoals. Physical handling during the capture of individuals or pairs for rehabilitation carries the risk of transfer of disease from human handlers to the wildlife. Handling may also induce stress. Capture, rehabilitation and release could result in individuals being removed from their home ranges, increasing competition elsewhere in the population for resources. However, these risks are offset by the net benefit of successful rehabilitation of oiled individuals.

Although marine reptile (turtle) habitat critical and inter-nesting buffer BIA occur within the EMBA (see Section 4.6.4.3), the rookeries are not predicted to come into contact with shoreline oil (Appendix H).

The overall spill response will be mobilised and coordinated by the CA. In accordance with the WA State Hazard Plan for Marine Oil Pollution (2019), during a maritime environmental emergency DBCA will lead the oiled wildlife response under the control of the appointed CA. In Commonwealth waters the CA may also engage AMOSC to coordinate or support oiled wildlife response. Vessel crew would only be engaged in any pre-emptive response at the direction of the control agency and trained oiled wildlife response team (e.g. DBCA, AMOSC).

Good Industry Practice

Spill response strategies are selected by the CA following an assessment of their potential benefits and/or dis-benefits using an industry-standard approach (i.e. NEBA or SIMA). (EPS 11.1)
Oiled wildlife response is coordinated by trained and experience personnel under the designated CA, with guidance from the Western Australian Oiled Wildlife Response Plan (DpaW 2014b) and the Pilbara Region Oiled Wildlife Response Plan (DpaW 2014a). Vessel personnel will only respond under the direction of DBCA or AMOSC. (EPS 11.2)
Vessels used in oiled wildlife capture will approach fauna from the spill toward the animals at less than 6 knots. (EPS 11.3)

Environmental Impact Assessment

Potential Consequence	Rank	Likelihood Discussion	Rank	Residual Risk
Marine fauna				
The implementation of oiled wildlife response, including relocation/hazing to avoid oiling and capture following oiling for rehabilitation purposes may cause short term impacts (<1 year recovery) to individuals.	[B] Moderate	Given the well-established and proven history of effective oiled wildlife response protocols it is considered is considered unlikely that lasting negative impacts would occur.	[2] Unlikely	[5] Acceptable

Risk Type		Overall Residual Risk
Type A Risk	Risk is determined to be Type A as: • the activity and risks are well understood, with little uncertainty • good practice control measures are well defined • there has been no stakeholder feedback concerning the potential impact of oiled wildlife displacement and handling during emergency response activities. Given the application of 'Good Practice' control measures, the activity is relatively well understood, the predicted residual risk is well understood and there is no significant stakeholder interest the basis of ALARP has been made on a 'Type A' decision context.	Acceptable

ALARP Justification

Given the decision context is 'Type A', and:

- Searcher has a high degree of certainty of the effectiveness of well-established control measures to ensure the level of impact to marine fauna from oiled wildlife displacement and handling during emergency response activities is ALARP.

• All good practice control measures have been adopted by Searcher to manage the potential impacts and risks associated with oiled fauna emergency response; and • There has been no stakeholder feedback concerning oiled fauna emergency response due to the survey Searcher considers that all potential environmental impacts and risks associated with oiled wildlife displacement and handling during emergency response activities are managed to ALARP.	
Demonstration of Acceptability	
Acceptable Level Criteria (General)	***Statement of how the acceptance criteria has been met***
1. The environmental impact or risk is deemed to be ALARP.	The residual risks associated with oiled wildlife displacement and handling during emergency response activities are ALARP as detailed above.
2. Principles of ESD not compromised and relevant requirements for environmental approvals (EPBC Act Part 3, Division 1) met.	There is no threat of serious or irreversible environmental damage to any matters of national environmental significance associated with oiled wildlife displacement and handling during emergency response activities. There is no significant threat to biodiversity and ecological integrity associated with oiled wildlife displacement and handling during emergency response activities. There is no serious threat to the quality of the environment available to future generations associated with oiled wildlife displacement and handling during emergency response activities.
3. The management of the activity is consistent with a plan of management for a Marine Park and/or a recovery plan for a threatened species.	Oiled wildlife displacement and handling during emergency response activities poses no impact to any protected areas, therefore, there are no relevant management plans. The Whale Shark Wildlife Management Program no. 57 states that the effects of oil pollution on whale sharks is poorly understood, and so recommends a precautionary approach. The Conservation Management Plan for the Blue Whale (2015-2025) and the Recovery Plan for Marine Turtles in Australia (2017-2027) identify acute chemical discharge as causing long-term, population level decline due to toxicity and associated mortality and recommends the use of an oil spill/ emergency response plan , which is provided as a control measure in Section 6.10 and is a requirement under the OPGGS(E)R.
4. Legislation and Other Requirements.	Searcher will implement a NOPSEMA accepted OPEP as required under the OPGGS(E)R.
5. Internal Context – Searcher.	Consistent with Searcher's Environmental Policy.
6. External Context – Stakeholder objects and claims addressed.	Emergency response agencies to be notified and consulted under OPEP.

7 IMPLEMENTATION STRATEGY

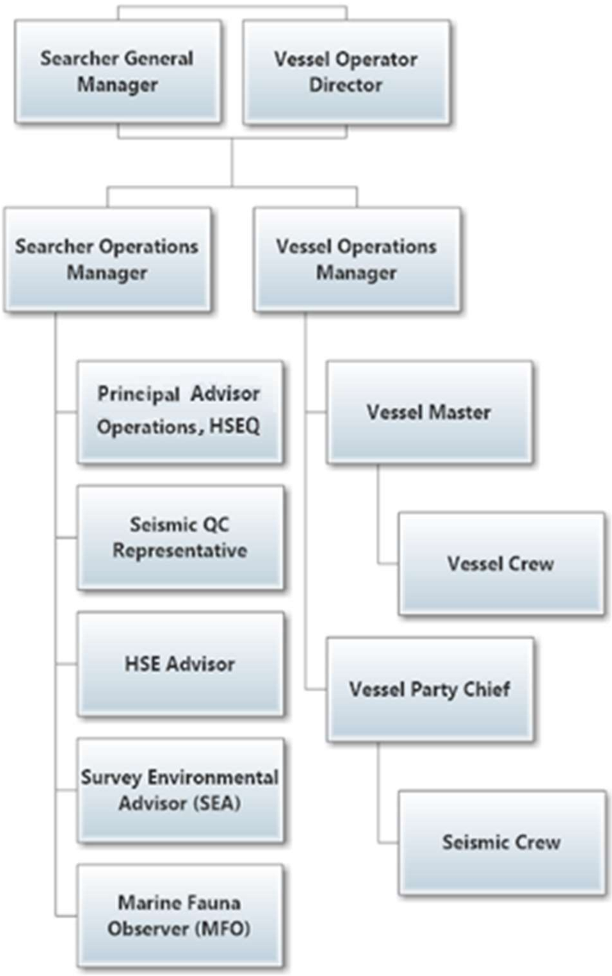
The implementation strategy is provided in accordance with Regulation 14 of the OPGGS(E)R. Searcher is responsible for ensuring that the proposed Possum 3D MSS is managed in accordance with this implementation strategy, the Searcher Environment Policy and Searcher Integrated Management System (IMS).

7.1 ENVIRONMENTAL MANAGEMENT SYSTEM

The Searcher OH&S Policy (HSE-POL-01) and Environmental Policy (HSE-POL-02; Appendix A) are part of the Searcher IMS. These are the systems, procedures and plans that describe how Searcher manages their business activities and ensure that appropriate management measures are applied as required to minimise the risk of environmental disturbance from operations.

7.2 ROLES AND RESPONSIBILITIES

Key implementation, management and review roles and responsibilities for Searcher and contractor personnel are described in Table 7.1. It is the responsibility of all Searcher employees and contractors to ensure that the requirements of the Searcher OH&S Policy (HSE-POL-01) and Environmental Policy (HSE-POL-02; Appendix A) are applied in their areas of responsibility and that the personnel are suitably trained and competent in their respective roles. The chain of command for planned activities is presented in Figure 7.1. Emergency response details are provided in Section 7.10.



QC = Quality Control; MFO = Marine Fauna Observer; SEA = Survey Environmental Advisor

Figure 7.1 – Chain of command during planned activities

Table 7.1 – Roles and responsibilities relevant to this EP

Role	Responsibilities
Searcher General Manager	Has overall responsibility and accountability for delivering the business goals and vision. Develops and enforces company standards, procedures, policies and guidelines for quality and Health, Safety and Environment (HSE).
Searcher Operations Manager	Liaises with third parties and governments to ensure compliance with company policies and legislation. Provides a link between the company and those on board the seismic vessel to have direct access to the highest level of management. Manages the Quality Health, Safety and Environment (QHSE) and Integrated Management System (IMS) to ensure the company adopts a strong QHSE culture, operating at or above industry and internationally recognised standards at all times.
Searcher Principal Advisor Operations & HSEQ	Provides support, environmental assistance, project management, report co-ordination, government and third-party liaison for company operations activities, including preparation of approvals documentation and stakeholder consultation. Develops, implements and improves the QHSE and IMS.
Searcher QC Representative	Acts as Searcher's representative relaying instruction from company management to the crew, monitors data quality and operational productivity.
Marine Fauna Observer (MFO)	Coordinates monitoring efforts with the survey operation (through seismic personnel and vessel bridge crew). Conducts visual observations for marine animals during MSS. Advises on and monitors compliance with applicable regulations, guidelines and permits, as stipulated by the country or specific region of operation. Ensures compliance with this EP and the standard cetacean interaction management procedures outlined in the EPBC Policy Statement 2.1, including adequate fauna watch and advise on implementation of operational responses to regulatory mitigation measure requirements. Maintains and distributes records of marine mammal sightings and other species of concern and submits daily and final survey sighting reports to the Operations Manager, via the QC Representative.
Searcher HSE Advisor	Searcher will assign a HSE Advisor to monitor HSE performance during the activity. The HSE Advisor has a primary role of monitoring vessel HSE performance and compliance with the activity Project HSE Plan, Searcher's QHSE, IMS and recognised industry standards. The HSE Advisor also acts to relieve the Searcher QC Representative during break and off-shift periods. HSE Advisors are experienced seismic personnel with strong HSE credentials. The HSE Advisor reports to the Searcher QC Representative but has the authority to shut down any unsafe acts observed. The HSE Advisor also has responsibility with the QC Representative to notify the Searcher Operations Manager in the event of an oil spill.
Searcher Survey Environmental Advisor (SEA)	Responsible for monitoring and reporting on the compliance of all EP commitments, through observations and assessments of performance against stated criteria. Gathers evidence to support compliance or, as may be required, to document any and all breaches of the EP commitments. Ensure all criteria in the EP Compliance Register are assessed at the recommended intervals for each item. Holds a dual role as part-time MFO to support the dedicated MFO during breaks etc. Reports to the Seismic QC Representative for daily operational matters. Prepares weekly and survey close-out reports for NOPSEMA using the applicable notification and reporting forms for the activity.
Acquisition contractor's Vessel Operator Director	Has top level responsibility for all vessel-based operations, usually reporting to the Board of Directors on the operational and financial performance of the vessel(s) assigned under his/her control. Has ultimate responsibility for ensuring that all seismic survey operations performed by the vessel are conducted within or exceeding the company's own Integrated Management Systems, the Client's management systems and the Government regulatory requirements of the countries within which those operations take place.
Acquisition contractor's Vessel Operations Manager	This shore-based position manages and coordinates all tasks and activities of seismic vessel operations, other than routine daily activities that are managed by the Vessel Party Chief. Organises vessel mobilisations, port calls, crew changes, resupply, refuelling and demobilisation activities. Ensures that the company management system is implemented, adhered to, measured and improved by all involved. Ensures compliance with local regulations in all areas of operation.
Acquisition contractor's Vessel Master	Has ultimate responsibility (at sea) for the safe execution of all vessel operations including compliance with relevant regulations and notifications. Ensures vessel audits, inspections, emergency drills, training, HSE and inductions are undertaken. Ensures maintenance of equipment and records to statutory requirements. Implements the SOPEP, if required, in accordance with the incident reporting procedures.

Role	Responsibilities
	Reports to the Vessel Operations Manager regarding logistics and operational support but has the authority to overrule any external directives that may risk the safety of the vessel and its crew or the environment in which it is operating. Responsible for ensuring that oil spill containment and recovery kits are appropriately stocked at all times throughout the proposed survey. Conduct a SOPEP drill assessment and evaluation of all completed drills and debrief the crew regarding the efficiency of the drill as well as recommendations for future drills. Ensures that all vessels will have spill response bins/kits in close proximity to hydrocarbon storage areas.
Acquisition contractor's Vessel Crew	Responsible for applying non-seismic vessel operating procedures in a professional and safe manner with attention to good housekeeping procedures and work practices. Includes personnel responsible for the repair and maintenance of vessel plant and equipment, food and accommodation for all crew, watch keeping and vessel navigation and compliance with local and international laws of the sea. Ensure that any incidents are immediately reported to the Vessel Master.
Acquisition contractor's Vessel Party Chief	Located on the vessel and is responsible for the direction, oversight, logging and reporting on the day-to-day conduct of the survey. Verifies that operations are undertaken in a manner consistent with the performance objectives and environmental management procedures detailed in this EP. Ensures that activities are monitored for compliance against this EP, with outcomes and any changes in operational risk being reported to the Operations Manager. Ensures procedures and work instructions are known, understood and followed. Collects data and records for the Environmental Performance Close-out report. Ensures induction is conducted with vessel crew with environmental sensitivities, control measures and roles and responsibilities are communicated and understood.
Acquisition contractor's Seismic Crew	Responsible for application of seismic survey operating practices and procedures in a professional and safe manner, with attention to good housekeeping procedures and work practices. Ensure that any HSE incidents associated with the seismic activities are immediately reported to the Vessel Master and Vessel Party Chief. Required to be positively involved in the implementation of the company and vessel management systems, including HSE Observation Cards, Permits to Work, HSE and Toolbox Meetings and Emergency Drills. Includes Instrument Operators, Navigation personnel, Observers, Seismic Source Mechanics, Data Processors, Medics and HSE Advisors.

7.3 TRAINING AND COMPETENCIES

7.3.1 Environmental Inductions

All personnel required to work on the survey and support vessels will be given an HSE induction prior to the commencement of the Possum 3D MSS. Induction records (Register) will be maintained to ensure all personnel are inducted and attended relevant HSE inductions. The induction will include the following information (EPS 12.1) :

- a description of the environmental sensitivities, heritage and conservation values of the Possum 3D MSS operational area and surrounding waters
- overview of marine fauna and other marine users likely to occur in the area
- outline of all environmental management measures and EPSs detailed in the EP, including:
    a. fauna interaction requirements
    b. policy of no fishing
    c. protocols for communicating and interacting with fishers
    d. procedures for reporting of any environmental incidents or hazards
- overview of highest risk activities, emergency response and spill management procedures as detailed in the EP and OPEP
- importance of following procedures and using JHAs to identify environmental risks and mitigation measures
- roles and environmental responsibilities, HSE expectations including reporting of key personnel aboard the survey vessel, including during emergencies.

7.3.2 Competencies

Specific responsibilities for Searcher employees will be detailed in job descriptions and appropriate training provided to individuals.

As relevant, seismic and support vessel crew will hold a current certificate appropriate to their duties in accordance with Marine Order 70 – seafarer certification (e.g. STCW or Elements of Shipboard Safety) and be familiar with the ships' navigational equipment (see sections 6 and 7 of the International Safety Management Code).

A training, induction and competency matrix will record that relevant crew have been trained as necessary for their position.

7.3.2.1 Vessel Master

The survey vessel master shall possess appropriate skills, knowledge and qualifications to command the vessel as required by AMSA for the tonnage and vessel class to be utilised.

7.3.2.2 Marine Fauna Observers

An experienced MFO, as determined through review of their CV and relevant experience, will be employed for the duration of the Possum 3D MSS. MFO must be trained to an internationally recognised standard and have conducted at least 1 survey under the supervision of a qualified MMO, in accordance with the EPBC Policy Statement 2.1 requirements, MFOs will have been "*trained and experienced in whale identification and behaviour, distance estimation, and be capable of making accurate identifications and observations of whales in Australian waters*."

7.4 CONTRACTOR MANAGEMENT

The requirements of this EP will be rolled out to contractors through the following processes (EPS 12.1) :

1. The requirement to comply with the EP will be included in contracts for vessels.
2. A copy of the approved EP and OPEP will be provided to the vessel operators.
3. Contractor HSE Plan will be required to acknowledge, as appropriate, relevant commitments in the EP.
4. Contractor personnel will be required to attend the HSE Induction (Section 7.3.1).
5. A review of contractor compliance with the relevant environmental performance standards will be initiated prior to mobilisation (as detailed in Section 7.5).

7.5 RECORD KEEPING

The collection of records against the measurement criteria in Section 8.1 will form part of the permanent record of compliance maintained by Searcher. Records generated for the Possum 3D MSS will be easily retrievable and retained for five years after the day when the EP ceases to be in force. Operational documents and records associated with this EP include:

- the EP that is in force and any versions of the EP previously in force;
- induction presentation and attendance records;
- training certification records, training and competency matrices;
- daily reports;
- waste manifests;
- biofouling records (e.g. biofouling management plan and record book);
- marine fauna observation sheets;
- audit and inspection records;
- management of change (MoC) records;
- consultation records;
- written incident notifications;
- recordable and reportable incident reports;
- incident investigation records; and
- evidence of close-out of corrective actions from incident investigations and inspections.

Records will be made available in accordance with Regulation 28 of the OPGGS(E)R to the persons listed under Sub regulation 28(2) on written request.

7.6 ASSURANCE ACTIVITIES

An Environmental Compliance Register (ECR) will document all EPSs and EPOs and will be the primary reference for compliance monitoring. The register will include the identification of personnel responsible for the implementation of each commitment as well as the proposed assurance activity which will be used to confirm compliance with the commitments. The register will be maintained up to date with any changes to commitments which have been documented through the requirements under management of change (Section 7.8).

The ECR will document all EPSs and EPOs and will be used to support audit, inspection and monitoring activities and record evidence of compliance.

Any non-conformances identified during an assurance activity will be reported, tracked and closed-out in accordance with Section 7.7.

7.6.1 Reviews, audits and inspections

Audits and inspections which will be undertaken are as follows:

- premobilisation assessment of vessel compliance against relevant EPSs (e.g. procedures and equipment for managing routine discharges and emissions are in place, SOPEP is in place).
- premobilisation assessment of completion of all commitments assigned to Searcher to directly action
- weekly HSE inspections of the seismic vessel will include assessment of compliance with relevant EPSs.
- a post campaign review of relevant EPSs.

Relevant EPSs for each review, audit and inspection are indicated in Section 9.

7.6.1.1 Environment Plan Review

Annually, and at least 12 weeks prior to the survey (unless the annual review falls within the same period), Searcher will undertake a pre-survey review of the EP (EPS 1.25) to ensure that the environmental impacts and risks of the activity continue to be identified and reduced to a level that is ALARP, the control measures, EPSs and EPOs in the EP appropriate for reducing the environmental risks of the activity to a level that is ALARP. The review will consider the following:

- legislative or regulatory guideline changes (Section 2);
- Industry practises, Financial assurance requirements, Stakeholder expectations
- existing information and available scientific literature relating to any component of the receiving environment described in Section 4 (including BIAs);
- changes to stakeholders;
- overlap with specific charter and dive operators and if SIMOPS is required; and
- avoidance of multiple surveys undertaken in same area less than one month apart.

Searcher's Change Management procedure (IMS-PRO-01, Section 7.8), will determine if identified changes or modifications to the Possum 3D MSS triggers revision of the EP under Regulation 17 of the OPGGS(E)R.

If new information (from scheduled verification see Figure 8.1) suggests that impacts or risks are no longer reduced to acceptable levels, or that controls are no longer effective in reducing the impacts or risks to ALARP and acceptable levels, then identifying further controls will follow the risk assessment methodology described in Section 5. Any opportunities for improvement identified through the risk assessment (i.e. new controls adopted) could be implemented via a Management of Change (Section 7.8). If the result of the risk assessment determines that the residual risk ranking has increased for a given risk for the activity, a revised EP will be prepared and submitted to NOPSEMA.

The OPEP will be reviewed in accordance with the review schedule set out in Section 1.1 of the OPEP (Appendix I).

7.6.2 Monitoring activities

Searcher will request survey vessels to maintain and make available a quantitative record of emissions and discharges as required under Regulation 14(7) of the OPGGS(E)R, including seismic operation records, waste discharges and estimates of sewerage discharges.

7.6.3 Emergency Response Tests

Searcher will initiate emergency response tests as required with the appropriate personnel.

The Acquisition Contractor's Vessel Master will conduct a vessel SOPEP and OPEP test via a drill assessment and evaluation with recommendations for future drills :

- prior to commencement of the activity,
- when response arrangements are significantly modified, following response exercises,

- where required by any action defined in the post-exercise report.

7.7 MANAGEMENT OF NON-CONFORMANCE

Non-conformances identified during assurance activities or in relation to an incident shall be tracked and monitored until closed. Searcher employees and contractors are required to report all environmental incidents and any non-conformance with an EPO or EPS detailed in the EP as well as Searcher's environmental management framework and contractor HSE systems.

Where non-conformances suggest that specified mitigation measures are no longer adequately demonstrating that the activity is managed to ALARP, or where new developments in the scientific understanding and knowledge of impacts and risks is present, an internal risk assessment will follow the process described in Section 5. To ensure that the environmental impacts and risks of the activity are continually identified and reduced to a level that is ALARP and acceptable, inadequacies and improvement opportunities will be amended via a Management of Change (Section 7.8).

Incidents and non-conformances on board the vessel will be reported in accordance with the vessel operator internal HSE incident reporting procedures, including details of the event, immediate actions to control the situation, and corrective actions to prevent reoccurrence. Detailed investigations will be undertaken by Searcher for all high potential (serious consequence and above rated) environmental incidents. These investigations will include the Master, Party Chief, SEA and Client Site Representative, as appropriate. The regulatory reporting requirements for non-conformance are outlined in Section 7.9.

7.8 MANAGEMENT OF CHANGE

Searcher will monitor potential internal and external triggers of change to the activity. If any of the following types of changes are identified the Searcher Change Management Procedure (IMS-PRO-01) will be implemented, considering the HSE and quality implications of temporary or permanent organisational, system or operational changes.

Internal changes:

- new stage of activity required e.g. timeline changes required to complete acquisition or changes to spatial extent of the activity
- reduced ability to effectively implement the EP to meet its stated performance standards
- incremental changes in the activity, including changes to equipment, increasing the risk of significant impact.

External changes:

- new hazards or risks, e.g. new relevant person, or relevant person with new meritorious issues, gazetting of a new marine park
- NOPSEMA website listing of new third-party Eps including increased petroleum exploration in the region with potential for increased cumulative risks or simultaneous activities in the area that may impact Searcher or be impacted by Searcher activities (e.g. divers working in the area)
- legislative changes or government documents, such as changes to management plans, species recovery plans, conservation advice releases from DAWE
- new publications, research or guidelines
- external audits, inspections and investigations.

Monitoring for potential external triggers of change will be conducted via subscriptions to relevant government websites, journals and advices, as well as through the ongoing consultation process (Section 8.7).

Changes will also be identified via the assurance activities detailed in Section 7.6.1.

A risk assessment will be undertaken for changes to assess the potential environmental impact of the change using the risk assessment process described in Section 5.

Searcher will submit a proposed revision of this EP to NOPSEMA if any of the triggers under Division 2.4 of the OPGGS(E)R are met:

- the commencement of any new activity, or any significant modification, change, or new stage of an existing activity, not provided for in this EP
- the occurrence of any:

  - significant new environmental impact or risk
  - significant increase in an existing environmental impact or risk
  - series of new environmental impacts or risks which together amount to a significant new environmental impact or risk or a significant increase in existing environmental impact or risk
- a change of titleholder
- upon the request by the regulator.

An EP change register will be maintained for the EP and the OPEP to track the closeout of any actions implementing the change, including updating the EP and OPEP Environmental Commitments Register. If there is a need to reissue the EP to NOPSEMA, all changes recorded in the register will be incorporated when revising the EP.

7.9 REPORTING ARRANGEMENTS

7.9.1 Annual Report and Environmental Performance Report

Regulation 14(2) of the OPGGS(E)R requires that "*the titleholder will report to the Regulator in relation to the titleholder's environmental performance for the activity; and provide that the interval between reports will not be more than 1 year*". Searcher will submit to NOPSEMA an annual report comprising a review of achievement of the EPO and EPS for that year. Annual reports shall be submitted within two months of the anniversary of the acceptance of this EP, and will include an assessment of adherence to requirements of the EP, including the EPOs and EPSs (see Section 9), and a review of all recordable and reportable environmental incidents (see Section 7.9.3)

Regulation 26(C) requires "*a titleholder undertaking an activity must submit a report to the Regulator in relation to the titleholder's environmental performance for the activity, at intervals provided for in the environment plan.*" The annual report shall be submitted to satisfy this requirement.

7.9.2 Marine Fauna Reporting

A record will be maintaned of marine fauna interactions during operations. The MFO Final Report on the conduct of the survey, and any marine fauna sightings/interactions (including any whale-instigated shut-downs of the acoustic source), will be provided to the DAWE within two months of the completion of the activity containing:

- the location, date and start-up time of the survey;
- the date/times/reasons when observations were hampered by poor visibility or high winds;
- the location and time any start-up delays, power downs or stop work procedures instigated as a result of whale sightings;
- the location, time and distance of any cetacean, whale shark and turtle sightings; and
- the date and time of completion of the survey and details of any incidents (reportable, recordable) / non-conformances.

Detailed reports of all cetacean sightings will be recorded using the DAWE Cetacean Sightings Application (available upon request to sightingsdata@aad.gov.au) to ensure all marine fauna sightings are properly recorded and reported.

7.9.3 Incident Reporting

7.9.3.1 Reportable Environmental Incidents

A reportable environmental incident is defined under Regulation 4 of the OPGGS(E)R as '*an incident relating to the activity that has caused, or has the potential to cause, moderate to significant environmental damage*'. Searcher have determined that this relates to a consequence rating (as described in Section 5) of Serious [C] or above and the following incidents would be reportable:

- introduction of IMS species;
- vessel collision resulting in large hydrocarbon spill; and
- vessel collision with protected marine fauna.
- injured fauna not necessarily attributed to the vessel
- a large volume of hazardous chemical or waste release greater than Level 1 spill

In line with guidance provided by NOPSEMA (Notification and Reporting of Environmental Incidents Guidance Rev 4 2014), additional environmental incidents that are required to be reported to NOPSEMA, whether or not they have been classified as having the potential to cause '*moderate to significant environmental damage*' includes any impacts to Part 3 Protected Matters under the *Environment Protection and Biodiversity Conservation Act 1999*. Matters under Part 3 of the EPBC Act that are relevant to the proposed activity are as follows:

- National Heritage places;
- Listed Threatened Species and Communities;
- Listed Migratory Species;
- Commonwealth marine areas; and
- Nationally Important Wetlands.

The notification method and timing to be used for reportable environmental incidents is described in Table 7.2.

7.9.3.2 Recordable Environmental Incidents

A recordable environmental incident as defined in the OPGGS(E)R as "*an incident arising from the activity that breaches an environmental performance outcome or standard in the EP that applies to the activity and is not a reportable environmental incident". In accordance with Reg 26B* recordable environmental incident report will be submitted not later than 15 days after each calendar month. will be provided monthly.

Section 9 of this EP details the EPO, EPS and measurement criteria for the activity. Any breach of these will be raised as a recordable environmental incident and managed as per the requirements in Table 7.2.

7.9.3.3 Incident reporting to other agencies

In the event of a significant impact to MNES, Searcher will, in addition to notifying NOPSEMA, provide a written notification to DAWE within three days of becoming aware of the event, and provide additional information as available, if requested by DAWE.

Introduction of IMS and any other species that appear to have clear impacts or invasive characteristics will be reported to the Commonwealth Department of Agriculture – Marine Biosecurity Unit and WA DPRID within 24 hours following confirmation that species has invasive characteristics. This notification will be forwarded to industry bodies where relevant (e.g. WAFIC).

Actual or suspected injury/mortality of protected marine fauna as a result of vessel collision will be reported to the online National Ship Strike Database as soon as possible or within 7 days of becoming aware of the incident.

Additional requirements related to the reporting of oil spills are detailed in the Possum 3D MSS OPEP (Appendix I).

The vessels are responsible for reporting all chemical spills to water to AMSA.

Table 7.2 – Summary of External Incident Reporting

Relevant person or organisation	Requirement	Timing	Method
NOPSEMA	Notification and reporting of all **recordable** environmental incidents Containing a record of all recordable environmental incidents that occurred during the calendar month. If no recordable environmental incidents have occurred during a particular month, a Nil Incident report must be submitted.	ASAP after the end of the calendar month, and in any case, not later than 15 days after the end of the calendar month.	Written to submissions@nopsema.gov.au
	Notification and reporting of all **reportable** environmental incidents. • all material facts and circumstances concerning the incident that are known at the time • any actions taken to avoid or mitigate any adverse environmental effects • any corrective actions that have been taken, or are proposed to be taken, to prevent a repeat of similar incidents occurring.	Verbal notification to NOPSEMA ASAP and no later than 2 hours, of a reportable environmental incident occurring.	Verbal to 1300 674 472
NOPSEMA NOPTA WA DMIRS	Notification and reporting of all **reportable** environmental incidents including • all material facts and circumstances concerning the incident that are known at the time • any actions taken to avoid or mitigate any adverse environmental effects • any corrective actions that have been taken, or may be taken, to stop, control or remedy the reportable incident • actions taken, or proposed to be taken, to prevent a repeat of similar incidents occurring	Initial written notification using form N-03000-FM0831 ASAP to NOPSEMA. Part 1 not later than 3 days after the first occurrence of the reportable incident, or another period specified by NOPSEMA, and Part 2 within 30 days of notified incident if the incident is an accident or dangerous occurrence. This report is copied to NOPTA and WA DMIRS within 7 days of giving the written report to NOPSEMA.	Written to NOPSEMA to submissions@nopsema.gov.au NOPTA to resources@nopta.gov.au WA DMIRS to petroleum.environment@dmirs.wa.gov.au
DAWE NOPSEMA	Injury to EPBC Act listed migratory or threatened species	ASAP no later than 48 hrs of becoming aware of the incident	Verbal or written to DAWE Phone: (02) 6274 1372 or 1800 110 395. Email: compliance@environment.gov.au NOPSEMA to submissions@nopsema.gov.au
Australian Antarctic Division –Australian Marine Mammal Centre	Actual or suspected injury to whales from ship strike	ASAP or within 7 days of becoming aware of the incident	Online via the National Ship Strike Database: https://data.marinemammals.gov.au/report/shipstrike/new
Commonwealth Department of Agriculture-Marine Biosecurity Unit WA DPIRD Industry bodies where relevant eg WAFIC	Introduction of IMS – Pests and any other species that appear to have clear impacts or invasive characteristics.	Within 24 hours following confirmation that species has invasive characteristics	Written to biosecurity@fish.wa.gov.au

Relevant person or organisation	Requirement	Timing	Method
WAPOL WA Registrar of Aboriginal Sites	Discovery of Aboriginal remains made during the activity, or though oil spill response activities	ASAP	WAPOL Verbal to 131 444 WA Registrar of Aboriginal Sites Verbal to (08) 6551 8000 Written to registrar@dplh.wa.gov.au

7.10 EMERGENCY RESPONSE

The survey vessel will have a vessel-specific Emergency Response Plan (ERP) and SOPEP. In addition, an OPEP (Appendix G) has been developed for the Possum 3D MSS, in accordance with Regulation 14(8) of the OPGGS(E)R. The OPEP is provided describes the spill response framework, response strategies, response organisation, equipment and resources, exercises and drills, and mobilisation of the Searcher Incident Management Team (IMT).

As described in the OPEP, AMSA is the Control Agency for marine pollution events in Commonwealth waters and will therefore direct and lead the spill response arrangements and monitoring requirements in the event of a significant marine oil spill. The vessel SOPEP is the principal response document for the vessel in the event of an oil spill, providing specific response provisions to contain onboard spills or mitigate oil spills originating from the vessel. Specific emergency procedures include steps to control discharges for bunkering spills, hull damage, fire and explosions, collisions, tank failure, sinking and vapour release.

The feasible spill response options identified in the OPEP are limited to source control, and monitoring and evaluation, with possible oiled wildlife recovery. Vessel activity associated with these responses would present the same impacts and risks assessed for survey operations in Sections 6 & 7 and is not expected to introduce additional hazards to the marine environment or to result in significant additional potential impacts to those previously described.

7.10.1 Emergency Response Command

In the event of an emergency of any type the survey vessel master will assume overall onsite command and act as the Emergency Response Coordinator (ERC) unless otherwise dictated in the OPEP. All persons aboard the vessel/s will be required to act under the ERC's directions. The survey vessel will maintain communications with the Searcher VOM and/or other emergency services in the event of an emergency. Emergency response support can be provided by Searcher if requested by the ERC. The survey and support vessels will have equipment aboard for responding to emergencies, including but not limited to medical equipment, firefighting equipment and oil spill equipment.

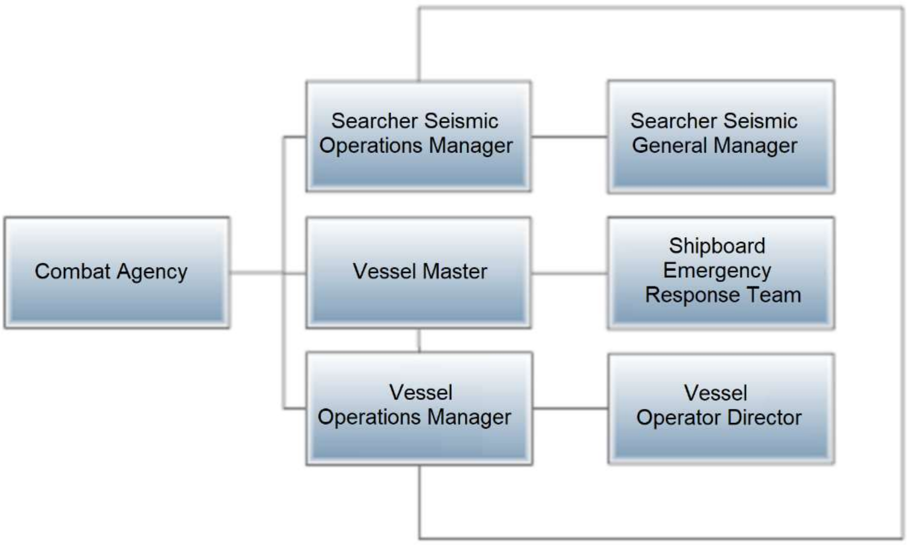


Figure 7.2 – Emergency chain of command

7.10.2 Cyclone and Dangerous Weather

Tropical cyclones and other severe weather events have the potential to cause damage to survey equipment, risk to the safety and health of survey personnel, and potential to cause spills of hazardous materials into the environment from damaged vessels. Surveys conducted within the operational area may have to be undertaken during cyclone season (December to April) in order to avoid peak migration periods for whales and whale sharks.

The seismic vessel will implement an extreme weather procedure for the Possum 3D MSS in the event of an approaching dangerous weather situation. In addition to customised forecasts the following regional charts on the Bureau of Meteorology website provide useful information and are sometimes more accurate than some of the customised local area modelling, including:

- four-day MSLP (Mean Sea Level Pressure) prognosis;
- 10-m wind analysis; and
- Australian Region Total Significant Wave Height.

If sustained, severe weather looks to be forming within the region, the vessels may leave the survey area for safer waters. The survey vessel will retrieve the seismic equipment prior to leaving the Operational Area when moving to safer waters and in a worst-case scenario proceed to the nearest port.

The petroleum activity commences when the seismic source is first deployed within the Operational Area and extends until the seismic source has been retrieved and the seismic vessel has exited the Operational Area. This EP does not cover periods when the survey and support vessel are not engaged in survey or associated activities, as at those times the survey vessel are deemed to be operating under the Navigation Act 2012 and not performing a petroleum activity. These actions include:

- cyclone or dangerous weather avoidance;
- maintenance activities outside the Operational Area;
- port calls; and
- crew changes via helicopter/support vessel.

7.11 CONTINUOUS IMPROVEMENT

Searcher has a comprehensive Integrated Management System covering QHSE Systems and is certified to ISO 9001:2015 for the provision of geological, geophysical, geotechnical and GIS data acquisition, collection, processing and interpretation to the exploration and resources sectors.

Searcher has processes and procedures to ensure that the organisation has the culture, processes and structures to identify and manage potential health, safety and environment hazards over the life of activity operations. Searcher has a corresponding bespoke risk management software which is used as a checklist of known impacts and risks. An Environment Impact Identification (ENVID) workshop is run prior to each project and subsequently reviewed to record any lessons learnt as continual improvement for future project execution.

Searcher's senior management is committed to continually improve the standards, quality and safety of its products, activities and services through improvements in its processes and procedures throughout all aspects of its business.

8 CONSULTATION

8.1 BACKGROUND

In accordance with Regulation 10A(g) of the OPGGS(E)R this section demonstrates that (i) the titleholder has carried out the consultation required Regulation 11A, and that (ii) the measures (if any) that the titleholder has adopted, or proposes to adopt, because of the consultations, are appropriate.

For the purposes of the Consultation Process, the information materials and flyers include information to clarify the Survey Areas as below:
• The '**Acquisition Area**' (AA) covering ~5,400 sqkm is the focus area where the full-fold 3D seismic data will be acquired.
• The '**Active Source Area**' (ASA) of ~8,584 sqkm includes a buffer around the Acquisition Area and is the area within which the seismic energy source may be operational, including soft start procedures and line run-outs (required to obtain full fold coverage). The full seismic source will not be operational outside of this area, although small, individual source elements may be tested during maintenance outside the ASA but still within the Operations Area.
• The '**Operational Area**' (OA) covers ~13,447 sqkm providing an ASA 'operational buffer', required for activities including streamer deployment, retrieval, maintenance or recovery, routine vessel manoeuvring and other non-seismic vessel activities.

Any reference to the AA in consultation materials therefore specifically relates to the 5,400 sqkm focus area, where the full-fold 3D seismic data will be acquired, which is yet to be defined and may be anywhere within the 8,584 sqkm ASA (Figure 1.1 Acquisition Area)

8.2 STAKEHOLDER CONSULTATION PROCESS

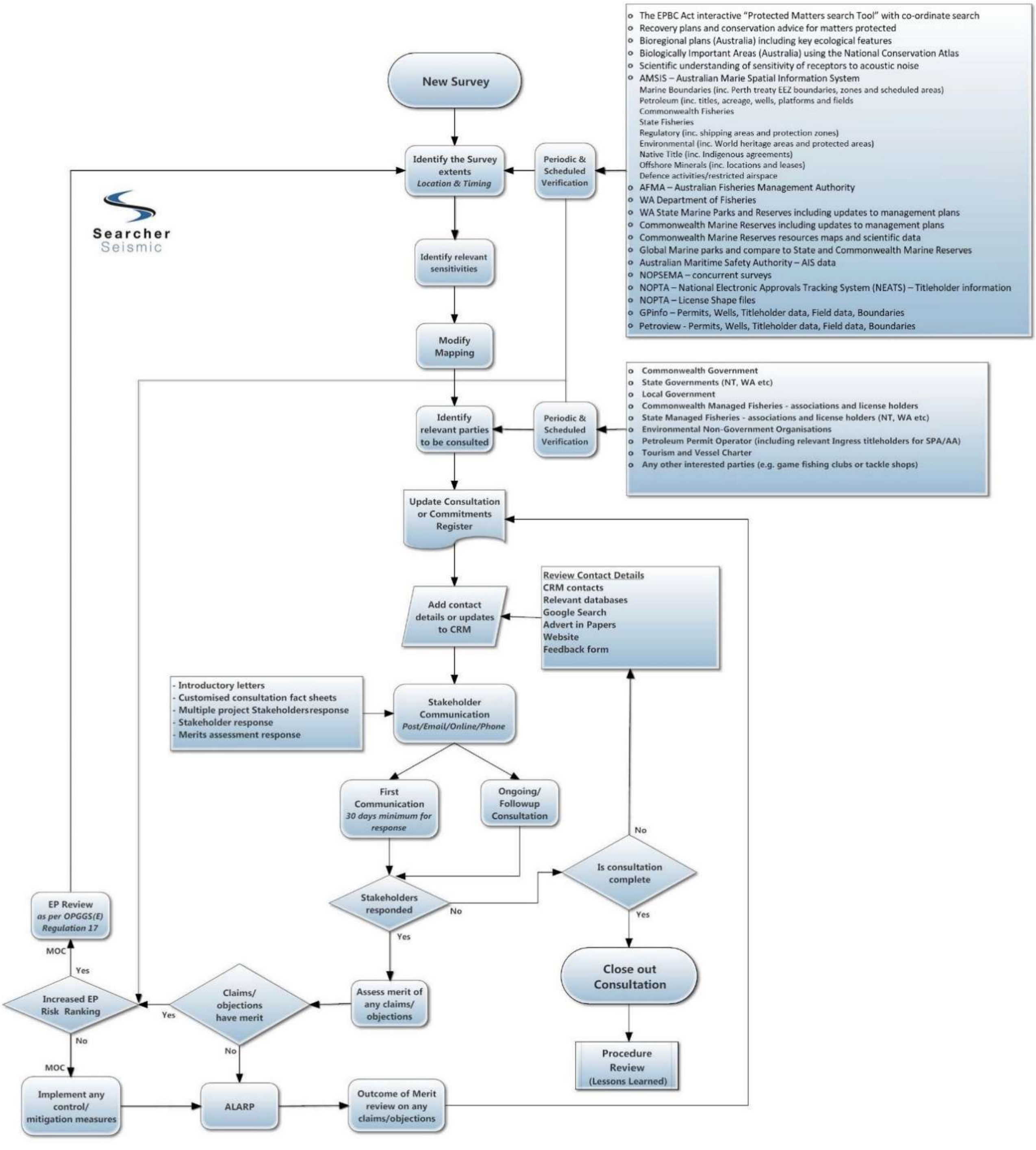


Figure 8.1 – Searcher's consultation process with MOC

8.2.1 Stakeholder identification

OPGGS(E) Regulation 11A requires that titleholders consult with relevant persons ('stakeholders') in the course of preparing an EP. OPGGS(E) Regulation 11A considers a relevant person to be:

- each Department or agency of the Commonwealth to which the activities to be carried out under the environment plan, or the revision of the environment plan, may be relevant, OPGGS(E)Reg 11A (a);
- each Department or agency of a State or the Northern Territory to which the activities to be carried out under the environment plan, or the revision of the environment plan, may be relevant, OPGGS(E)Reg 11A (b);
- the Department of the responsible State Minister, or the responsible Northern Territory Minister, OPGGS(E)Reg 11A (c);
- a person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the environment plan, or the revision of the environment plan, OPGGS(E)Reg 11A (d);
- any other person or organisation that the titleholder considers relevant , OPGGS(E)Reg 11A (e).

For the purposes of this EP, and in accordance with Regulation 11A, relevant stakeholders are defined as a person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP. Relevant stakeholders are further sub-divided into those stakeholders that have an active interest and may potentially be affected by the survey, and stakeholders who may be able to provide relevant information or, in Searchers opinion should be informed but who may not have an active interest in the survey.

Searcher's consultation process (Figure 8.1), is aimed at identifying stakeholders in line with NOPSEMA's criteria for identifying whether a person or organisation is a relevant person (NOPSEMA 2019b):

- functions, a person or organisation's power, duty, authority, or responsibilities.
- interests, a person or organisation's rights, advantages, duties, and liabilities; or a group or organisation having a common concern.
- activities, a thing or things that a person or group does or has done.

The stakeholder identification process consists of internal company procedures for data updates, periodic and scheduled verification along with considering the nature, scale, spatial extent, and timing of the survey activities. Searcher then subsequently reviews current and historical activities to gather information about the functions, interests and activities of individuals or organisations that may reasonably be expected to be affected by the Possum 3D MSS:

Consultation for the Possum 3D MSS identified a number of groups of stakeholders and 139 relevant stakeholders, including (but not limited to):

- government agencies
    - Commonwealth (e.g. Defence, environmental management/emergency response authorities) [19]
    - State (e.g. port authorities, environmental management/emergency response authorities) [16]
    - local shires (e.g. shire/council/State members) [7]
- community (e.g. support groups) [9]
- environmental non-governmental organisations [8]
- fishers
    - commercial (e.g. individuals, industry groups and associations) [37]
    - recreational (e.g. game fishing clubs and associations) [10]
- petroleum exploration and production companies [7]
- scientific research institutions [3]
- shipping, charter and tourism [21]
- other interested parties (e.g. communications entities with infrastructure). [2]

Subsequent to the initial stakeholder identification, a total of 3 public submissions were received, consisting of 6015 additional interested parties who commented on the draft EP. (see APPENDIX J Titleholder report on public comment).

The following resources were used to ascertain relevant stakeholders within the identified groups.

In order to ensure that each government body was given the opportunity to raise objections or concerns that could assist with the development of the EP, Searcher contacted commonwealth or state government departments, agencies and the responsible state Minister, with authority or jurisdiction over the survey area.

As mentioned in section 4.7.1, an investigation of the Commonwealth and WA State fisheries was undertaken to determine the fisheries authorised to operate within the proposed operational area. The following government agencies make available fishing reports and technical data to assist in determining relevant fisheries license holders and contact information. The examination of catch data from AFMA and ABARES was used to determine which Commonwealth fisheries overlap and have interests within the OA. Fish Cube data was extracted by DPIRD on 28/10/2019 (data 2014-2018) and again on 19/07/21 (data to 2020) to identify recorded catch data in the area over the last 7 years and provide a list of current WA state fisheries license holders with active interests within the OA.

Fisheries authorities and associations such as WAFIC were contacted to confirm the listed commercial fishing operators were relevant to consult with thereby limiting unnecessary communication and stakeholder fatigue where possible. All license holders from the initial Fish Cube Data extract were contacted including MMF. As initial fisheries catch and effort data recorded between 2014-2019 sourced from DPIRD on 28/10/2019 identified one 2018 record of fishing effort in approximately 400m of water within the acquisition area, all license holders for MMF Area 2 were contacted as,we were unable to determine the individual fisher potentially fishing within the acquisition area. License holders for each fishery may change over time therefore all lists were updated annually in order to make sure that any additional relevant, new and current license holders were contacted.

The National Electronic Approvals Tracking System (NEATS) was used to access information concerning relevant offshore petroleum exploration and production title holders and relevant Oil and Gas industry operators within the geographic area of the survey.
The NOPSEMA website was accessed to identify current Industry Environment Plans to determine relevant operators of any concurrent seismic surveys that may be active in the vicinity of the Possum 3D MSS.

Community groups, charter, recreational or tourism activity operators, associates or organisations with conservation and scientific research interests, associates or other parties affected by or relevant to the geographic location or environmental sensitivities of the survey were identified in consultation with industry subject matter experts and Searcher's internal stakeholder database. This has been further bolstered by Searcher's consultation process (Figure 8.1), including records of previous consultation efforts for other EP's in the area, conducting additional internet searches or in direct communication with other stakeholders during the consultation process.

The register of relevant stakeholders for the Possum 3D MSS is listed in APPENDIX E and summary of key consultation outcomes is provided in Table 8.1 and APPENDIX J Titleholder Report on public comment.

8.2.2 Provision of sufficient information and time to respond

The OPGGS(E)R require that sufficient time and proposed survey information be provided for stakeholders to digest the materials provided and prepare an informed response on how their functions, interests, or activities may be affected.

Initial consultation for Possum 3D MSS consisted of distributing fact sheets (see APPENDIX G), including a location map sent on 25th December 2019 via email, or postal service where an email address was unavailable, to each stakeholder (or their representative). The fact sheets were targeted to the information requirements of the stakeholder group, i.e. one for general stakeholders (F001) and the second targeted to commercial fishery stakeholders (F002) with additional information on potential impacts to Commonwealth & State Commercial Fishers . The flyers detailed the location, duration, survey specifications and identified risks of the activity such that stakeholders could make an informed assessment of possible consequences of the activity on their functions, interests, or activities. Some relevant stakeholders were further contacted by phone to obtain current email addresses and were then added to the distribution list. Any additional stakeholders identified as a result of the consultation were subsequently contacted by email, phone and/or post. Stakeholders were requested to respond and provide feedback by 30th January 2020 (36 days) via a dedicated email address (feedback@searcherseismic.com). Responses to this email address are automatically forwarded to all the relevant individuals within Searcher with responsibility for overseeing the response.

A subsequent flyer (F003) with updated information was sent to Fisheries and general stakeholders on 1st April 2020. This flyer contained a summary of underwater sound modelling results conducted by JASCO, a link to the acoustic modelling report and requested any additional comments for consideration in the planning phase of the project.

A further flyer (F004) with updated information was sent to fisheries and general stakeholders on 18th May 2020. This flyer provided notification of intent to extend the Possum 3D MSS EP validity to July 2023 as the COVID-19 pandemic had been identified as a force majeure event by NOPTA, thereby making a decision to allow a 12-month suspension and extension of permit title conditions. Stakeholders were requested to provide response by 31st May 2020.

Searcher checked the current Commonwealth and WA State fisheries permit holders on 1 June 2021 as Fisheries licenses are renewed annually. Two new Commonwealth Fisheries permit holders were identified, one of which Searcher was already in correspondence with their representative and the remaining license holder was contacted by email on 3 June 2021 and requested to respond and provide feedback by 1st July 2021 (28 days).

Follow up flyers (F005/F006), emails and phone call communications with relevant stakeholders have taken place throughout the consultation process (APPENDIX E) and have been conducted to conclusion as listed in Table 8.1.

Searcher submitted this Environment Plan for completeness check on 8 November 2021 and on acceptance entered a 30 day period of public comment where the Environment Plan was published on the NOPSEMA website from 15th November 2021 to 15th December 2021.

In accordance with NOPSEMA's Assessment Policy, advertisements inviting public comment on the EP were published in relevant regional (North West Telegraph 24/11/21 & 8/12/21) , state (The Sunday Times 28/11/21) and national newspapers (The Australian 24/11/21). The adverts appeared in the North West Telegraph/The Sunday times and The Australian respectively as below in Figure 8.2:

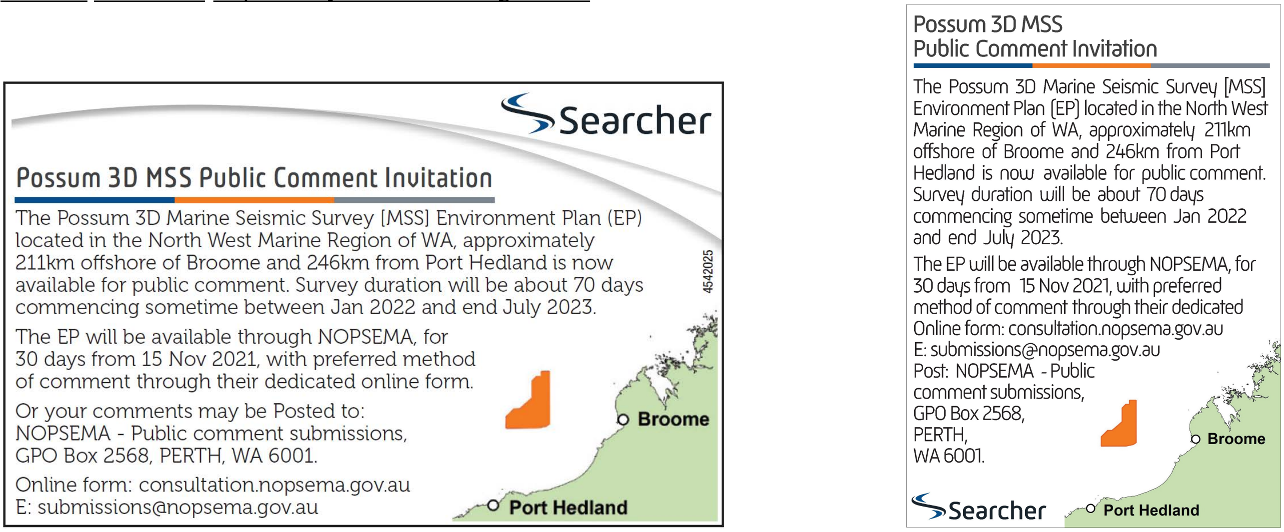


Figure 8.2 – Adverts inviting public comment

Searcher also published an entry on the home page of the company website (Figure 8.3), under News and Press Releases, to an information page on the prospective survey with details on how to provide comment through the NOPSEMA contact details and dedicated website form:

Figure 8.3 – Website entry

Any comments will be responded to through the required "Titleholder report on public comment" which will be published on NOPSEMA's website along with the EP for assessment, in accordance with the OPGGS (E) Reg 2009.

Searcher is confident that it has provided stakeholders sufficient information to make an informed assessment of the possible impacts of the survey on their functions interests or activities, and sufficient time to provide relevant feedback for Searcher to assess stakeholder claims and action relevant controls as merited.

8.3 RESULT OF CONSULTATION

A summary of consultation for the Possum 3D MSS is presented in – Table 8.1 with ongoing Stakeholder notifications found in APPENDIX F. The responses from the 30 day public consultation period did not identify any new merited objections or claims however the comments received in general terms are presented in APPENDIX J. The key themes of merited objections or claims are the same as those found for other 3D marine seismic surveys of a similar nature and scale.

Several relevant persons or organisations did not reply to consultation attempts or auto-replied only to acknowledge receipt of the initial consultation flyer with no feedback on the Possum 3D MSS. Searcher will however continue to keep non-responsive Stakeholders informed of the survey activity updates and key milestones such as survey commencement or completion.

Table 8.1 – Stakeholder consultation key outcomes

Company/Stakeholder	Stakeholder Response Summary	Assessment of Claims	Status
Government - Commonwealth, OPGGS(E) Reg 11A (a)			
Australian Fisheries Management Authority	AFMA is unable to comment on individual proposals however request to consult with all fishers who have entitlements to fish within the proposed area. Provided links for fisheries concession holder lists and relevant fishing industry associations.	Searcher phoned to confirm they have consulted relevant associations, fisheries and individual concession holders as identified. To reduce stakeholder fatigue only individuals or companies of fisheries that have been Historically active in the OA are considered relevant for the purposes of this EP. Key commercial fisheries species within the OA and extended EMBA have however been considered throughout the EP. No further response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications and request annual updates as required.	Closed
Australian Hydrographic Office	No concerns raised at time of EP submission, Stakeholder requests to be kept informed once survey proposal is confirmed.	No concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise, provide appropriate survey notifications and keep AHO informed once survey proposal is confirmed.	Closed
Australian Maritime Safety Authority	Requested AMSA's Joint Rescue Coordination Centre (JRCC) be notified by e-mail to rccaus@amsa.gov.au (Phone: 1800 641 792 or +61 2 6230 6811) for promulgation of radio-navigation warnings at least 24-48 hours before operations commence with relevant details for safety at sea. Also requested JRCC be advised when operations start and end. Requested contacting the AHO at datacentre@hydro.gov.au no less than four working weeks before operations. Information provided on how to obtain a vessel traffic for the survey area of interest.	Searcher has included the requests and information provided in the relevant sections of the EP, commitments register and notifications table . Searcher will continue to provide survey notifications.	Closed
Department of Agriculture, Water and the Environment – Biosecurity	Offshore Installation operation Bio-security assessment questionnaire sent for completion. Requested Vessel to report under Maritime Arrivals Reporting System (MARS). Vessel inspection possibly required prior to mobilisation to OA Vessel biosecurity assessment contact is seaports@agriculture.gov.au DAWR confirmed that completion of the bio-security assessment questionnaire is not valid as this is not an Offshore Installation operation.	Searcher confirm that this is not an Offshore Installation operation and therefore the received bio-security assessment questionnaire is not relevant. The contracted vessel will be responsible for meeting regulated requirements for import to Australian water if relevant. Searcher has included the applicable requests in the relevant sections of the EP and commitments register. Searcher will continue to provide survey notifications.	Closed
Department of Agriculture, Water and the Environment – Fisheries	Confirmation of receipt, department remains interested to be informed of future developments	No concerns raised at time of EP submission. Stakeholder has requested to be kept informed of future developments. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	Closed
Director of National Parks	DNP noted the location of the survey with approval requiring an accepted Environment Plan under OPGGS (E) reg 2009. DNP noted specific values for Mermaid Reef and Argo-Rowley Terrace Marine Parks. Guidance note link provided to ensure EP identifies and manages all risks and is consistent with the relevant management plans. Further Emergency Response guidance for DNP provided. Updates for DNP to be sent to : marineparks@awe.gov.au	Searcher has included the requests and information provided in the relevant sections of the EP, commitments register and notifications table . We will further adhere to the required Emergency Response notifications should there be any oil/gas pollution incidences associated with the activity and occurring within or are likely to impact on a marine park. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	Closed
National Native Title Tribunal	N/A Thanking Searcher for the opportunity to provide feedback on the proposed survey. It would not be appropriate for the NNTT to comment on the proposal. Stakeholder has elected to opt out of the consultation process.	Stakeholder has elected to opt out of the consultation process. No concerns raised at time of EP submission accordingly Searcher considers consultation efforts to be adequate.	Closed

Company/Stakeholder	Stakeholder Response Summary	Assessment of Claims	Status
Commonwealth Marine Reserves Branch	See Director of National parks	See Director of National parks	Closed
Stakeholder ID 8, 11, 17, 18, 32, 33, 41, 42, 49, 68, 106	N/A	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	Closed
Government - State, OPGGS(E) Reg 11A (b)			
WA Department of Biodiversity, Conservation and Attractions	Request to resend flyer and to provide 4 weeks' notice to representative from the DBCA Environmental Protection Branch and DBCA Operations Officer - West Kimberley informed of any future operations and mobilisations. Offer to forward survey information to recreational and commercial visitors to the Rowley Shoals, if needed.	No concerns or comments regarding the Possum 3D MSS survey. Searcher will provide 4 weeks notification of future operations and mobilisations to contacts provided and survey notifications to EMBAdmin@dbca.wa.gov.au.	Closed
WA Department of Planning Lands and Heritage	Possum 3D MSS does not intersect with a Registered Aboriginal site or heritage place therefore no approvals are required under the AHA.	Possum 3D MSS does not intersect with a Registered Aboriginal site or heritage place therefore no approvals are required under the AHA. No further concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	Closed
WA Department of Primary Industries & Regional Development	No concerns raised. On request DPIRD confirmed and provided relevant fisheries and FishCube catch and effort data.	Searcher confirmed relevant fisheries and acquired Fish Cube catch and effort data annually. No concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise, provide appropriate survey notifications and will continue to request annual updates as required.	Closed
WA Department of Transport	DoT provided a link to the Department of Transport Offshore Petroleum Industry Guidance Note – Marine Oil Pollution: Response and Consultation Arrangements (September 2018) for consultation, in the case of a spill impacting State waters. They further advised that given the details in the OPEP and key modelling information provided outlining the low risk to State waters, a full review has not been deemed necessary at this time. Request for a copy of the final accepted OPEP to be sent for their records.	Searcher has reviewed the guidance note and provided DoT the OPEP with key modelling outcomes showing no requirement for shoreline clean-up on 22/04/2020. Searcher has included the requests and necessary information in the relevant sections of the EP, OPEP, commitments register and/or notifications table. DoT has requested a copy of the final approved EP and OPEP which will be forwarded upon acceptance. No further concerns raised at time of EP submission. Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	Closed
Western Australian Museum	WA Museum advised no record of any known UCH sites located in the proposed survey area. Requested notification of any discovery of shipwreck, aircraft or other underwater cultural heritage feature, under the Commonwealth Underwater Cultural Heritage Act 2018.	Searcher has included notifying WA Museum of any discovery of shipwreck, aircraft or other underwater cultural heritage feature, under the Commonwealth Underwater Cultural Heritage Act 2018 in the commitments register. No further concerns raised at time of EP submission. Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	Closed
Stakeholder ID 60, 77, 84, 87, 88, 116, 117, 118, 119, 123, 126	N/A	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	Closed
Local Shire or Council, OPGGS(E) Reg 11A (c)			
State Member for Pilbara	Thanked Searcher for good work to date, has no issues with the project and would like to be kept informed.	Searcher will keep State Member for Pilbara informed of survey progress and continue to provide survey notifications.	Closed
Stakeholder ID 27, 54, 102, 104, 105, 109	N/A	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	Closed
Community, OPGGS(E) Reg 11A (d)			
Stakeholder ID 2, 30, 38, 80, 85, 86, 89, 90, 91	N/A	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	Closed
Environmental non-governmental organisations (ENGO), OPGGS(E) Reg 11A (e)			
Stakeholder ID 13, 16, 31, 35, 46, 55, 131, 132	N/A	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	Closed

Company/Stakeholder	Stakeholder Response Summary	Assessment of Claims	Status
Fishing - Commercial, OPGGS(E) Reg 11A (d)			
North West Slope Trawl Fishery Stakeholder ID 130 (7, 48, 99, 136)	Feedback form received with Map of fishing activity locations. Concerns regarding possible negative impact to commercial activities including displacement, disruption to supply and unknown negative impact on target species (scampi). WAFIC responded on behalf of Stakeholder noting key fishing location with no distinct seasonal patterns, fishing throughout 12 months of the year at water depths of 200-750m. Noted history of most activity in Mermaid Reef and focussed between August to April. Requested formal inclusion of CSEP in the EP with adjustment protocol adopted. Stakeholder cc'd in relevant WAFIC communications.	Acknowledged stakeholders interests are with North West Slope Trawl and noted concerns regarding displacement off the fishing grounds, disruption of supply to market and unknown negative impact on the target species. Searcher requested further information on fisheries interests, specific times in the area or diving activities for further consideration and survey planning. Continued efforts to contact stakeholder by email and phone with no response. WAFIC advised they are working on behalf of Stakeholder ID130. Noted Stakeholder ID130's fishing efforts concentrated to North of the survey, between August to April, therefore fishing activity overlap with the survey window likely to be between December to April. Searcher forwarded survey timing, acoustic modelling access and offered to work together to identify the best window of opportunity to minimise disruption to fishing schedule. Searcher requested on water contact details to assist with communications. Stakeholder ID130 raised concerns regarding impact of the Possum survey on their fishery resource (primarily scampi) and potential impacts to their commercial catch. Searcher has responded with information from a thorough review based on best science available with more details available in Appendix E: Evaluation of Environmental Impact on Crustaceans: The seismic survey has the potential to cause statocyst damage in crustaceans, however these impacts are likely to be partially recoverable after successive moulting (Day et al 2019). The modelling from JASCO (2020) for the Possum 3D MSS survey shows that noise at the seabed that could cause statocyst damage to crustaceans is predicted to 141m either side of each sail line in shallower waters. However, as the vessel moves into deeper water, this propagation distance at the seabed will become smaller. The sail lines for the survey are planned to be separated by 112.5 m therefore, dependent on depth, most or all the seabed within the survey could be affected by noise levels that could induce statocyst injury in crustaceans. However, there is no evidence to suggest that lethal levels of noise will be emitted from the seismic source. The predicted minor impacts to crustaceans are not expected to have an impact on the broader crustacean populations in the region for the following reasons: • The minor statocyst impacts are not expected to be lethal and are predicted to repair through time • No other sub-lethal effects are known to occur • Effects on behaviour are very unlikely • The area of seabed exposed is extremely small in the context of the very large and the likely inter-connected crustacean populations of the north west Australian waters (Wilson 2013) that are likely to be inherently resilient to such a small perturbation. Scampi key spawning period is identified to be September - October control measures have been proposed to mitigate the impact to scampi from underwater noise including : • Reduction of the operational and acquisition areas to reduce overlap with commercial fishing areas • Use of the smallest array size that will achieve the survey objectives • Spatial and Temporal Survey design changes to reduce Stakeholder ID130's displacement off the fishing grounds • Avoidance of identified spawning period for scampi (Sept-Oct) As the proposed survey area overlaps an extremely small portion, 9,221 km (2.33%) of the North West Slope Trawl (Scampi) Fishery (NWSTF) management area, with over 97% of the fishery unaffected by the survey, it is reasonably predicted that the Possum 3D survey is unlikely to affect the overall catch rates of scampi in the North West Slope Trawl fishery and any effects to stocks in the 2.33% of the NWSTF fishery are unlikely to be permanent In consideration of impacts to commercial catch, Searcher have provided Stakeholder ID 130 with the adopted definitive version of the Collaborative Seismic Environment Plan Adjustment Protocol (CSEP) currently ratified and agreed with all commercial fishing peak industry bodies, including WAFIC. The CSEP details an evidence-based process for commercial fishers to make a claim for loss of catch, displacement or gear damage within an Adjustment Area, a copy of which is available on the NERA website (NERA 2021). Although automatic read reply was received, no direct response has been received at the time of EP submission and WAFIC have no further comment at this time on behalf of Stakeholder ID 130 for the Possum 3D MSS. No further response from stakeholder. Searcher considers consultation efforts to be adequate however Searcher will continue to address any future comments should they arise, provide notifications and pursue on water contact details for communications regarding simultaneous activities and appropriate sharing of ocean access.	Closed

Company/Stakeholder	Stakeholder Response Summary	Assessment of Claims	Status
North West Slope Trawl Fishery Stakeholder ID 135, 6, 50, 92, 114	N/A	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	Closed
Mackerel Managed Fishery: Area 2 Stakeholder ID 101	N/A Stakeholder has elected to opt out of the consultation process.	Stakeholder is no longer a fishing license holder and has elected to opt out of the consultation process. No concerns raised at time of EP submission and stakeholder is no longer considered relevant to the Possum 3D MSS.	Closed
Mackerel Managed Fishery: Area 2 Stakeholder ID 23, 24, 45, 53, 56, 57, 64, 66, 95, 96, 98, 112	N/A	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	Closed
Other identified Commercial Fishers or Associations: Western Australian Fishing Industry Council	1. The commercial fishing sector is in almost all cases the ONLY “relevant AND potentially affected party” to the activities described in the EP and relevant to the Possum EP. 2. Thanked for providing information specific to commercial fisheries in received flyer F002 3. Thanked for reducing stakeholder fatigue and limiting consultation to Mackerel Managed Fishery (Area 2) and North-West Slope Trawl Fishery 4. Noted WAFIC’s agreed engagement with mackerel fishers for no consultation in water depths greater than 100 metres. However due to reported effort appreciate caution re notifying Mackerel Area 2 fishers. 5. Thanked for engaging with ASBTIA and Stakeholder ID73. 6. Requested engagement with Pearl Producers Association (PPA) 7. Difficult for active fishers to respond and provide feedback when the survey window is over nearly a two year period. 8. Expressed frustration with key criteria regarding the survey timing is always “vessel availability” or whale season, WAFIC’s expectation being best possible “window of opportunity” is deduced and vessels are booked in advance where possible. 9. Request to ensure the EP accounts for each fishery with a legal right to fish in the survey area 10. Noted SW Salmon Fishery do not fish, migrate or spawn in area of the Possum 3D MSS.	1. Searcher acknowledged but will continue to communicate with commercial fishing sector and all other identified relevant parties. 2. Acknowledged and thanked 3. Acknowledged and thanked 4. Bathymetry data shows no water depths in survey area as less than 100m however Managed Mackerel Fishers (MMF) Area 2 have been contacted to identify any potential active fishers. 5. Acknowledged and thanked 6. Confirmed PPA was contacted and will continue to keep informed 7. Confirmed EP validity, timing and 1 acquisition window of 70 days has been communicated to stakeholders for response. 8. Searcher confirmed survey designs identify the best "window of opportunity" considering Environmental, social constraints, relevant approvals, and stakeholder communication. Vessel availability is then sourced and booked, in advance where possible. 9. Searcher will address all relevant fisheries in the EP. 10. Acknowledged and thanked	Closed

Company/Stakeholder	Stakeholder Response Summary	Assessment of Claims	Status
Other identified Commercial Fishers or Associations: Western Australian Fishing Industry Council cont.	11. Requested the sound modelling information. 12. Requested the environmental impact assessments relevant to commercial fisheries please? 13. Request for provision for compensation of potentially affected parties not wait for NERA compensation protocol outcomes. 14. Noted the consultation flyer has a register or opt out button. 15. Requested not to confuse a lack of replies from commercial fishers as a lack of interest / concern. 16. Noted commercial fishers are extremely busy fishing plus they receive a phenomenal volume of consultation requests. 17. Noted naming convention incorrect and reference to NERA Collaborative Seismic EP (CSEP) has no value as still at ground zero. 18. Questioned the proposed activity schedule, window and 12-month access period which pays zero consideration to sustainability and cumulative impacts and is unacceptable. 19. Specified that no commercial fisheries including Mackerel fishers have dive activities in water depths greater than 100 metres Questioned inclusion of "where possible, plans will be made to avoid overlapping seismic and dive activities" and offered that the statement is a valueless / pointless inclusion in the "fact" sheet. 20. Mackerel fishers do not fish in water depths greater than 100m. To avoid fatigue WAFIC recommend consultation be limited to the stakeholders who are "relevant and potentially impacted" by the activity.	11. Provided access to the acoustic modelling 12. Environmental impact assessments will be incorporated into the EP which will be available for public comment on NOPSEMA website for 30 days after submission. 13. The NERA CSEP Commercial Fisher Adjustment Protocol was finalised and broadly accepted by all major peak commercial fishing industry bodies, including AFMA, WAFIC and the NTSC in May 2021. It was circulated to all relevant WA and Commonwealth commercial fisher stakeholders on May 18th, published on the NERA web site in late May and referenced in the WAFIC Newsletter on August 24th, 2021. Searcher has since committed to adopting the NERA CSEP Adjustment Protocol for the Possum 3D MSS. 14. A choice to "Opt-out" is made available to reduce stakeholder fatigue. 15. Searcher will continue to communicate directly with identified, relevant and interested stakeholders providing sufficient time for response. 16. Searcher will try to minimise stakeholder fatigue by sending consultation requests to communicate only with relevant and interested stakeholders. 17. Corrected name and confirmed CSEP is likely to be complete by time Possum 3D MSS EP is submitted and that Searcher has committed to adopt any ratified outcomes. 18. Initial consultation and feedback at the planning stage enables identification of the most appropriate acquisition window, minimising potential adverse effects on relevant stakeholders and apply further relevant controls to the survey. The activity window and access period is a maximum 70 days and has been designed with mitigating controls, to consider sustainability and cumulative impact issues to all relevant parties including avoiding active fishing areas to SE as identified by DPIRD. 19. Acknowledged, however Managed Mackerel Fishery has a catch history in the OA therefore consultation has included area specific current license holders. Searcher must include and respond to all potentially relevant identified activities including recreational divers who may be in or close to the OA. 20. Acknowledged. Fisheries Consultation has been limited to current license holders with a catch history in the OA (or limited to area specific Fisheries where license holders were unable to be identified) with a catch history in the OA.	

Company/Stakeholder	Stakeholder Response Summary	Assessment of Claims	Status
Other identified Commercial Fishers or Associations: Western Australian Fishing Industry Council cont.	21. Advised not to assume low or no fishing activity area in blocks sourced from FishCube 22. Noted fact sheet had no reference regarding the impacts on the key indicator species of each fishery overlapping the OA. Also questioned whether peak spawning periods have been identified and how Searcher will avoid/mitigate 23. Identified North West Slope Trawl Fishery (NWSTF), with targeted water depths between 200 and 750m, as key potentially affected fishery. Requested potential impacts and mitigation efforts on fishing activities and the scampi resource to be addressed in detail in the Possum EP. 24. Advised there is enough research to show there may be potential negative impacts to the resource and the food chain (note the quite recent impact to plankton paper) 25. Advised it is completely unacceptable to the commercial fishing industry for there to be simultaneous seismic surveys over the same fisheries. Citing it restricts fishing, moves fish from habitat and known locations. This is not appropriate sharing of ocean access. 26. Raised concern and cannot comprehend the potential impacts to fish spawning activities with simultaneous seismic surveys over the same fisheries. 27. Note you have listed the simultaneous surveys which are potentially planned to take place in the vicinity of or similar timeframes as the Possum MSS but have not included past seismic surveys which overlap the survey, this is unacceptable. 29. Raised concern that Seismic survey EP consultation requests and actual seismic survey activities are well up, it is completely unacceptable for a fishery to have seismic survey activities over the commercial fishing area year in and year out and multiple times within a calendar year with no breaks. The Northern Demersal Scalefish and Mackerel fisheries (amongst many others) are being hammered. 30. What mitigation /considerations have you included in your EP regarding past surveys over the fisheries which are being overlapped by the Possum MSS – not just the OA – over the actual fisheries?	21. Acknowledged FishCube data covers fishing activity only. Any block with fishing history data has been deemed relevant for contacting potentially impacted stakeholders. 22. initial round of consultation was to gain feedback for planning the Possum 3D MSS. Key indicator species were identified and communicated to stakeholders, including WAFIC, in a subsequent flyer F003 and are further addressed in the EP which will be available for public comment. Provided WAFIC with preliminary noise modelling results It is not possible to avoid overlap however there are no known spawning aggregations for key or indicator species within the OA. 23. Confirmed Possum 3D MSS OA overlaps 9,221 km (2.33%) of the NWSTF management area. Potential impacts and mitigation efforts will be addressed within the EP but provided preliminary assessment summary, with spawning periods, showing catch rates or effects to stocks are unlikely to be changed or permanent and are not expected to impact the broader populations in the region. 24. Cited relevant scientific peer reviewed papers confirming limited impacts are expected from the seismic activity relative to the natural variation in zooplankton concentrations and mortality rates. 25. At the time of the response , there are no simultaneous Seismic Surveys planned over the Possum 3D MSS OA. This information will be updated in the EP which will be made available for 30-day public comment. We are continuing to consider the interests of commercial fishers and narrow the window of opportunity, within the environmental constraints of our survey, to provide the best possible outcome for all parties. In this manner Searcher supports appropriate sharing of ocean access. 26. Searcher has provided preliminary noise modelling results and has included the information in the relevant sections of the EP. The Possum 3D MSS has a limited spatial and temporal footprint with a maximum of 70 days acquisition and has included relevant controls throughout the EP to mitigate potential impacts. 27. Seismic surveys were forwarded to WAFIC and have been communicated to stakeholders, including WAFIC, in a subsequent flyer F003 Planned surveys all have limited spatial overlap with the Possum 3D MSS OA, and have varying activity windows. Only 2 historical surveys in the past 5 years are in the vicinity of Possum and only one has a minor overlap with the OA. 29. Searcher acknowledged that EP consultation requests have increased due to regulatory requirements for both contracted, speculative and lapsed survey EP's. Searcher cannot speculate on the broader reasons for the alleged impact on the fisheries, but can observe that current and previous seismic acquisition in the area is restricted in areal extent and duration. 30. Effects from the survey will be temporary as the seismic vessel traverses each survey line, and fish are expected to move away as the seismic array approaches. The body of peer-reviewed literature does not indicate any long-term abandonment of fishing grounds by commercial species and the total number of fish within the fishery stock remains unchanged.	Closed

Company/Stakeholder	Stakeholder Response Summary	Assessment of Claims	Status
Other identified Commercial Fishers or Associations: Western Australian Fishing Industry Council cont.	31. There is enough science demonstrating that seismic surveys potentially impact the resource – not accounting for past surveys is completely unacceptable. 32. Requested whether Searcher has investigated other surveys which are going through the approval process which will overlap the fisheries being overlapped by Possum. Simply put, no identification of, consideration for or accountable mitigations in place for any form of cumulative impacts. 33. Requested clarification on whether the survey overlaps the Joint Authority Northern Shark Fishery? 34. Requested Searcher's policy in relation to "No fishing from support/commercial vessels"? 35. Requested what processes Searcher has to quantitively assess any damage to fish stocks, fish spawn, the food chain such as plankton etc due to seismic survey activity? 36. Does Searcher plan to do any pre-survey stock assessments and if not what science is Searcher using to have a complete understanding of the marine environment prior to the commencement of the seismic survey? 37. What science is Searcher using to demonstrate that you have a full understanding of fish spawning practices and will avoid all seismic activities during spawning periods? 38. What science is Searcher using to demonstrate that you have a full understanding of fish behavioural activities and will avoid all seismic activities during key fish schooling, migrating patterns etc? 39. What processes does Searcher have using bespoke or available science to assess short / medium and long term cumulative impacts on key indicator species? 40. What is the proponent's communication policy with all staff and vessel crew, contractors and sub-contractors regarding interacting and protecting the rights of active commercial fishers on the water? 41. All support vessels must divert around active fishing activity (even if not convenient to do so) All support vessels are to avoid any close engagement with any commercial fishing activity and do their utmost not to create an ocean disturbance risking the split of schooling fish 42. What will be the main port used by support vessels? <u>May 2020</u> WAFIC thanked Searcher for the detailed reply, clearly addressing the issues and concerns raised by WAFIC. <u>June 2021</u> WAFIC cc'd in response to Stakeholder ID 130. New representative thanked Searcher for providing important consultation outcomes from previous communications. No further comments at this time, request to keep updated with survey commencement.	31. There has been no seismic survey activities over the Possum 3D MSS OA since 2012. Considering that there is limited overlap by the Possum 3D MSS of the fishery areas the impact from the Possum 3D MSS is considered likely to be negligible. 32. Previous and future planned seismic surveys in the vicinity of the Possum 3D MSS were identified, forwarded and are included in the EP. The body of peer-reviewed literature does not indicate any long-term abandonment of fishing grounds by commercial species due to seismic activity, with several studies indicating that catch levels returned to pre-survey levels after seismic activity had ceased however additional mitigation (proposed control measures) have been adopted and communicated to all stakeholders. Searcher is not aware of any other future surveys which will overlap the fisheries, and cannot plan for future work that is unknown. 33. The Possum 3D MSS does not overlap the Joint Authority Northern Shark Fishery. 34. Searcher can confirm that all vessel staff and contractors will be advised of the policy of "zero recreational fishing from support/ commercial vessels" via the induction process and will strictly enforce adherence to the policy during the survey. 35. Assessment of the environmental impacts and risks including the potential impacts of underwater noise from seismic operations on fish stocks, fish spawn, aspects of the food chain (including plankton and benthic ecosystems) will be conducted and incorporated into the EP and made available for public review. 36. Searcher does not intend to do any pre-survey stock assessments at this time. Searcher has used the best available science and further reputable resources including but not limited to the SPRAT database, WA Museum, CSIRO and AIMS research reports, and online government enquiry systems to describe and understand the existing marine environment within the Possum 3D MSS operational and acquisition areas and the environment that may be affected by the survey (EMBA). 37. Well-known and reputable fisheries scientists and fish biologists (e.g. Allen; Edgar; Newman; Mackie) have been cited to demonstrate a complete understanding of fish spawning practices, however there are no known spawning aggregations for key or indicator species for commercial fisheries historically active within 10 km of the Possum 3D MSS acquisition area. 38. The potential impacts will be assessed and presented in the EP however a summary outline was presented. The assessment will take into consideration underwater noise modelling, records of commercial fish catches and the best available science on fish behaviour. 39. Searcher Seismic provided information and proposed controls for other proposed seismic surveys, with limited spatial overlap, in the vicinity of the Possum 3D MSS OA, that may or may not be partly acquired within the same calendar year as the Possum 3D MSS. An assessment of the environmental impacts and risks associated with the Possum 3D MSS is being undertaken by Searcher for the development of the EP. 40. Searcher will put in place an appropriate induction process and communication protocols which will convey to all staff, vessel crew, contractors and sub-contractors regarding relevant communication protocols and controls in place regarding interaction with fishers and to mitigate, potential displacement 41. Searcher is continuing to consider the interests of commercial fishers and narrow the window of opportunity, within the environmental constraints of our survey, to provide the best possible outcome for all parties. Controls in place regarding minimising disturbance from the seismic and support vessels have been communicated to stakeholders and are included as part of the second round of consultation and as per the attached Flyer (F003) and will be further detailed in the Environment Plan as submitted to NOPSEMA. In this manner Searcher supports appropriate sharing of ocean access. 42. The main port used by support vessels is most likely to be Broome however this is still to be confirmed. <u>May 2020</u> WAFIC confirmed Searcher have clearly addressed the issues and concerns raised by WAFIC. Further Mackerel Fishery, PIlbara Area 2 (actively fished area), has been defined in the EP (Figure 4.20). Relevant North West Slope Trawl license holders have been forwarded comprehensive information on potential impacts to scampi resource. Evidence based adjustment protocol has been adopted for the Possum 3D MSS. <u>June 2021</u> WAFIC cc'd in response to Stakeholder ID 130. Important consultation outcomes from previous communications forwarded to New representative for review. No further comments raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	Closed
Stakeholder ID 22	N/A Stakeholder has elected to opt out of the consultation process.	Stakeholder has elected to opt out of the consultation process. No concerns raised at time of EP submission and stakeholder is no longer considered relevant to the Possum 3D MSS.	Closed
Stakeholder ID 61	N/A Stakeholder has elected to opt out of the consultation process.	Stakeholder has elected to opt out of the consultation process. No concerns raised at time of EP submission and stakeholder is no longer considered relevant to the Possum 3D MSS.	Closed

Company/Stakeholder	Stakeholder Response Summary	Assessment of Claims	Status
Other identified Commercial Fishers or Associations Stakeholder ID 4, 9, 10, 34, 36, 37, 69, 72, 73, 83, 125	N/A	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	Closed
Fishing - Recreational, OPGGS(E) Reg 11A (d)			
Stakeholder ID 21, 26, 28, 47, 74, 75, 78, 82, 93, 124	N/A	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	Closed
Petroleum Exploration & Production, OPGGS(E) Reg 11A (d)			
3D Oil	3D Oil requested further information regarding timing and shape files for survey operational boundaries to determine cumulative analysis for possible concurrent surveys.	Request for Ingress, shape files and requested information sent. Searcher will confirm Ingress has been granted prior to entry into 3D Oil's Permit. Searcher will plan to avoid overlapping seismic activity or develop a simultaneous operations (SIMOPS) plan where this is not possible. Searcher has included the information provided in the relevant sections of the EP, commitments register and notifications table . Searcher will continue to consult with 3D Oil and provide survey notifications.	Closed
INPEX	INPEX requested information regarding timing and shape files for survey operational boundaries to determine cumulative analysis for possible concurrent surveys. The INPEX survey is due to start on 20 December 2021 with a duration of 90 days and is likely to be completed by April.	Information regarding Operational Area and Acquisition Area shape files were sent. The INPEX survey is due to start on 20 December 2021 with a duration of 90 days, as the INPEX survey is likely to be completed by April it is unlikely that the surveys will be conducted at the same time. However, Searcher will plan to avoid overlapping seismic activity or develop a simultaneous operations (SIMOPS) plan where this is not possible. Searcher has included the information provided in the relevant sections of the EP, commitments register, notifications table. Searcher will continue to consult with INPEX and provide survey notifications.	Closed
Pathfinder Energy	Pathfinder has forwarded the Ingress document to their legal team to confirm content prior to signature.	Request for Ingress sent and has been forwarded to legal team to confirm content, Searcher will confirm Ingress has been granted prior to entry into Pathfinder's Permits. No comments or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	Closed
Santos	SANTOS will action the Ingress request closer to the survey date. SANTOS is planning the Keraudren 3D Extension Seismic Survey with the same vessel as the Possum 3D MSS therefore no simultaneous operations are likely to occur.	Request for Ingress sent, Searcher will confirm Ingress has been granted prior to entry into Santos's Permits. SANTOS is planning the Keraudren 3D Extension Seismic Survey with the same vessel as the Possum 3D MSS therefore no simultaneous operations are likely to occur. Searcher will plan to avoid overlapping seismic activity or develop a simultaneous operations (SIMOPS) plan where this is not possible. No concerns raised at time of EP submission, Searcher will continue to consult with SANTOS and provide survey notifications.	Closed
TGS	Requested detailed information regarding timing and shape files exchanged for survey operational boundaries to determine cumulative analysis for possible concurrent surveys. Operational Area shape files and map received for Capreolus Phase 2.	Provided detailed information regarding timing and shape files exchanged for survey operational boundaries to determine cumulative analysis for possible concurrent surveys. A separation of >82km exists between our Operational Areas. This is outside the 60km distance we recognise as requiring to develop a simultaneous operations plan (SIMOPS) for any concurrent surveys. Searcher will continue to consult with TGS to provide on-water details for communications and survey notifications.	Closed
PGS	No acquisition in the vicinity of Possum 3D MSS. Requested to be kept in the loop regarding the survey.	Provided detailed information regarding timing and shape files exchanged for survey operational boundaries to determine cumulative analysis for possible concurrent surveys. No requirement for simultaneous operations (SIMOPS) as PGS have no planned acquisition. Searcher will continue to consult with PGS and provide survey notifications.	Closed

Company/Stakeholder	Stakeholder Response Summary	Assessment of Claims	Status
Stakeholder ID 20	N/A	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	Closed
Scientific Research, OPGGS(E) Reg 11A (d)			
Australian Institute of Marine Science	AIMS have a long term oceanographic mooring deployed within the survey area. AIMS requested the planned clearances of vessel/streamers etc to the ODAS mark and notification of transit paths and times near NWSROW during active survey campaigns.	Searcher provided a current indicative survOPT model with acquisition run-in/run-outs/turns shown in consideration of the IMOS buoy and application of a 1000m buffer will be added to the commitments register. Searcher will make sure the buoy location is noted and considered in our final survey design and will keep AIMS informed of any updates, transit paths, times near NWSROW and continue to provide survey notifications.	Closed
University of Western Australia	Stakeholder has no objections to the seismic survey. The UWA Ocean Glider has been picked up and they have no plans for anything more at this time.	No concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	Closed
Stakeholder ID 128	N/A	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	Closed
Shipping, Charter or Tourism, OPGGS(E) Reg 11A (d)			
Kimberley Quest	Kimberley Quest advised they have no diving operations in the vicinity of Possum survey as only potentially run in October/November.	Searcher will notify stakeholder if survey is schedule changes to include October/November. No further concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	Closed
Stakeholder ID 3, 5, 25, 29, 44, 51, 52, 58, 59, 63, 65, 67, 71, 76, 79, 94, 100, 108, 134, 111	N/A	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	Closed
Other interested Parties, OPGGS(E) Reg 11A (d)			
Australian Communications and Media Authority (ACMA)	The seismic survey is not in the vicinity of any existing protection Zones therefore ACMA have no comment to offer. Encouraged Searcher to contact any submarine cable operators in the identified waters if not already conducted.	Searcher has contacted Vocus as the operator of the North West Cable System submarine cable and Telstra. No further concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	Closed
Stakeholder ID 107, 113	N/A	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	Closed

8.4 RECORDS OF STAKEHOLDER CONSULTATION

A consultation register has been created to support consultation which will be kept live throughout the survey and for the duration of the EP, as a tool to record and prompt consultation. The register contains:

- the name / title of the relevant organisation and contact, where available
- contact details for the relevant person or organisation (email, telephone, postal address)
- a record of consultation with the relevant person, including
  - information provided;
  - date of consultation feedback or response;
  - a summary of each response made by a relevant person;
  - a merit assessment of any objection or claim made by a relevant person in relation to the stated adverse impact of the survey;
  - a summary of the response, or proposed response, if any, to each objection or claim;
  - any additional information provided by Searcher following the merit assessment.

A register of all relevant stakeholder consultation to date is provided in Appendix E. Copies of full transcript records have also been provided as a confidential submission in Appendix G. Searcher considers all consultation to be pertinent as stakeholders who may not have a direct active interest may still be able to provide information to enhance the outcomes of the survey.

The consultation register is a "living document" which will be updated during the survey and will be used during the post survey review.

8.5 SENSITIVE INFORMATION

All stakeholders consulted have been asked if any information or response provided is to remain confidential. Any personal details, and/or information subject to such a request is not published, and has been provided in redacted format to preserve the privacy of the individual including specifically Table 8.1 and Appendix E.

8.6 PUBLIC COMMENT

NOPSEMA will publish an invitation to comment on this EP for period of 30 days after the EP is made available on the NOPSEMA website under Regulations 9(AB) and 11(B). Searcher will advise relevant stakeholders when the complete EP is available for public review on the NOPSEMA website. Searcher will also publish notices to direct the public to make comment within the designated timeframe on the NOPSEMA website in the following medium:

- Searcher website
- a national newspaper
- a State-wide newspaper (WA); and
- a regional newspaper close to the activity location.

8.7 ONGOING CONSULTATION

Searcher will continue to engage with relevant stakeholders prior to, during and on completion of the Possum 3D MSS as appropriate. This includes ongoing engagement to inform relevant stakeholders about key milestones, activities and any other pertinent information. The schedule for ongoing consultation notifications is provided in Appendix F. Searcher will maintain ongoing consultation with identified relevant persons and organisations and record in the consultation register throughout the survey.

Searcher further recognises that new relevant persons may be identified, and also some stakeholders already contacted may cease to be relevant during the life of the Possum 3D MSS EP. Where Searcher becomes aware of additional stakeholders whose functions, interest or activities may be affected, those stakeholders will be contacted and given the opportunity to make comment. Searcher will address any concerns or claims and where relevant provide pertinent information including adopted control measures to address their concerns.

If Searcher becomes aware of any additional concerns, claims, or new information not identified prior to commencing the activity, Searcher will immediately attempt to contact and consult with the relevant stakeholders. Searcher will address any concerns or claims raised during such ongoing consultation and will assess for their merits, provide a response and if necessary, manage actions through Searcher's change management process detailed in Section 7.8.

9 EPO, EPS AND MEASUREMENT CRITERIA

Regulation 13(7) of the OPEGGS(E)R requires that an EP include environmental performance outcomes (EPO), environmental performance standards (EPS) and measurement criteria that address legislative and other controls to manage the environmental impacts and risks of the activity.

EPO and EPS for surveys conducted within the Possum 3D MSS operational area have been identified for the environmental aspects assessed via the risk assessment process (Section 6). These EPO and EPS set the standards against which Searcher will measure environmental performance and implementation of the control measures identified in this EP. For each EPO and EPS, appropriate measurement criteria for determining whether the standard has been met have been identified (Table 9.1 and Table 9.2).

The EPO, EPS and measurement criteria specified are consistent with legislative requirements and Searcher policies, standards and procedures. They have been developed based on the Legislation, Codes and Standards, Good Industry Practice, Professional Judgement, Risk Based Analysis, Company Values and Societal Values decision tools outlined in Section 6, as part of the ALARP demonstration process.

A breach of an EPO or EPS, as detailed in Section 7.9.3, constitutes a 'Recordable Incident' under the Environment Regulations.

Table 9.1 – Possum 3D MSS Environmental Performance Outcomes

Receptor	EPO #	Environmental Performance Outcome
Plankton communities	EPO 1	No long term or permanent impacts to plankton communities as a result of the activity.
Benthic communities	EPO 2	No permanent change in benthic communities as a result of the activity.
Marine fauna including EPBC listed cetaceans, turtles, fish, sharks and other marine species	EPO 3	No physical injury, mortality or disturbance during peak breeding or migration period to EPBC Act listed (marine fauna) species due to noise and light associated with the operation of vessels and seismic sources and seismic acquisition is consistent with the Recovery Plans for EPBC listed marine species.
Shoreline habitats	EPO 4	No impact on a shoreline as a result of routine operations.
Protected areas	EPO 5	No impact on values of marine protected areas not inconsistent with the management principles and objectives of the marine park or other protected area.
Commercial fisheries	EPO 6	Displacement of commercial fisheries is limited to the caution zone around the seismic survey vessel as an acceptable level of disruption.
	EPO 7	No serious or irreversible impact to fish stock, spawning or fishing activities due to the activity.
	EPO 8	No loss of total annual catch income for commercial fishing licence holders; they are no worse off as a result of the seismic survey.
Commercial shipping	EPO 9	Disturbance to commercial shipping is limited to the caution zone around the seismic survey vessel as an acceptable level of disruption.
Tourism and Recreation	EPO 10	Displacement of tourism and recreation is limited to the mutually agreed area during SIMOPS planning.
	EPO 11	No health impacts on divers or recreational activities due to seismic sound.
Petroleum exploration and production	EPO 12	Disturbance to petroleum exploration and production is limited to the caution zone around the seismic survey vessel as an acceptable level of disruption, or changes required under SIMOPS planning.
Defence activities	EPO 13	No disruption to defence activities.
Research activities	EPO 14	No disruption to research activities beyond that which is agreed to in SIMOPS planning.
All Receptors	EPO 15	No unplanned objects, emissions or discharges to sea or air
All Receptors	EPO 16	No long-term environmental impact to identified sensitive receptors in the event of an unplanned hydrocarbon spill to sea
Plankton communities Benthic communities Marine Fauna Protected areas Commercial fisheries Tourism and Recreation	EPO 17	No introduction of marine pest species.
Relevant stakeholders (including government, fisheries and marine users)	EPO 18	Consultation with directly affected stakeholders prior, during and after the activity

Table 9.2 – Possum 3D MSS Control Measures, Environmental Performance Standards, Measurement Criteria and Environmental Performance outcomes

Control measure	EPS #	EPS	Measurement Criteria	EPO
		Physical Presence of Vessels		
Stakeholder Consultation	EPS 1.1	Stakeholder review conducted two months prior to the commencement of survey activities if the survey commences more than 4 months following EP acceptance.	Records of stakeholder review completed two months prior to activity commencement if the survey commences more than 4 months following EP acceptance.	EPO 18
Stakeholder Consultation: Including Notices to Mariners	EPS 1.2	Notification of survey commencement and forecast of operations issued prior to mobilisation, to relevant stakeholders, as per APPENDIX F.	Consultation records show survey commencement notifications and forecast of operations are issued prior to mobilisation and align with notification times listed in APPENDIX F,	EPO 18
Stakeholder Consultation	EPS 1.3	Notifications during survey issued, to relevant stakeholders, as per APPENDIX F.	Consultation records show notifications are issued during the survey as required and align with notification times listed in APPENDIX F,	EPO 18
Stakeholder Consultation: Including Notices to Mariners	EPS 1.4	Notification of survey completion issued after demobilisation, to relevant stakeholders, as per APPENDIX F.	Consultation records show survey completion notifications are issued after demobilisation and align with notification times listed in APPENDIX F.	EPO 18
Stakeholder Consultation	EPS 1.5	Stakeholders actively operating in or near the operational area will be kept informed of daily survey activities through 24-hour look-ahead communication	Records show stakeholders actively operating in or near the operational area receive 24-hr look-ahead communication throughout the survey.	EPO 18
Navigation equipment and procedures	EPS 1.6	AIS tracking device and Automatic Radar Plotting Aid (ARPA) installed on survey vessels and operating to aid identification by other vessels, including vessel speed, heading and virtual outer tail buoy locations to cover the extent of the seismic array.	Inspection records confirm operational AIS/ARPA installed on the seismic and support vessels.	EPO 6 EPO 9 EPO 10
Marine Orders Part 30: Prevention of Collisions 2016, Section 9 – Requirements of International Regulations	EPS 1.7	Vessel to maintain appropriate lighting, navigation and communication at all times to inform other users of the position and intentions of the survey vessel, in compliance with the Navigation Act 2012, COLREGS (International Regulations for Preventing Collisions at Sea 1972), Chapter IV (Radiocommunications) and Chapter V (Safety of Navigation) of SOLAS (International Convention on the Safety of Life at Sea 1974) AMSA Marine Orders Part 30.	Evidence that vessels have navigational lights and communication system that comply with relevant marine orders and legislation.	EPO 6 EPO 9 EPO 10
Offshore Petroleum and Greenhouse Gas Act 2006, specifically Chapter 2 Part 2.14 Section 280 – Interference with	EPS 1.8	Searcher will conduct the survey in a manner that does not interfere with: (a) navigation; or (b) fishing; or (c) the conservation of the resources of the sea and seabed; or (d) any activities of another person being lawfully carried on by way of:	Records show that Searcher conducted the survey in a manner that didn't interfere with the rights of other users.	EPO 6 EPO 9 EPO 10 EPO 12

Control measure	EPS #	EPS	Measurement Criteria	EPO
Others Rights applying to a petroleum exploration permit		(i) exploration for, recovery of or conveyance of a mineral (whether petroleum or not); or (ii) construction or operation of a pipeline; or (e) the enjoyment of native title rights and interests (within the meaning of the Native Title Act 1993); to a greater extent than is necessary for the reasonable exercise of the rights and performance of the duties of the first person.		
Communication and interaction protocols	EPS 1.9	Searcher will ensure that suitable protocols for communication and interaction with vessel operators encountered during the survey are defined and implemented during the campaign.	Records show communication and interaction protocols developed and followed as required during the campaign.	EPO 6 EPO 9 EPO 10
EPBC Regulations 2000 – Part 8 Division 8.1 (Regulation 8.05 and 8.06).	EPS 1.10	Interaction between survey vessel and cetaceans (whales and dolphins) within the operational area will be consistent with EPBC Regulations 2000 – Part 8 Division 8.1 (Regulation 8.05 and 8.06).	MFO report demonstrates no breaches of EPBC Regulations 2000 (Part 8.05 and 8.06).	EPO 3
Whale Shark Wildlife Management Program no. 57 (DpaW 2013) – Whale shark interaction code of conduct for vessels	EPS 1.11	Seismic and support vessels will not knowingly approach within 30 m of a whale shark or travel at more than 8 knots within a 250 m radius of a whale shark.	MFO records show that the seismic and support vessels speed of less than 8 knots when within a 250 m radius of a known whale shark. Records show seismic and support vessels did not knowingly approach within 30 m of a whale shark.	EPO 3
Equipment specification and procedures	EPS 1.12	Streamer tail buoys will be fitted with appropriate turtle guards.	Inspection of streamer tail buoys records presence of turtle guards.	EPO 3
Survey/Support Vessel Procedure	EPS 1.13	Seismic and support vessels will not knowingly travel at more than 6 knots within 300 m of a turtle.	Records show that seismic and support vessels did not knowingly travel at more than 6 knots within 300 m of a turtle.	EPO 3
Equipment specification and procedures	EPS 1.14	Streamers fitted with Automatic Streamer Recovery Devices	Pre-start inspection shows evidence that automatic streamer recovery devices are attached to streamers.	EPO 3
Recovery of entangled marine fauna	EPS 1.15	All entangled marine fauna recovered to the seismic or support vessels will be returned to the sea as quickly as practicable.	MFO report confirms that any marine life recovered with wet equipment was recorded and then quickly returned to the ocean.	EPO 3
Support Vessel Procedure	EPS 1.16	Up to two support vessels used throughout the activity to manage vessel interactions and maintain communications with commercial shipping in the survey area, assist in the recovery of lost streamers and warning the survey vessel of in-water hazards 24/7. In case of emergency one support vessel will be capable of taking survey vessel under tow with all equipment deployed (to keep survey vessel and in-water equipment under control and in forward motion). A dedicated support vessel with tow capabilities will always remain with the survey vessel when within 20km of Mermaid Reef or other marine park.	Records demonstrate that dedicated support vessels are employed for the duration of the activity, stationed with the survey vessel when appropriate and records of vessel interactions are maintained.	EPO 9

Control measure	EPS #	EPS	Measurement Criteria	EPO
Recreational fishing restrictions	EPS 1.17	Policy of no recreational fishing from seismic or support vessel is communicated to all crew as part of project induction.	Records show that the policy of no recreational fishing from seismic or support vessels is included in project induction material for vessel crews.	EPO 18
Survey Design	EPS 1.18	Survey temporally and spatially designed with northern area acquired toward the end of the survey acquisition.	Records show that northern area acquired toward the end of the survey.	EPO 6 EPO 9 EPO 10
Survey Design	EPS 1.19	Survey temporally designed to be outside known peak fishing and key spawning periods for the NWSTF resource identified as September to October	Records show survey is conducted outside the period of September to October.	EPO 7 EPO 8
Survey Design	EPS 1.20	Survey spatially designed with application of a 1000m buffer around the AIMS Research Oceanographic Mooring, (NWSROW buoy location: S 17deg 45.481', E 119 deg 54.366')	Records show 1000m avoidance of the AIMS Research Oceanographic Mooring, (NWSROW buoy location: S 17deg 45.481', E 119 deg 54.366')	EPO 14
Commercial Fishery Adjustment	EPS 1.21	Payment of adjustment to commercial fishers for evidence-based loss of catch, displacement and Fishing gear loss or damage.	Records show impartial assessment of evidence-based claims, as per the NERA CSEP Adjustment Protocol.	EPO 8
Stakeholder Consultation	EPS 1.22	Consultation with stakeholders during the development of the EP, prior to and throughout the survey activity and EP validity	Consultation register shows stakeholder consultation throughout the EP development, survey activity and validity	EPO 18
Survey Vessel Procedure	EPS 1.23	Survey vessel will not leave the Operational Area with guns deployed unless in emergency	Navigation charts show that Survey vessel will not leave the Operational Area with guns deployed unless in emergency.	EPO 5
Survey/Support Vessel Procedure	EPS 1.24	Wherever possible the Mermaid and other reefs will be avoided as an emergency anchorage	Navigation records show Mermaid and other reefs were avoided as an emergency anchorage	EPO 5
Stakeholder Consultation	EPS 1.25	Annually, and at least 12 weeks prior to the survey (unless the annual review falls within the same period), Searcher will undertake a pre-survey review of the EP.	Stakeholder Register shows ongoing consultation records for the duration of the EP.	EPO 18
Multi-Client Survey	EPS 1.26	Conduct survey as multi-client operation	Records show data is available to multiple clients	EPO 12
		Invasive Marine Species		
Biosecurity Act 2015, Chapter 4, Managing biosecurity risks: conveyances	EPS 2.1	Vessels will demonstrate that at last arrival in Australian Territorial Waters from an international voyage, details of ballast water exchange were submitted via a Pre-Arrival Report (PAR) 96-12 hours prior to arrival and assessed by a biosecurity officer in a first entry port in Australia via MARS; and if a vessel does not meet one of the exceptions outlined in the Biosecurity (Exposed Conveyances—Exceptions from Biosecurity Control) Determination 2016 , they submit a Pre-Arrival Report (PAR) 96-12 hours prior to re-entry into Australian territorial waters and be assessed by a biosecurity officer in a first port of arrival via MARS.	Records show that a PAR was submitted by each vessel if arriving from international waters immediately prior to mobilisation to the operational area and that ballast water exchange requirements have been met.	EPO 17

Control measure	EPS #	EPS	Measurement Criteria	EPO
Ballast management plan	EPS 2.2	Survey vessels will carry a valid Ballast Water Management Plan including: o Ballast water exchange; o Ballast water management systems; o Sediment management; o Duties of officers and crew; o Coordination with local authorities; and o Record keeping o Ballast Water Management Certificate.	Pre-mobilisation Inspection check list confirm an approved Ballast Water Management Plan in place and a valid Ballast Water Management certificate onboard all vessels prior to activity commencement.	EPO 15 EPO 17
Australian Ballast Water Requirements Version 8 2020	EPS 2.3	All ballast water operations are recorded in the Ballast Water Record System.	All ballast water operations are recorded in the Ballast Water Record System.	EPO 15
Anti-foulant system	EPS 2.4	Survey vessels have a certified anti-fouling coating on the hull and certification is in place in accordance with AMSA Marine Order Part 98 (Anti-fouling systems). Date of application will be within the active period for the coating, as defined by the manufacturer.	International Anti-fouling System Certificate shows anti-fouling application date is consistent with manufacturers recommendation for active life.	EPO 17
National Biofouling Management Guidance for the Petroleum Production and Exploration Industry 2009	EPS 2.5	Items periodically immersed in water, such as anchors and cables, ropes, fenders and small boats (tenders) will be clean of biofouling such as entangled seaweed, mud and other sediments after recovery and before stowage.	Inspection records show items periodically immersed in water are clean of biofouling before stowage.	EPO 17
National Biofouling Management Guidance for the Petroleum Production and Exploration Industry 2009	EPS 2.6	Routine cleaning, maintenance and storage practices of seismic survey equipment is undertaken throughout the survey as required.	Maintenance records show that routine cleaning and maintenance of seismic survey equipment occurred throughout the survey.	EPO 17
National Biofouling Management Guidance for the Petroleum Production and Exploration Industry 2009 and Aquatic Biosecurity Solution, Vessel-Check tool (DHI 2021)	EPS 2.7	Vessels which have entered Western Australian waters from international waters or interstate waters immediately prior to mobilising to the operational area will be required to provide an IMS risk assessment using the Aquatic Biosecurity Solution, Vessel-Check tool (DHI 2021). Corrective action to be taken as required to demonstrate a low IMS risk prior to mobilisation to the operational area.	Biofouling risk assessment report confirming survey vessel poses low risk of introducing IMS.	EPO 17
Ballast water management plan	EPS 2.8	Ballast water tanks of survey vessels within the operational area contain 'low-risk' ballast water (at least 95% of the ballast water in that tank is from a low-risk source)	Ballast water exchange records demonstrate that ballast water on survey vessels within the operational area has been obtained from a low-risk source.	EPO 15 EPO 17
		Artificial Light		
External vessel lighting follows National Light Pollution	EPS 3.1	Temporary lighting for night-time maintenance on deck will be directed only to the work area, with light spill to water minimised.	Pre-maintenance HSE assessments show night-time maintenance work performed using lighting that is directed to work area.	EPO 3 EPO 9

Control measure	EPS #	EPS	Measurement Criteria	EPO
Guidelines for Wildlife (DoEE and DBCA 2020)				
		Anthropogenic Sound – Seismic		
Equipment specification and procedures	EPS 4.1	The minimum practical source size will be selected to acquire survey data and meet the geophysical objectives of the survey.	Records show that the minimum practical source size was selected to acquire survey data.	EPO 3
Stakeholder Consultation to develop a concurrent operations plan for any concurrent surveys identified within 60 km of the acquisition area.	EPS 4.2	Searcher will engage with proponents identified as having potential concurrent seismic activities prior to commencing the Possum 3D MSS and develop a concurrent operations plan for any concurrent surveys identified within 60 km of the acquisition area.	Stakeholder engagement records A copy of simultaneous operations plan	EPO 18
Separation distance of 40 km between the survey vessel and other operating seismic sources.	EPS 4.3	A minimum separation distance of 40 km will be maintained between the Possum 3D MSS survey vessel and other operating seismic sources.	Survey records and vessel communications confirm a minimum separation distance of 40 km will be maintained between the Possum 3D MSS survey vessel and other operating seismic sources	EPO 18
Safe Diving Distance from Seismic Surveying Operations (DMAC 2020)	EPS 4.4	The requirements of DMAC Guidance Note 12 Rev 2.1 (2020): Safe Diving Distance from Seismic Surveying Operations will be implemented	Stakeholder engagement records and seismic vessel logs (as applicable) demonstrate the requirements of DMAC Guidance Note 12 Rev 2.1 were followed.	EPO 11
Shutdown procedures for whale	EPS 4.5	EPBC Policy Statement 2.1 Interaction between offshore seismic exploration and whales Part A: Standard Management Measures - with 500 m shutdown, 2 km low power and 3 km observation zones will be implemented. - Do not program seismic surveys in areas where and when whales are likely to be breeding, calving, resting or feeding. Operational Procedures: Pre start-up visual observation Soft start Start-up delays Operations Stop work Night-time and low visibility	MFO records / reports show that marine fauna interaction procedures are followed during survey including precaution zones, soft starts and recommencement procedures . Vessel logs show records of all soft starts, shut down procedures and timing of acquisition. Induction records confirm that vessel crew and survey personnel have been inducted on the implementation requirements of Part A of the EPBC Policy Statement 2.1.	EPO 3
Shutdown procedures for whale sharks.	EPS 4.6	EPBC Policy Statement 2.1 Part A: Standard Management Measures will be applied to whale sharks – with 500m shutdown zone. Operational Procedures including: Pre start-up visual observation	MFOs records / reports show that marine fauna interaction procedures are followed during survey including precaution zones, soft starts and recommencement procedures. Vessel logs show records of all soft starts, shut down procedures and timing of acquisition.	EPO 3

Control measure	EPS #	EPS	Measurement Criteria	EPO
		Soft start Start-up delays Operations Stop work Night-time and low visibility	Induction records confirm that vessel crew and survey personnel have been inducted on the implementation requirements of Part A of the EPBC Policy Statement 2.1.	
Application of EPBC Policy Statement 2.1 Part B: Use of MFOs (MMOs)	EPS 4.7	Application of EPBC Policy Statement 2.1 Part B: Up to two MFO's, trained to an internationally recognised standard, will be on board with one MFO on watch at all times during daylight hours of seismic acquisition.	CV and MFO records / reports show that MFOs suitably qualified, engaged and on watch at all times during daylight hours for the duration of the survey.	EPO 3
Shutdown procedures for the pygmy blue whale	EPS 4.8	Consistent with EPBC Policy Statement 2.1 Part B, adaptive management will be applied if the survey period overlaps the pygmy blue whale migration period (September to December, April to July). If three blue whale-instigated power-down or shut-down situations, or seven or more confirmed blue whale sightings, occur during a 24 hour period (commencing from the time of the first whale instigated shut-down or sighting), seismic acquisition will not be undertaken during the subsequent night-time. Seismic acquisition will not resume at night-time until there has been a 24-hour period of seismic acquisition during which no power-downs / shutdowns have occurred for pygmy blue whales.	MFOs records / reports show that marine fauna interaction procedures are followed during survey including precaution zones, soft starts and recommencement procedures. Vessel logs show records of all soft starts, shut down procedures and timing of acquisition. Induction records confirm that vessel crew and survey personnel have been inducted on the implementation requirements of Part A of the EPBC Policy Statement 2.1.	EPO 3
Phasing of the survey to avoid pygmy blue whale and whale shark migration period	EPS 4.9	The seismic acquisition window will be restricted to between December and July inclusive.	Regulatory notifications (10 days prior to the survey and 10 days after the demobilisation) issued to NOPSEMA confirm acquisition occurs within the period December to July inclusive.	EPO 3
100 m 'turtle pause' when a turtle is within 100 m of the active source	EPS 4.10	100 m 'turtle pause' when a turtle is within 100 m of the active source	MFO Records / reports show implementation of turtle pause	EPO 3
		Atmospheric Emissions		
Marine Order 97 (Marine pollution prevention — air pollution) 2013 Division 2: Certificates	EPS 5.1	All survey vessels (subject to vessel class described in Marine Order 97) hold a valid EIAPP certificate for each marine diesel engine > 130 kW; an IAPP certificate; and an IEE certificate.	Pre-mobilisation inspection check list to confirm relevant certificates or equivalent are in place and they are current. Records of fuel consumption quantify emissions and discharges.	EPO 15
Marine Order 97 (Marine pollution prevention — air pollution) 2013 Division 4: Incineration on board vessels	EPS 5.2	There will be no incineration of any matter on board a vessel in an incinerator that does not comply with regulation 16 of Annex VI unless AMSA has allowed exclusion.	Records show there was no unlawful incineration onboard the survey vessels. Or a copy of AMSA approved exclusions, if required	EPO 15

Control measure	EPS #	EPS	Measurement Criteria	EPO
Marine Order 97 (Marine pollution prevention — air pollution) 2013 Division 4: Incineration on board vessels	EPS 5.3	A person must not incinerate any matter on board a vessel if incineration of the matter is prohibited (either absolutely or in a specified circumstance or a specified way) by regulation 16 of Annex VI unless AMSA has allowed exclusion.	Records show no prohibited matters are incinerated on board a survey vessel. Or a copy of AMSA approved exclusions, if required	EPO 15
Protection of the Sea (Prevention of Pollution from Ships) Act 1983, Div 2, 26FEG(1)(b)	EPS 5.4	Survey vessels comply with the 0.50 % m/m fuel oil sulphur limit by either:	Records demonstrate that each survey vessel complies with the prescribed sulphur content of fuel oil	EPO 15
All vessel engines to be maintained in accordance with manufacturers specifications	EPS 5.5	Seismic and support vessel engines will be maintained as per manufacturer's specification.	Vessel maintenance records show that maintenance has been undertaken on vessels engine in accordance with the manufacture's specifications.	EPO 15
Marine Order 97 (Marine pollution prevention — air pollution) 2013 Division 6: Energy efficiency-ship energy efficiency management plan	EPS 5.6	As required by vessel class, survey vessels will have a SEEMP and it will contain the information required by 2016 Guidelines for the development of a ship energy efficiency management plan, adopted by IMO resolution MEPC.282(70) and as amended from time to time.	Pre-mobilisation inspection check list to confirm relevant SEEMP adopted	EPO 15
	Discharge of Sewage, Greywater and Putrescible Waste			
Waste Management Procedures are in place and implemented during the survey in accordance with Protection of the Sea (Prevention of Pollution from Ships) Act 1983 and Marine Order 96	EPS 6.1	Sewage discharge between 3 nm and 12 nm from land is comminuted and disinfected by approved systems and holds valid International Sewage Pollution Prevention (ISPP) certificate under the Protection of the Sea (Prevention of Pollution from Ships) Act 1983 and Marine Order 96	Records in Inspection checklist and records of emissions and discharges show sewage system is functional and in use. Valid International Sewage Pollution Prevention certificate	EPO 15
Waste Management Procedures are in place and implemented during the survey in accordance with Protection of the Sea (Prevention of Pollution from Ships) Act 1983 and Marine Order 96	EPS 6.2	Sewage (treated or untreated) originating from holding tanks is discharged at a moderate rate while the ship is proceeding en route at a speed not less than 4 knots as per the Protection of the Sea (Prevention of Pollution from Ships) Act 1983 and Marine Order 96.	Records in Inspection checklist show discharges of sewage occur at a speed of more than 4 knots.	EPO 15

Control measure	EPS #	EPS	Measurement Criteria	EPO
Waste Management Procedures are in place and implemented during the survey in accordance with Protection of the Sea (Prevention of Pollution from Ships) Act 1983 and Marine Order 96	EPS 6.3	All food wastes discharged >3 nm and <12 nm from land and macerated to <25 mm as per the Protection of the Sea (Prevention of Pollution from Ships) Act 1983 and Marine Order 96.	Records in Inspection checklist show discharges of food waste are compliant with the distances specified in Marine Order 95. Records show macerator is functional and macerates to < 25 mm.	EPO 15
Waste Management Procedures are in place and implemented during the survey in accordance with Protection of the Sea (Prevention of Pollution from Ships) Act 1983 and Marine Order 96	EPS 6.4	Records of food waste disposal to be maintained in a Garbage Record Book as per the Protection of the Sea (Prevention of Pollution from Ships) Act 1983 and Marine Order 96.	Records in the Garbage Record book	EPO 15
Sewage treatment system	EPS 6.5	Sewage treatment plant is in good working order as per the Protection of the Sea (Prevention of Pollution from Ships) Act 1983 and Marine Order 96.	Vessel equipment maintenance records show that there are no outstanding maintenance activities for equipment.	EPO 15
Waste Management Procedures are in place and implemented during the survey in accordance with Protection of the Sea (Prevention of Pollution from Ships) Act 1983 and Marine Order 96	EPS 6.6	Vessels of 12 m length or over display placards notifying passengers and crew of the disposal requirements, including for food waste as per the Protection of the Sea (Prevention of Pollution from Ships) Act 1983 and Marine Order 96.	in Inspection checklist provides Evidence of placards notifying of disposal requirements being displayed is sighted.	EPO 15
		Discharge of Deck Drainage and Bilge Water		
Bilge Water Management	EPS 7.1	In accordance with Regulations 12 and 14 of MARPOL Annex I, all bilge water is treated through an OWS set to prevent the discharge of water with >15 ppm oil in water (OIW) content and will hold a valid IOPP.	Valid International Oil Pollution Prevention certificate.	EPO 15
Equipment Maintenance	EPS 7.2	In accordance with Regulations 12 and 14 of MARPOL Annex I, the oily water separator is in good working order.	Records confirm the OWS system is maintained in accordance with the manufacturer's requirements. Vessel equipment maintenance records show that there are no outstanding maintenance activities for equipment.	EPO 15
Equipment Maintenance	EPS 7.3	In accordance with Regulations 12 and 14 of MARPOL Annex I, the oily water meter is operational and calibrated in accordance with manufacturers specifications	Record of calibrations evidence that the meters are operational.	EPO 15

Control measure	EPS #	EPS	Measurement Criteria	EPO
Equipment Maintenance	EPS 7.4	All vessels will maintain an Oil Record Book In accordance with Regulations 12 and 14 of MARPOL Annex I.	Inspection checklist shows that all vessels have maintained an Oil Record Book.	EPO 15
paragraph 26AB(6)(a) of the Pollution Prevention Act	EPS 7.5	For paragraph 26AB(6)(a) of the Pollution Prevention Act substances are only washed overboard if the Vessel Master: • has considered the physical, chemical and biological properties of the substance; and • reasonably considers that washing overboard is the most appropriate manner of disposal; and • has authorised the washing overboard.	Vessel records show that substances listed under paragraph 26AB(6)(a) of the Pollution Prevention Act are only washed overboard if the vessel master has considered all aspects listed under that section of the Act.	EPO 15
Marine Order 95	EPS 7.6	There will be no discharge of harmful cleaning agents prescribed under Marine Order 95.	Records confirm only cleaning agents compliant with Marine Order 95 are used during the campaign.	EPO 15
Harmful Substances Storage & Management	EPS 7.7	If the vessel has on board harmful substances in packaged form, Searcher will comply with regulations 2 to 5 of Annex III (of MARPOL), that: • packages shall be adequate to minimize the hazard to the marine environment, having regard to their specific contents; • Packages containing a harmful substance shall be durably marked with the correct technical name (trade names alone shall not be used) and, further, shall be durably marked or labelled to indicate that the substance is a marine pollutant. Such identification shall be supplemented where possible by any other means, for example, by use of the relevant United Nations number; and • The method of marking the correct technical name and of affixing labels on packages containing a harmful substance shall be such that this information will still be identifiable on packages surviving at least three months' immersion in the sea. In considering suitable marking and labelling, account shall be taken of the durability of the materials used and of the surface of the package. • stowage plan with location of harmful substances on board. • properly stowed and secured so as to minimize the hazards to the marine environment without impairing the safety of the ship and persons on board;	Inspection records show that packaged harmful substances are stowed in accordance with MARPOL Annex III.	EPO 15
Vessel spill response Plans (SOPEP)	EPS 7.8	Deck spills will be cleaned up in accordance with the vessel's accepted SOPEP.	Incident records show that deck spills are cleaned up in accordance with the vessel's SOPEP.	EPO 15 EPO 16
		Discharge of Cooling Water and Desalination Brine		

Control measure	EPS #	EPS	Measurement Criteria	EPO
Desalination plant and cooling water systems to be maintained in accordance with manufacturers specifications	EPS 8.1	Desalination plant and cooling water systems are maintained in accordance with planned maintenance program so as to remain in good working order.	Records show routine completion of maintenance in accordance with manufacturer specifications or preventative maintenance system.	EPO 15
		Dropped Objects and Solid Waste		
Dropped object prevention and recovery	EPS 9.1	Solid streamers are used for the duration of the survey.	Inspection records show that seismic streamers are not fluid filled.	EPO 15
Dropped object prevention and recovery	EPS 9.2	Seismic streamers have redundant attachment points to the seismic vessel.	Inspection records show that seismic streamers have redundant attachment points to the survey vessel.	EPO 15
Dropped object prevention and recovery	EPS 9.3	Waste and equipment on deck will be stored securely and all outside bins have lids which can be closed or have nets fitted.	Inspection records show that equipment and waste on deck is stored securely and outside bins have lids which can be closed or have nets fitted.	EPO 15
Dropped object prevention and recovery	EPS 9.4	Automatic Streamer Recovery Devices attached to streamers will be set to the shallowest depth feasible for the requirements of the operating depth of the streamers.	Pre-start inspection checklist shows evidence that automatic recovery devices are attached to streamers and depth is set.	EPO 15
		Marine Hydrocarbon Spills		
Vessel refuelling and bunkering procedures	EPS 10.1	All refuelling of the survey vessels will be carried out in accordance vessel refuelling and bunkering procedures which will require: • Constant surveillance, communication protocols and daylight refuelling. • Dry-break couplings and non-return valves on fuel transfer hoses that are to be maintained regularly.	Records demonstrate that bunkering procedures in place prior to mobilisation of vessels. Records show that bunkering performed in compliance with bunkering procedures.	EPO 16
Vessel spill response Plans (SOPEP/ ERP)	EPS 10.2	Survey vessels will hold a current ERP and SOPEP in compliance with MARPOL 73/78 Annex I (as applied in Australia under the Protection of the Sea (Prevention of Pollution from Ships) Act 1983)); and AMSA Marine Orders – Part 91 Marine Pollution Prevention – Oil)	Records (Inspection check list) demonstrate the SOPEP is present on survey vessels, ERP is current and equipment identified for use under the SOPEP is available. Induction records confirm that vessel crew and survey personnel have been inducted on the implementation of SOPEP and familiar with SOPEP equipment.	EPO 16
Vessel spill response Plans (SOPEP/ OPEP/ ERP)	EPS 10.3	In the event of a hydrocarbon spill from a vessel the ERP and SOPEP shall be implemented. The Acquisition Contractor's Vessel Master will conduct a vessel SOPEP and OPEP test via a drill assessment and evaluation with recommendations for future drills: • prior to commencement of the activity,	Records demonstrate that the ERP and SOPEP were implemented in the event of a hydrocarbon spill. Induction records confirm that vessel crew and survey personnel have been inducted on the implementation of SOPEP	EPO 16

Control measure	EPS #	EPS	Measurement Criteria	EPO
		• when response arrangements are significantly modified, following response exercises, • where required by any action defined in the post-exercise report.		
NOPSEMA accepted Oil pollution emergency plan (OPEP)	EPS 10.4	In the event of a hydrocarbon spill to the marine environment, the NOPSEMA accepted Possum 3D MSS OPEP will be implemented as follows: • First-strike response shall be undertaken in accordance with Section 1 of the NOPSEMA accepted OPEP. • With the exception of first strike response, response strategies shall be under the guidance of the relevant Control Agency. Searcher and vessel operators will support the CA as requested.	Incident records confirm first-strike response undertaken in accordance with Section 1 of OPEP. Incident records confirm that beyond first strike response, all response by Searcher and the vessel operators is as directed by the CA. Induction records confirm that vessel crew and survey personnel have been inducted on the implementation Possum 3D MSS OPEP.	EPO 16
NOPSEMA accepted OSMP	EPS 10.5	In the event of a level 2 hydrocarbon spill to the marine environment, Searcher will implement the NOPSEMA accepted Possum 3D MSS OSMP as follows: • Each study will be implemented once initiation criteria are met. • The outcomes of initiated operational monitoring studies shall be used to inform the suitability of proposed response activities and / or the effectiveness of implemented response activities • The results of initiated scientific monitoring programs will be used to evaluate the effectiveness of implemented response activities. Operational and scientific studies shall not be terminated until the corresponding termination criteria as defined within the OSMP have been met.	Incident records confirm activation and termination consistent with the criteria in the OSMP for each study. Incident records confirm findings of the OSMP are fed back to the CA as appropriate.	EPO 16
Using MDO/MGO rather than HFO	EPS 10.6	Survey vessels use marine diesel or marine gas oil (instead of vessels using heavy fuel oils)	Records show Survey vessels use marine diesel or marine gas oil	EPO 16
		Oiled Fauna Displacement and Handling		
NOPSEMA accepted Oil pollution emergency plan (OPEP)	EPS 11.1	Spill response strategies are selected by the CA following an assessment of their potential benefits and/or dis-benefits using an industry-standard approach (i.e. NEBA or SIMA). Searcher personnel will support in the assessment process as requested.	Incident records show a NEBA, SIMA or other industry standard process is performed to assess spill response strategies.	EPO 16
NOPSEMA accepted Oil pollution emergency plan (OPEP)	EPS 11.2	During a maritime environmental emergency trained and experienced personnel from DBCA/AMOSC will lead the oiled wildlife response under the control of the appointed CA. Vessel personnel will be made available to support a response (where safe to do so) and will only respond under the direction of DBCA/AMOSC.	The OPEP designates DBCA as the lead of oiled wildlife response under the direction of the CA.	EPO 16

Control measure	EPS #	EPS	Measurement Criteria	EPO
NOPSEMA accepted Oil pollution emergency plan (OPEP)	EPS 11.3	Vessels used in oiled wildlife capture will approach fauna from the direction of the spill toward the animals at less than 6 knots.	Vessel records show that approach toward oiled wildlife is from the direction of the spill at no more than 6 knots.	EPO 16
EP implementation and Management	EPS 12.1	The requirements of this EP will be rolled out to contractors through the following processes: 1. The requirement to comply with the EP will be included in contracts for vessels. 2. A copy of the approved EP and OPEP will be provided to the vessel operators. 3. Contractor HSE Plan will be required to acknowledge, as appropriate, relevant commitments in the EP. 4. Contractor personnel will be required to attend the HSE Induction (Section 7.3.1). 5. A review of contractor compliance with the relevant environmental performance standards will be initiated prior to mobilisation (as detailed in Section 7.5).	A copy of contractors for vessels A copy of contractor's HSE Plan HSE Induction Register and Records of Inductions Pre-mobilisation review (Inspection Check lick) confirm contractor compliance with the relevant environmental performance standards	All

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GLOSSARY

Term	Explanation
Acceptable level	The level of impact or risk to the environment that may be considered broadly acceptable with regard to all relevant considerations listed in Section 5 and compliant with the guidance presented in Environment Plan Content Requirements (NOPSEMA, 2019)
Acquisition Area	Area within which the seismic source will be operational and seismic data will be acquired
As Low as Reasonably Practicable	Reducing impacts and risks based on the concept of reasonable practicability; the weighing up of the magnitude of impact or risk reduction against the cost of that reduction. In this context, a titleholder is required to implement all available control measures where the cost is not grossly disproportionate to the environmental benefit gained from implementing the control measure.
As Low as Reasonably Practicable assessment	Process by which Searcher demonstrates, through reasoned and supported arguments, that there are no other practical measures that could reasonably be taken to reduce risks further.
Consequence	The outcome of an event. The consequence considers extent, duration, severity and certainty of what would happen should prevention control measures fail.
Control measure	A system, an item of equipment, a person or a procedure, that is used as a basis for managing environmental impacts and risks. Control measures maintain and/or modify risk.
Cost	The sacrifice required for implementing a control measure, which includes an impost such as the money, time, and/or trouble required to implement a particular control measure. Environmental cost may also be a cost in some circumstances (e.g. dispersant use on an oil spill).
Environmental aspect	Element of an organisation's activities or products or services that interacts or can interact with the environment.
Environmental impact	Any change to the environment, whether adverse or beneficial, that wholly or partially results from an activity of a titleholder.
Environmental performance outcome	An environmental performance outcome is the measurable level of performance required for the management of an environmental aspect of an activity to ensure that environmental impacts and risks will be of an acceptable level.
Environmental performance standard	An environmental performance standard is a statement of the performance required of a control measure
Environmental risk	Risk is a deviation (positive or negative) from what is expected and reflects the uncertainty associated with unexpected events. A combination of the consequences of an event occurring and the likelihood of its occurrence. Environmental risks result from unplanned events that may occur as a result of the activity.
Event	The occurrence or change of a particular set of circumstances. Events can have one or more consequences and causes, can be expected or unexpected, and can be a risk source.
Indicator Species	Fisheries management term – term used to describe select fish species that are used to assess the risk to sustainability of all 'like' species susceptible to capture within a fishery resource (Newman et al 2018)
Likelihood	The chance that an event or consequence may happen i.e. "likelihood". Both terms have been adopted for this EP. The likelihood may be determined via quantitative means (where data is available), or via qualitative means based on oil and gas industry performance.
Measurement criteria	Measurement criteria define how environmental performance will be measured and are used to determine whether the environmental performance outcomes have been met during the activity.
Predicted impact	The level of environmental impact associated with planned activities, with control measures implemented.
Probability	Probability is a measure of the likelihood that an event will occur and is represented as a number between 0 and 1.
Residual risk	The level of environmental risk associated with unplanned events after risk treatment (with control measures implemented).
Support vessel	Vessel to remain on standby to direct shipping traffic away from the survey vessel during acquisition activities, scout the area ahead for hazards and support in the event of an emergency.
Survey vessel	Vessel undertaking MSS activities under this EP for acquiring survey data.
The Activity	Regulation 4 of OPGGS(E) Regulations 2009: Petroleum Activity means any operations or works in an offshore area carried out for the purpose of: a) exercising a right conferred on a petroleum titleholder under the Act by a petroleum title; or b) discharging an obligation imposed on a petroleum titleholder by the Act or a legislative instrument under the Act.

ACRONYMS AND ABBREVIATIONS

Term	Description
3D	3-dimensional
AASM	Airgun array source model
ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ADD	Acoustic deterrent devices
AFMA	Australian Fisheries Management Authority
AFZ	Australian Fishing Zone
AHO	Australian Hydrographic Office
AIMS	Australian Institute of Marine Science
AIS	Automatic Identification System
ALARP	As Low as Reasonably Practicable
AMP	Australian Marine Park
AMSA	Australian Maritime Safety Authority
APPEA	Australian Petroleum Production & Exploration Association
ARPA	Automatic radar plotting aid
AS/NZS	Australian Standard/ New Zealand Standard
AUSCOAST	Australian Coastguard
BIA	Biologically Important Area
BMSL	Below mean sea level
BoM	Bureau of Meteorology
Bonn Convention	Convention on the Conservation of Migratory Species of Wild Animals 1979
BRAHSS	Behavioural Response of Australian Humpback whales to Seismic Surveys
BRUV	Baited Remote Underwater Video
CoEP	Code of Environmental Practice
COLREGS	Convention on the International Regulations for Preventing Collisions at Sea 1972
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAWE	Department of Agriculture, Water and the Environment (formerly DoEE and DoE)
DAWR	Department of Agriculture and Water Resources
dB	Decibels
DBCA	Department of Biodiversity, Conservation and Attractions
DoE	Department of the Environment
DoEE	Department of the Environment and Energy
DoFWA	Department of Fisheries, Western Australia
DoT	Department of Transport
DPIRD	Department of Primary Industries and Regional Development
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
EEZ	Australia's exclusive economic zone
EIA	Environmental Impact Assessment
EIAPP	Engine International Air Pollution Prevention
EP	Environment plan
EPA	Western Australian Environmental Protection Authority
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EPO	Environmental Performance Outcome
EPS	Environmental Performance Standard
ERP	Emergency Response Plan
ESD	Ecologically Sustainable Development
FishCube	Fish Cube WA - Commercial Wild Catch Component Public Cube
FRDC	Fisheries Research and Development Corporation
GAB	Great Australian Bight
GIP	Good Industry Practice
GIS	Global Information System
HF	High frequency
HSE	Health, Safety and Environment
HSE MS	Health, Safety and Environment Management System
Hz	Hertz

Term	Description
IAGC	International Association of Geophysical Contractors
IAPP	International air pollution prevention
IEE	International Energy Efficiency
IMCRA	Integrated Marine and Coastal Regionalisation of Australia
IMO	Introduced Marine Organism
IMS	Invasive marine species
IOGP	International Association of Oil and Gas Producers
ISO	International Standards Organization
IUCN	International Union for Conservation of Nature
JASCO	JASCO Applied Sciences
KEF	Key ecological feature
KPI	Key Performance Indicator
LCS	Legislation, Codes and Standards
LF	Low frequency
MARPOL	International Convention for the Prevention of Pollution from Ships
MD	Mid frequency
MDO	Marine diesel oil
MEE	Western Australian State Hazard Plan for Maritime Environmental Emergencies
MF	Mid-frequency
MFO	Marine Fauna Observer
MGO	Marine gas oil
MNES	Matters of national environmental significance
MO	Marine Order
MoC	Management of Change
MOD	Maximum-over-depth
MSL	Mean Sea Level
MSS	Marine seismic survey
MUZ	Multiple use zone
NCVA	National Conservation Values Atlas
NDSMF	Northern Demersal Scalefish Managed Fishery
NERA	National Energy Resource Australia
nm	Nautical mile
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NWMR	North -west marine region
NWS	North-West Shelf
OA	Operations Area (see Glossary for details)
OBC	Ocean bottom cable
OPEP	Oil Pollution Emergency Plan
OPGGS Act	*Offshore Petroleum and Greenhouse Gas Storage Act 2006*
OPGGS(E)R	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009
OPRC	International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990
OPRC-HNS Protocol	Protocol on Preparedness, Response and Co-operation to Pollution Incidents by Hazardous and Noxious Substances, 2000
OSMP	Operational and Scientific Monitoring Program
PJ	Professional Judgement
PK	Zero-to-peak pressure levels
PK-PK	Peak-to-peak pressure levels
PMI	Potential mortal injury
PMST	Protected Matters Search Tool
Possum 3D MSS	Possum 3D Marine Seismic Survey
ppt	Parts per thousand
PTS	Permanent threshold shift
Rms	Root mean squared
ROV	Remotely Operated Vehicle
RPS	RPS Australia West Pty Ltd
SBT	Southern Bluefin Tuna

Term	Description
Searcher	Searcher Seismic Pty Ltd
SEL	Sound exposure level
SIMAP	Spill Impact Mapping and Assessment Program
SOPEP	Shipboard Oil Pollution Emergency Plan
SPL	Sound pressure level
STCW	International Convention on Standards of Training Certification and Watch Keeping for Seafarers
TAP	Threat Abatement Plan
The National Plan	The National Plan for Maritime Environmental Emergencies 2019
TTS	Temporary threshold shift
WCCD	Worst credible case discharge
WCDSCF	West Coast Deep-sea Crustacean Managed Fishery
WD	Water depth

APPENDIX A SEARCHERS ENVIRONMENTAL POLICY

ENVIRONMENTAL
Policy Statement

OBJECTIVE
Searcher Seismic Pty Ltd (Searcher) is a company that maintains the protection of the natural environment as an integral and significant component of all its business strategies.

At Searcher we are committed to identifying and managing the risks and impacts of our activities to minimise adverse environmental impacts, applying leading industry standard practices in our approach to environmental stewardship.

APPLICATION
This policy applies to Searcher and all its affiliates and subsidiaries and all personnel working on Searcher controlled workplaces, services and field-based operations.

The meaning of environment includes ecosystems and their constituent parts including: people and communities, natural and physical resources, the qualities and characteristics of locations, places and areas, the heritage value of places, and their social, economic and cultural features.

PRINCIPLES
The Directors and Senior Management are committed to:

- undertaking all operations in an environmentally conscious manner that minimises harm or damage to the natural environment.
- establishing measurable Environmental objectives and targets that promote continual improvement, aimed at prevention of pollution and conservation of energy.
- implementing, communicating and maintaining an integrated Quality, Health, Safety & Environmental management system that is clear, concise and easily understood.
- providing training and awareness to all stakeholders regarding the sensitive environment we operate within and must maintain and protect.
- reviewing our Environment policy and systems at least on an annual basis to ensure they comply and align with any legislative or company structure changes and industry best practice.
- conduct operations in compliance with relevant local environmental regulations, licenses and legislation and to industry best practice
- All Searcher employees, contractors and project partners are responsible for ensuring that the protection of the natural environment is always a major consideration.

O.A.

Signed: Odd Arne Larsen - Director 23 September 2021

Version: 10.0

APPENDIX B PMST REPORT

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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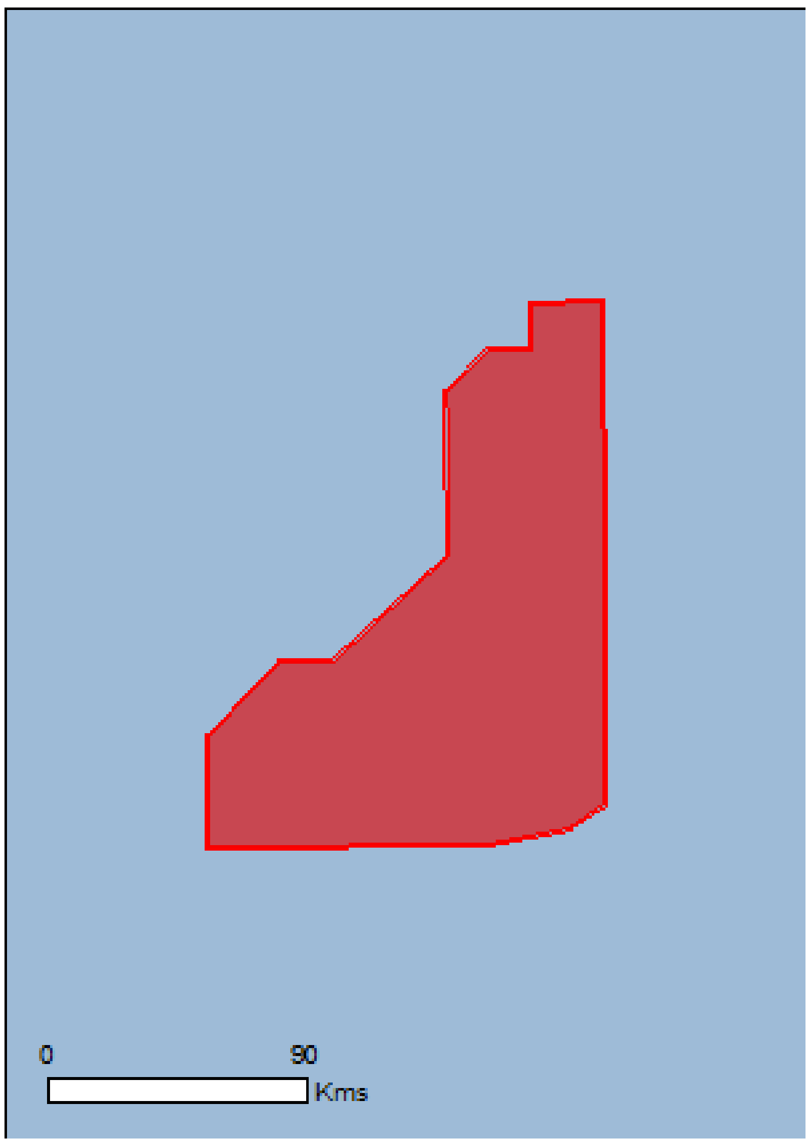

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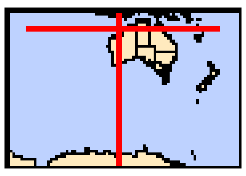

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	17
Listed Migratory Species:	35

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	61
Whales and Other Cetaceans:	25
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	1

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	None
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	2

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North-west

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
Sharks		
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Listed Migratory Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Foraging, feeding or related behaviour likely to occur within area
Sternula albifrons Little Tern [82849]		Congregation or aggregation known to occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat may occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat known to occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish	Vulnerable	Species or species

Name	Threatened	Type of Presence
[68442]		habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species

Name	Threatened	Type of Presence
		habitat known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Foraging, feeding or related behaviour likely to occur within area
Sterna albifrons Little Tern [813]		Congregation or aggregation known to occur within area
Fish		
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish [66220]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis mcdowelli null [25926]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia simus Dwarf Sperm Whale [58]		Species or species habitat may occur within area
Lagenodelphis hosei Fraser's Dolphin, Sarawak Dolphin [41]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat may occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Australian Marine Parks [Resource Information]

Name	Label
Argo-Rowley Terrace	Multiple Use Zone (IUCN VI)

Extra Information

Key Ecological Features (Marine) [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Ancient coastline at 125 m depth contour	North-west
Mermaid Reef and Commonwealth waters	North-west

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-17.59667 119.40333,-17.59306 119.40333,-17.27722 119.75861,-16.88139 119.75806,-16.7925 119.75778,-16.66611 119.88333,-16.66694 120.01944,-16.52833 120.01861,-16.52611 120.23556,-18.01278 120.24222,-18.07917 120.13917,-18.12667 119.88667,-18.135 119.01639,-17.815 119.01889,-17.66528 119.16778,-17.59667 119.23583,-17.59667 119.40333

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Australian Government

Department of Agriculture, Water and the Environment

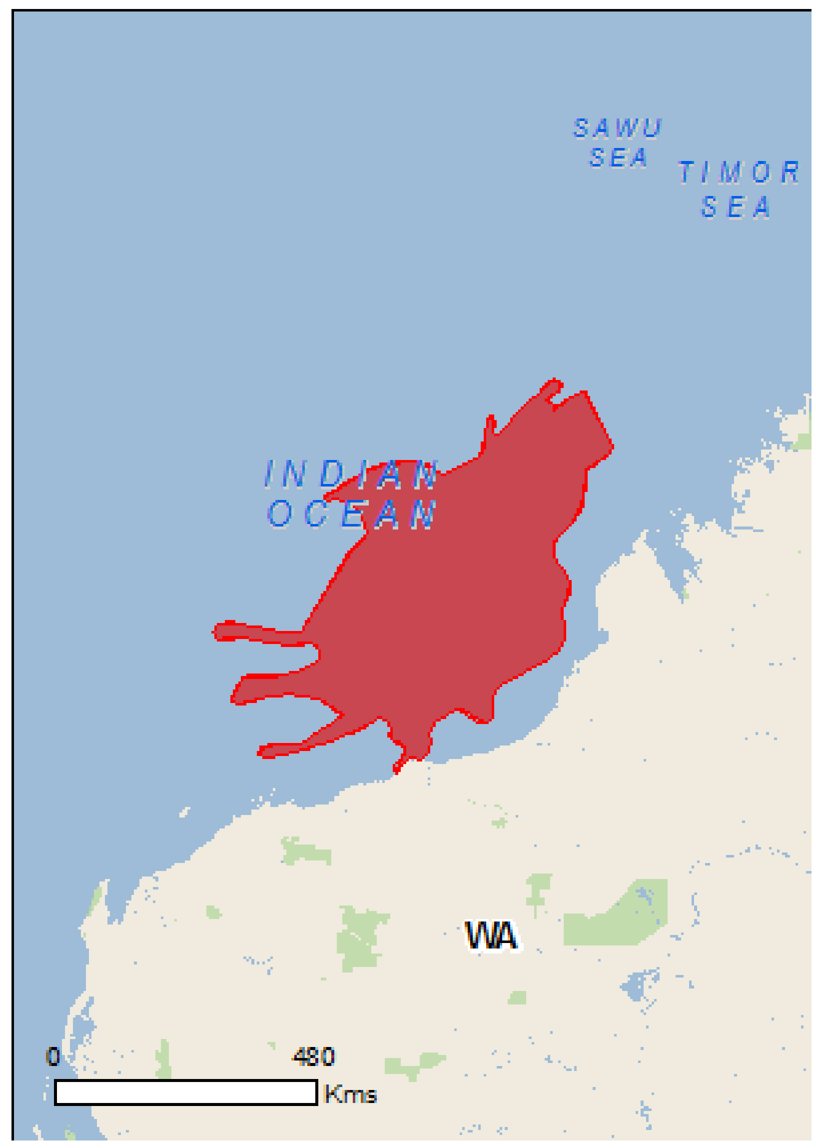
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

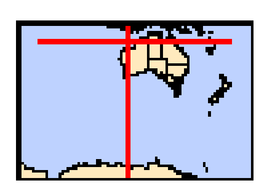
Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 27/08/21 13:19:52



Coordinates

Buffer: 1.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	35
Listed Migratory Species:	59

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	1
Listed Marine Species:	107
Whales and Other Cetaceans:	29
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	5

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	2
Regional Forest Agreements:	None
Invasive Species:	14
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	5

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North-west

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Russkoye Bar-tailed Godwit [86432]	Critically Endangered	Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within

Name	Status	Type of Presence
		area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat likely to occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
Macrotis lagotis Greater Bilby [282]	Vulnerable	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Reptiles		
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Species or species habitat likely to occur within area
Liasis olivaceus barroni Olive Python (Pilbara subspecies) [66699]	Vulnerable	Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur

Name	Status	Type of Presence
		within area
Sharks		
Carcharias taurus (west coast population) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Glyphis garricki Northern River Shark, New Guinea River Shark [82454]	Endangered	Species or species habitat may occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Listed Migratory Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Breeding known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding likely to occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sternula albifrons Little Tern [82849]		Congregation or aggregation known to occur within area

Name	Threatened	Type of Presence
Sula dactylatra Masked Booby [1021]		Breeding known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat known to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
Dugong dugon Dugong [28]		Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Species or species habitat likely to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta		Species or species habitat known to occur

Name	Threatened	Type of Presence
Ray [84994]		within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat likely to occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat likely to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Limnodromus semipalmatus Asian Dowitcher [843]		Species or species habitat likely to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Thalasseus bergii Greater Crested Tern [83000]		Breeding known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Natural		
Mermaid Reef - Rowley Shoals	WA	Listed place

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur

Name	Threatened	Type of Presence
		within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat likely to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat may occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Breeding known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat likely to occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat likely to occur within area
Larus novaehollandiae Silver Gull [810]		Breeding known to occur within area
Limnodromus semipalmatus Asian Dowitcher [843]		Species or species habitat likely to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding likely to occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Sterna albifrons Little Tern [813]		Congregation or aggregation known to occur within area
Sterna bengalensis Lesser Crested Tern [815]		Breeding known to occur within area
Sterna bergii Crested Tern [816]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sula dactylatra Masked Booby [1021]		Breeding known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area
Fish		
Acentronura larsonae Helen's Pygmy Pipehorse [66186]		Species or species habitat may occur within area
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Bulbonaricus brauni Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys latispinosus Muiron Island Pipefish [66196]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Doryrhamphus multiannulatus Many-banded Pipefish [66717]		Species or species habitat may occur within area
Doryrhamphus negrosensis Flagtail Pipefish, Masthead Island Pipefish [66213]		Species or species habitat may occur within area
Festucalex scalaris Ladder Pipefish [66216]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish [66220]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus nitidus Glittering Pipefish [66224]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Hippocampus trimaculatus Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Phoxocampus belcheri Black Rock Pipefish [66719]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Mammals		
Dugong dugon Dugong [28]		Species or species habitat known to occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Aipysurus tenuis Brown-lined Seasnake [1121]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Emydocephalus annulatus Turtle-headed Seasnake [1125]		Species or species habitat may occur within area
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Hydrelaps darwiniensis Black-ringed Seasnake [1100]		Species or species habitat may occur within area
Hydrophis coggeri Slender-necked Seasnake [25925]		Species or species habitat may occur within area
Hydrophis czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis mcdowelli null [25926]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Lapemis hardwickii Spine-bellied Seasnake [1113]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area

Name	Status	Type of Presence
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Indopacetus pacificus Longman's Beaked Whale [72]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia simus Dwarf Sperm Whale [58]		Species or species habitat may occur within area
Lagenodelphis hosei Fraser's Dolphin, Sarawak Dolphin [41]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Mesoplodon ginkgodens Gingko-toothed Beaked Whale, Gingko-toothed Whale, Gingko Beaked Whale [59564]		Species or species habitat may occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted		Species or species

Name	Status	Type of Presence
Bottlenose Dolphin [68418]		habitat likely to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Australian Marine Parks [Resource Information]

Name	Label
Argo-Rowley Terrace	Multiple Use Zone (IUCN VI)
Argo-Rowley Terrace	Special Purpose Zone (Trawl) (IUCN VI)
Eighty Mile Beach	Multiple Use Zone (IUCN VI)
Kimberley	Multiple Use Zone (IUCN VI)
Mermaid Reef	National Park Zone (IUCN II)

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Bedout Island	WA
Unnamed WA44672	WA

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Mammals		
Camelus dromedarius Dromedary, Camel [7]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Sus scrofa		
Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes		
Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Cenchrus ciliaris		
Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area
Jatropha gossypifolia		
Cotton-leaved Physic-Nut, Bellyache Bush, Cotton-leaf Physic Nut, Cotton-leaf Jatropha, Black Physic Nut [7507]		Species or species habitat likely to occur within area
Parkinsonia aculeata		
Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Prosopis spp.		
Mesquite, Algaroba [68407]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus		
Asian House Gecko [1708]		Species or species habitat likely to occur within area
Ramphotyphlops braminus		
Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat likely to occur within area

Nationally Important Wetlands [Resource Information]

Name	State
Mermaid Reef	EXT

Key Ecological Features (Marine) [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Ancient coastline at 125 m depth contour	North-west
Continental Slope Demersal Fish Communities	North-west
Glomar Shoals	North-west
Mermaid Reef and Commonwealth waters	North-west
Seringapatam Reef and Commonwealth waters in	North-west

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-14.331213 121.337155,-14.398301 121.435406,-14.484659 121.466141,-14.23481 121.818244,-14.205976 121.957061,-15.060849 122.410297,-15.168283 122.35561,-15.44683 121.977863,-15.54461 121.984696,-16.030463 121.907411,-16.265615 121.763458,-16.447643 121.570917,-16.586153 121.450741,-16.771861 121.437965,-16.8972 121.507114,-17.019539 121.639227,-17.209785 121.713655,-17.395731 121.689836,-17.517798 121.61573,-17.667112 121.575906,-17.918984 121.637793,-18.086437 121.615062,-18.263037 121.52801,-18.402893 121.369721,-18.536432 121.142228,-18.619607 120.974657,-18.682279 120.829287,-18.803943 120.574339,-18.906591 120.491874,-19.06782 120.444881,-19.31958 120.43141,-19.387593 120.348554,-19.37568 120.208859,-19.212357 119.971268,-19.198721 119.84088,-19.312494 119.651714,-19.369149 119.521686,-19.55738 119.393294,-19.701033 119.428146,-19.858096 119.404115,-19.963046 119.260392,-19.945914 119.144274,-19.973516 119.053854,-20.069646 118.967242,-20.163167 118.87745,-20.085878 118.852573,-19.990387 118.934197,-19.87634 118.988842,-19.762515 118.991504,-19.703433 118.923992,-19.672089 118.813235,-19.589081 118.762238,-19.478395 118.784764,-19.387258 118.748397,-19.325042 118.626314,-19.364547 118.508631,-19.508282 118.229206,-19.618965 117.962801,-19.674244 117.809919,-19.739747 117.606062,-19.807813 117.353374,-19.879399 117.031759,-19.938032 116.736634,-19.900332 116.61804,-19.793723 116.625355,-19.747328 116.903129,-19.748474 117.145911,-19.72389 117.281704,-19.527941 117.587403,-19.387224 117.827322,-19.290976 117.983073,-19.014893 117.61665,-18.996296 117.3435,-18.943108 117.070809,-18.968226 116.930573,-18.997714 116.80308,-19.036508 116.624976,-19.101482 116.30323,-19.050235 116.171436,-18.830161 116.267311,-18.711747 116.347074,-18.681017 116.515557,-18.681422 116.870094,-18.672311 117.043307,-18.570541 117.355147,-18.486646 117.499411,-18.394762 117.585711,-18.271185 117.596227,-18.177909 117.54094,-18.142321 117.450883,-18.170494 117.294552,-18.18019 117.145353,-18.145649 116.826972,-18.09462 116.530442,-18.082038 116.366688,-18.087018 116.067859,-18.106054 115.925799,-17.979757 115.851957,-17.861272 115.92243,-17.844568 116.136641,-17.854337 116.313194,-17.901875 116.489868,-17.963645 116.815267,-17.982855 116.982292,-17.995839 117.214317,-17.996628 117.303327,-16.750261 118.106913,-16.67239 118.170949,-16.551675 118.280918,-16.444931 118.373718,-16.277214 118.354081,-16.059321 118.201647,-15.972398 118.066206,-15.881448 117.922113,-15.927444 117.730113,-15.869593 117.684568,-15.788869 117.803284,-15.708325 117.937592,-15.644809 118.057929,-15.557343 118.228891,-15.488599 118.36326,-15.412609 118.52134,-15.355636 118.679941,-15.324453 118.856324,-15.302866 119.056963,-15.319891 119.239595,-15.368342 119.389508,-15.45678 119.529934,-15.517056 119.660779,-15.223114 120.243032,-15.094234 120.295055,-14.923802 120.322712,-14.66715 120.373432,-14.595122 120.42391,-14.721987 120.46049,-14.821978 120.45661,-14.872411 120.519031,-14.707338 120.710016,-14.543016 120.859612,-14.380593 121.032834,-14.244792 121.193905,-14.089313 121.349673,-14.007537 121.454654,-14.06229 121.583287,-14.17937 121.51287,-14.331213 121.337155

Acknowledgements

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-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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+61 2 6274 1111

Aboriginal Heritage Inquiry System

List of Registered Aboriginal Sites

Search Criteria

No Registered Aboriginal Sites in Coordinates - Area (-Possum_3D_Operational_Area_WGS84_UTM50S_111219 coordinates-.xlsx) - 737287.9mE, 8053015.3mN (MGA50) : 755072.5mE, 8053205.7mN (MGA50) : 793296.2mE, 8087662.4mN (MGA50) : 793863.1mE, 8131491.9mN (MGA50) : 793988.6mE, 8141352mN (MGA50) : 807566.8mE, 8155132.8mN (MGA50) : 822097.2mE, 8154829mN (MGA50) : 822251.1mE, 8170179.5mN (MGA50) : 845415.2mE, 8170077mN (MGA50) : 843377mE, 8005385mN (MGA50) : 832328.8mE, 7998220.7mN (MGA50) : 805491.1mE, 7993400mN (MGA50) : 713336mE, 7993690.3mN (MGA50) : 713997.9mE, 8029098mN (MGA50) : 721065.8mE, 8036364.5mN (MGA50) : 729981mE, 8045520.1mN (MGA50) : 737287.9mE, 8053015.3mN (MGA50)

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Copyright

Coordinate Accuracy

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Aboriginal Heritage Inquiry System

Map of Registered Aboriginal Sites

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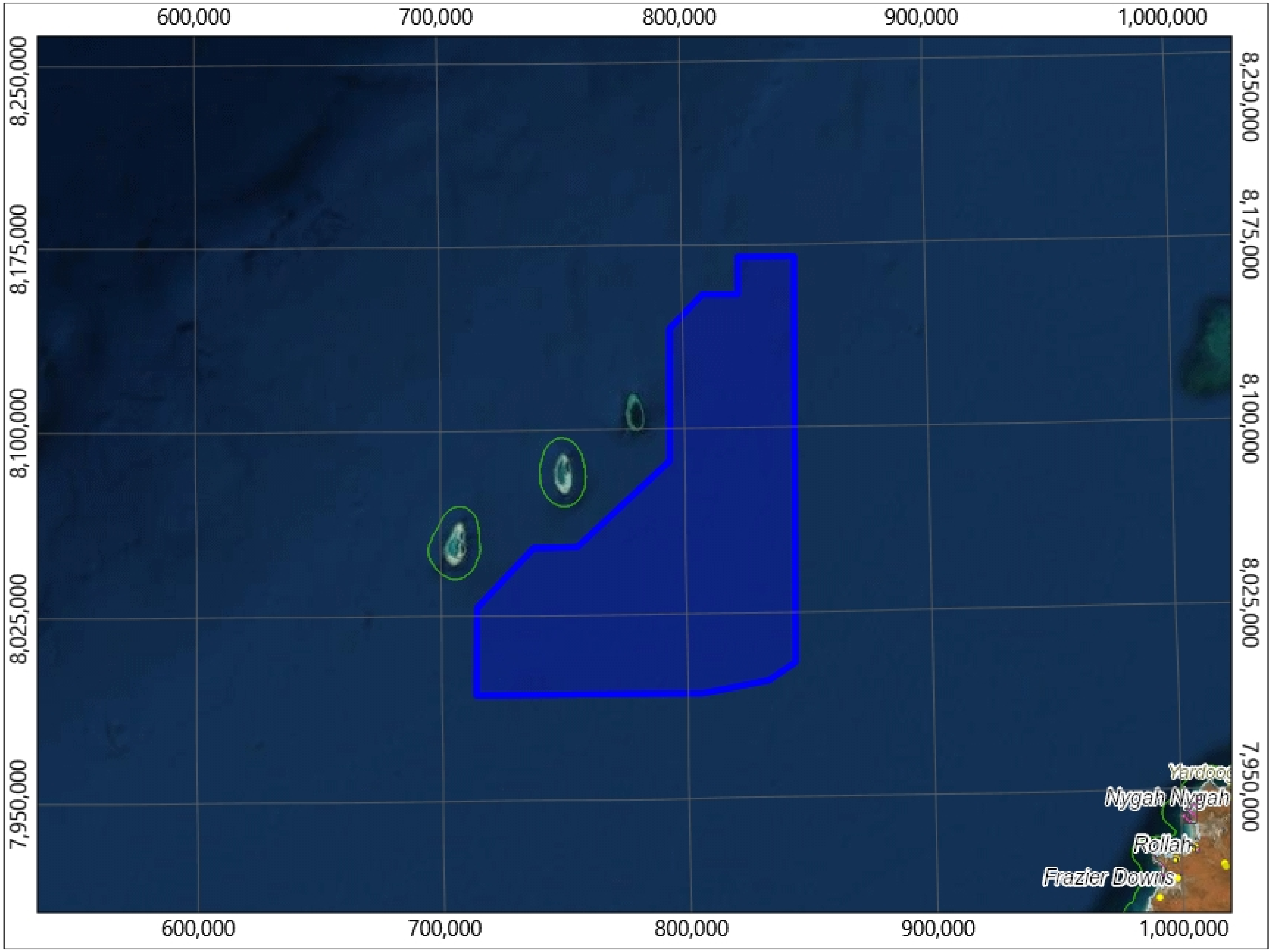


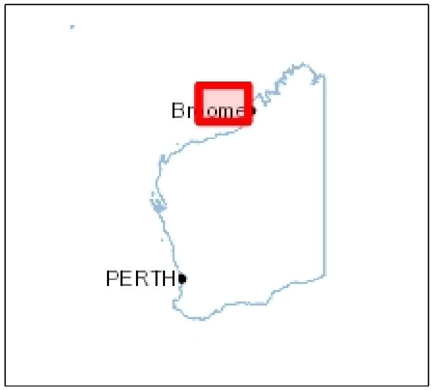
Legend

- Registered Aboriginal Site
- Search Area
- Town
- Road
- River
- Local Government Authority

81.67 kilometres

Map Scale 1 : 2,470,000

MGA Zone 50 (GDA94)



Aboriginal Heritage Inquiry System

List of Other Heritage Places

Search Criteria

No Other Heritage Places in Coordinates - Area (-Possum_3D_Operational_Area_WGS84_UTM50S_111219 coordinates-.xlsx) - 737287.9mE, 8053015.3mN (MGA50) : 755072.5mE, 8053205.7mN (MGA50) : 793296.2mE, 8087662.4mN (MGA50) : 793863.1mE, 8131491.9mN (MGA50) : 793988.6mE, 8141352mN (MGA50) : 807566.8mE, 8155132.8mN (MGA50) : 822097.2mE, 8154829mN (MGA50) : 822251.1mE, 8170179.5mN (MGA50) : 845415.2mE, 8170077mN (MGA50) : 843377mE, 8005385mN (MGA50) : 832328.8mE, 7998220.7mN (MGA50) : 805491.1mE, 7993400mN (MGA50) : 713336mE, 7993690.3mN (MGA50) : 713997.9mE, 8029098mN (MGA50) : 721065.8mE, 8036364.5mN (MGA50) : 729981mE, 8045520.1mN (MGA50) : 737287.9mE, 8053015.3mN (MGA50)

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Copyright

Coordinate Accuracy

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Department of Planning, Lands and Heritage

GOVERNMENT OF WESTERN AUSTRALIA

Aboriginal Heritage Inquiry System

Map of Other Heritage Places

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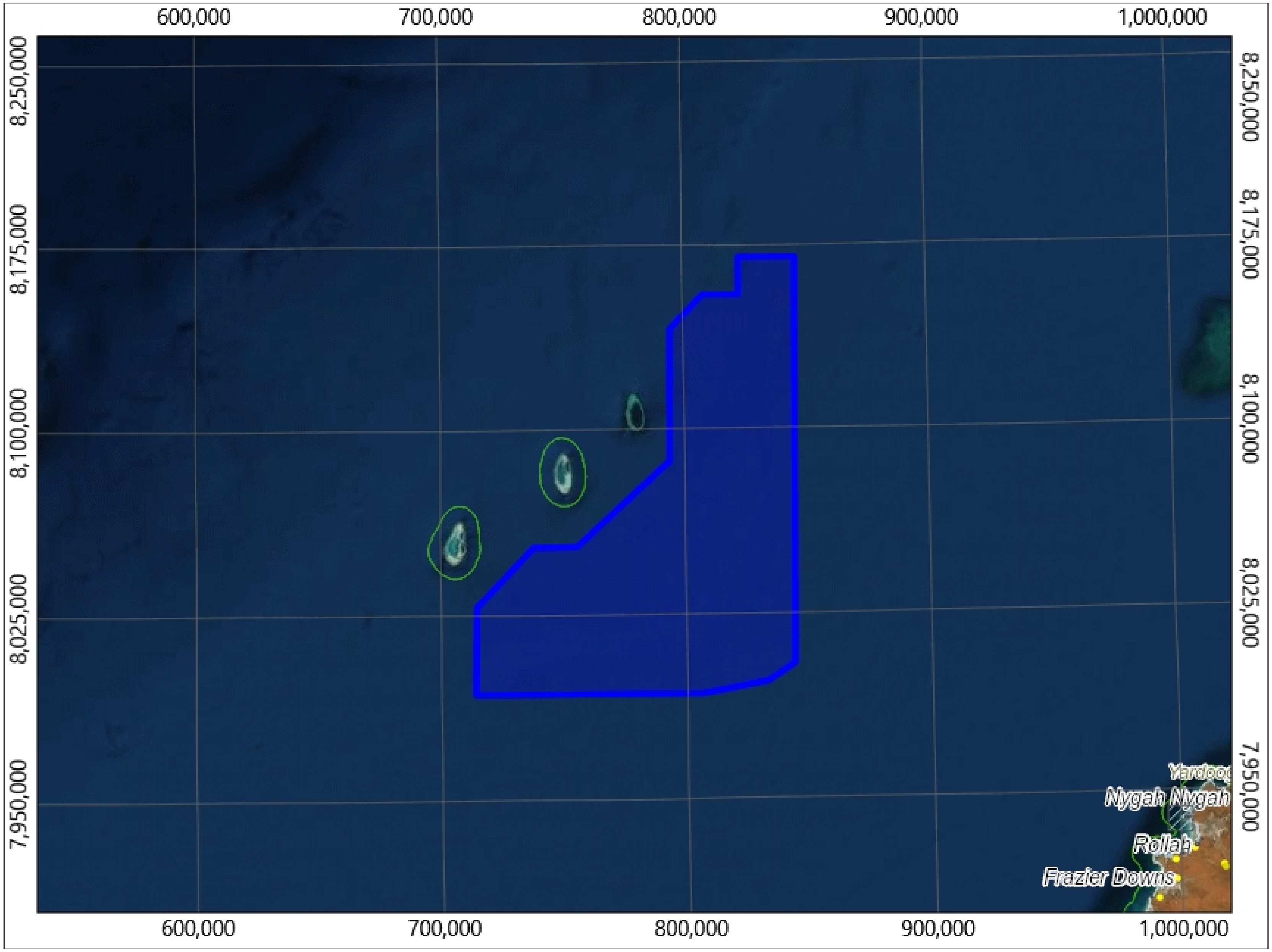


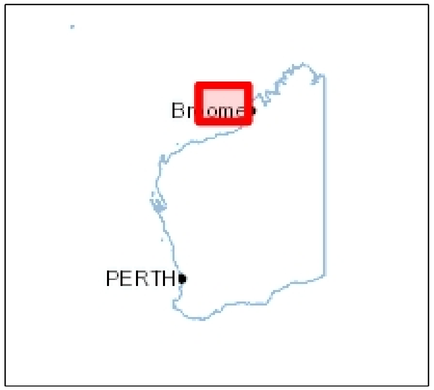
Legend

- Other Heritage Place
- Search Area
- Town
- Road
- River
- Local Government Authority

81.67 kilometres

Map Scale 1 : 2,470,000

MGA Zone 50 (GDA94)



Map created: 30/08/2021 3:02:36 PM by: GIS_NET_USER

Identifier: 559070

Aboriginal Heritage Inquiry System

List of Registered Aboriginal Sites

Search Criteria

No Registered Aboriginal Sites in Coordinates - Area (Possum 3D MSS EPBC protected Matters EMBA co-ords 2021.xlsx) - 121.337155°E, 14.331213°S (GDA94) : 121.435406°E, 14.398301°S (GDA94) : 121.466141°E, 14.484659°S (GDA94) : 121.818244°E, 14.23481°S (GDA94) : 121.957061°E, 14.205976°S (GDA94) : 122.410297°E, 15.060849°S (GDA94) : 122.35561°E, 15.168283°S (GDA94) : 121.977863°E, 15.44683°S (GDA94) : 121.984696°E, 15.54461°S (GDA94) : 121.907411°E, 16.030463°S (GDA94) : 121.763458°E, 16.265615°S (GDA94) : 121.570917°E, 16.447643°S (GDA94) : 121.450741°E, 16.586153°S (GDA94) : 121.437965°E, 16.771861°S (GDA94) : 121.507114°E, 16.8972°S (GDA94) : 121.639227°E, 17.019539°S (GDA94) : 121.713655°E, 17.209785°S (GDA94) : 121.689836°E, 17.395731°S (GDA94) : 121.61573°E, 17.517798°S (GDA94) : 121.575906°E, 17.667112°S (GDA94) : 121.637793°E, 17.918984°S (GDA94) : 121.615062°E, 18.086437°S (GDA94) : 121.52801°E, 18.263037°S (GDA94) : 121.369721°E, 18.402893°S (GDA94) : 121.142228°E, 18.536432°S 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Aboriginal Heritage Inquiry System

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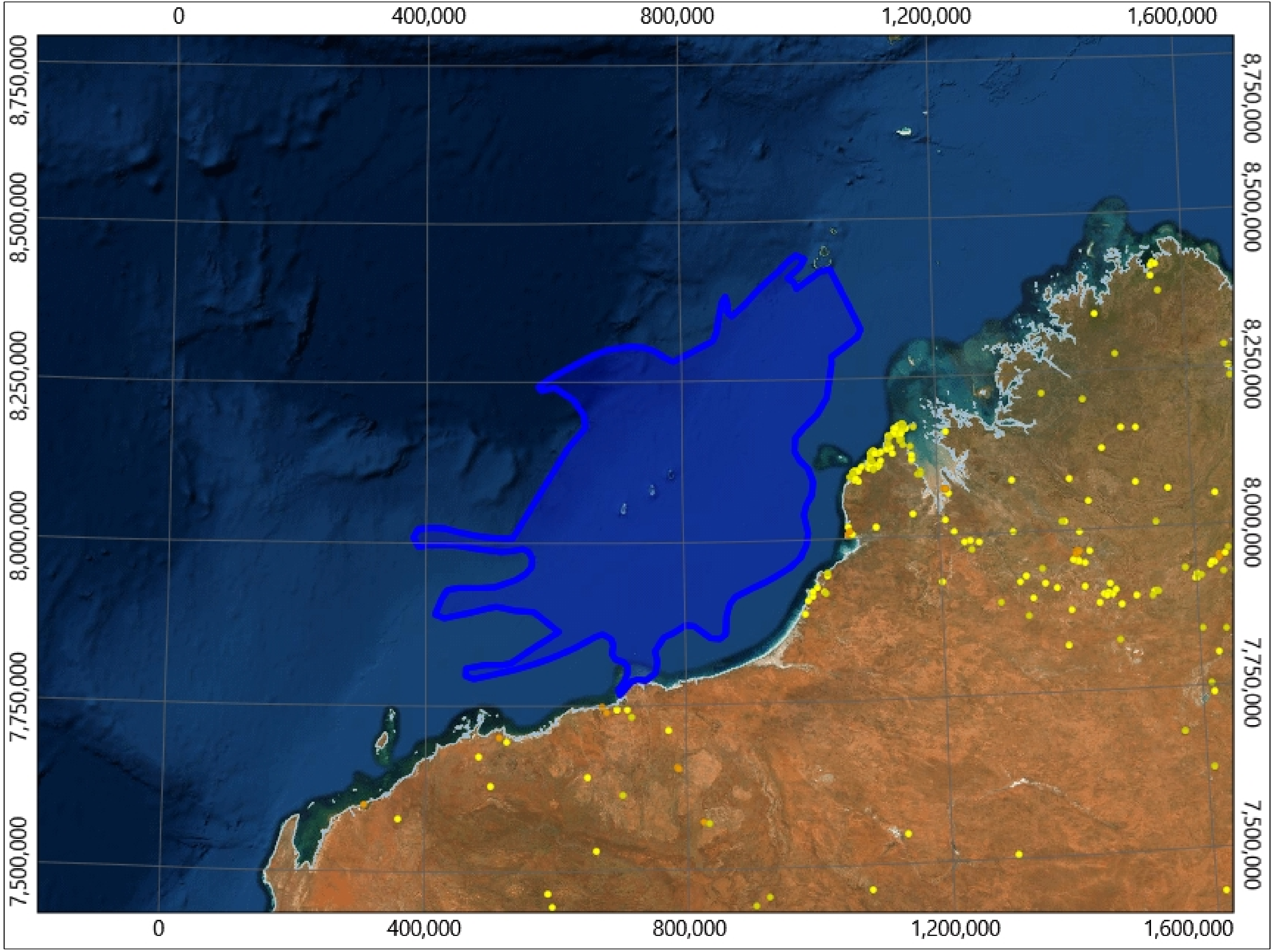


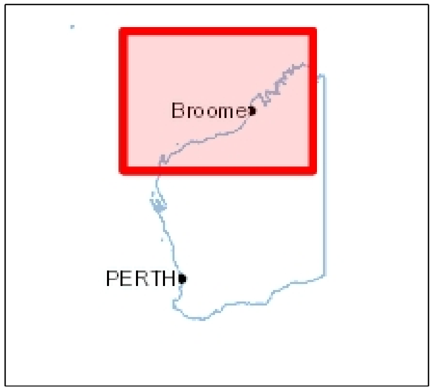
Legend

- Registered Aboriginal Site
- Search Area
- Town
- Road
- River
- Local Government Authority

312.20 kilometres

Map Scale 1 : 9,460,000

MGA Zone 50 (GDA94)



Map created: 30/08/2021 2:36:41 PM by: GIS_NET_USER

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List of Other Heritage Places

Search Criteria

1 Other Heritage Places in Coordinates - Area (Possum 3D MSS EPBC protected Matters EMBA co-ords 2021.xlsx) - 121.337155°E, 14.331213°S (GDA94) : 121.435406°E, 14.398301°S (GDA94) : 121.466141°E, 14.484659°S (GDA94) : 121.818244°E, 14.23481°S (GDA94) : 121.957061°E, 14.205976°S (GDA94) : 122.410297°E, 15.060849°S (GDA94) : 122.35561°E, 15.168283°S (GDA94) : 121.977863°E, 15.44683°S (GDA94) : 121.984696°E, 15.54461°S (GDA94) : 121.907411°E, 16.030463°S (GDA94) : 121.763458°E, 16.265615°S (GDA94) : 121.570917°E, 16.447643°S (GDA94) : 121.450741°E, 16.586153°S (GDA94) : 121.437965°E, 16.771861°S (GDA94) : 121.507114°E, 16.8972°S (GDA94) : 121.639227°E, 17.019539°S (GDA94) : 121.713655°E, 17.209785°S (GDA94) : 121.689836°E, 17.395731°S (GDA94) : 121.61573°E, 17.517798°S (GDA94) : 121.575906°E, 17.667112°S (GDA94) : 121.637793°E, 17.918984°S (GDA94) : 121.615062°E, 18.086437°S (GDA94) : 121.52801°E, 18.263037°S (GDA94) : 121.369721°E, 18.402893°S (GDA94) : 121.142228°E, 18.536432°S (GDA94) 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List of Other Heritage Places

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ID	Name	File Restricted	Boundary Restricted	Restrictions	Status	Type	Knowledge Holders	Coordinate	Legacy ID
20621	Bedout Island	No	No	No Gender Restrictions	Lodged	Mythological, Natural Feature, Other: Island	*Registered Knowledge Holder names available from DAA	720197mE 7832653mN Zone 50 [Reliable]	

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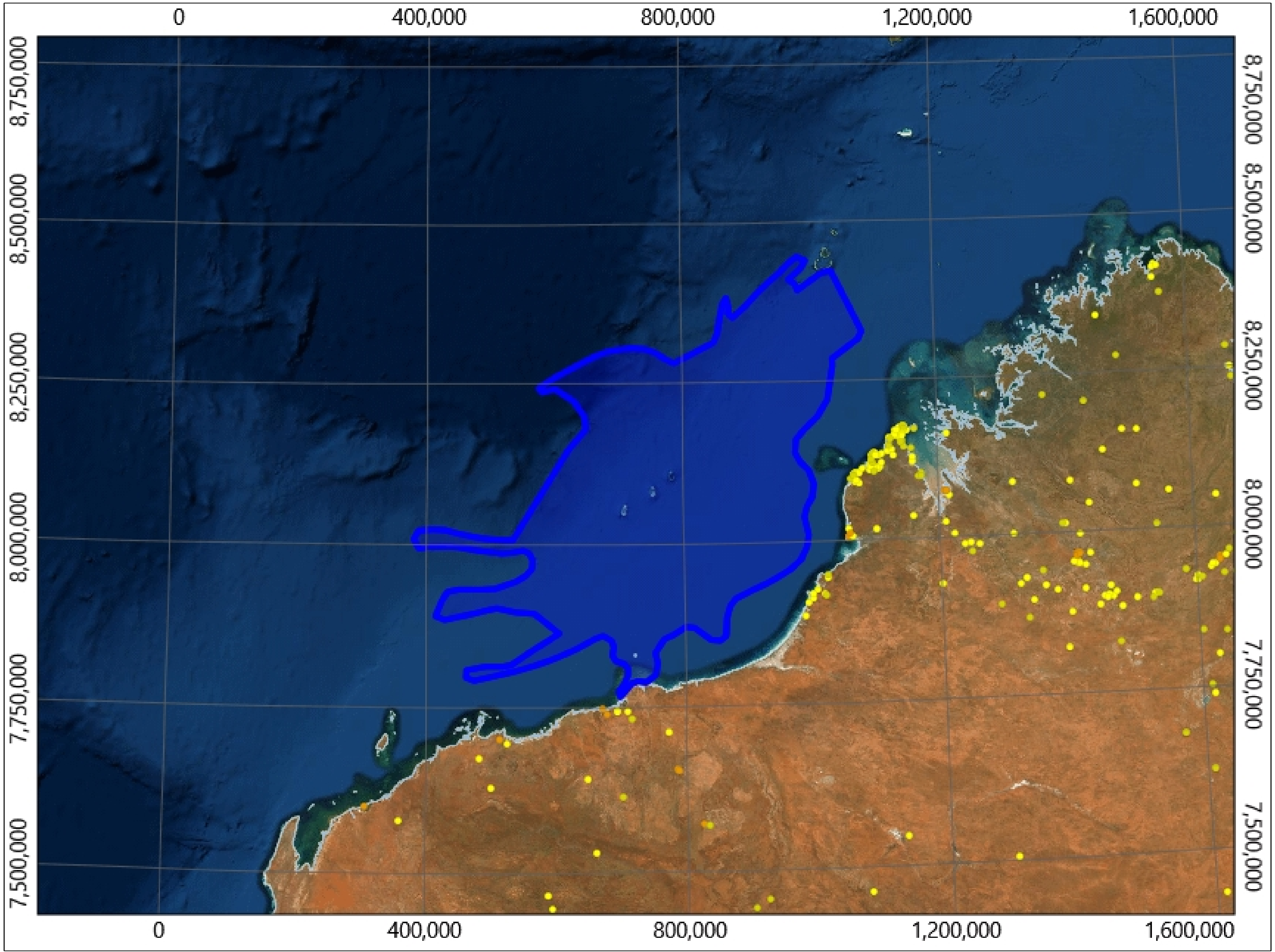
Map of Other Heritage Places



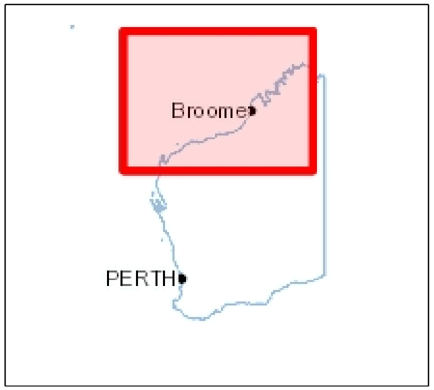
Legend

- Other Heritage Place
- Search Area
- Town
- Road
- River
- Local Government Authority

312.20 kilometres

Map Scale 1 : 9,460,000

MGA Zone 50 (GDA94)



APPENDIX C ACOUSTIC MODELLING REPORT

Possum 3-D Marine Seismic Survey

Acoustic Modelling for Assessing Marine Fauna Sound Exposures

Submitted to:
Rebecca McGrath
RPS Australia Asia Pacific

Contract Agreement: 23 January 2020

Authors:
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Craig McPherson

13 March 2020

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Contents

Figures

Tables

Executive Summary

JASCO Applied Sciences (JASCO) performed a numerical estimation study of underwater sound levels associated with the planned Possum 3-D Marine Seismic Survey (MSS) to assist in understanding the potential acoustic impact on marine fauna including fish, marine mammals, turtles, benthic invertebrates, plankton and corals, and at the 40 m contour surrounding Mermaid Reef.

Modelling considered three comparably sized seismic arrays with volumes up to 2820 in^3. These arrays were coupled with single impulse propagation modelling to determine the array most likely to produce the largest ranges to thresholds, which was determined to be a 2820 in^3 seismic source with a 6 m tow depth. Therefore, the modelling considered this 2820 in^3 seismic source in a triple source configuration, towed at 6 m depth behind a single vessel.

A specialised airgun array source model was used to predict the acoustic signature of the seismic source, and complementary underwater acoustic propagation models were used in conjunction with the modelled array signature to estimate sound levels over a large area around the source. Single-impulse sound fields were predicted at six sites within the Acquisition Area, with water depths between 121 and 427 m. Accumulated sound exposure fields were predicted for two representative scenarios for likely survey operations over 24 hours.

The modelling methodology considered source directivity and range-dependent environmental properties within the survey area. Estimated underwater acoustic levels are presented as sound pressure levels (SPL, L_{p}), zero-to-peak pressure levels (PK, L_{pk}), peak-to-peak pressure levels (PK-PK; $L_{\text{pk-pk}}$), and either single-impulse (i.e., per-pulse) or accumulated sound exposure levels (SEL, L_{E} or SEL$_{24h}$, $L_{\text{E,24h}}$) as appropriate for different noise effect criteria. A conservative sound speed profile that would be most supportive of sound propagation conditions for the period of the survey was defined and applied to all modelling.

The analysis considered the distances away from the seismic source at which several effects criteria or relevant sound levels were reached. The results are summarised below for the representative single-impulse sites and accumulated SEL scenarios.

Marine mammal injury and behaviour

- The maximum distance where the NMFS (2014) marine mammal behavioural response criterion of 160 dB re 1 µPa (SPL) could be exceeded varied between 6.80 and 8.48 km.
- The results for the criteria applied for marine mammal Permanent Threshold Shift (PTS), NMFS (2018), consider both metrics within the criteria (PK and SEL$_{24h}$). Table 1 summarises the maximum distances for PTS, along with the relevant metric (i.e. the metric which results in the longest distance, as required by the criteria) and the location of the results within this report.
- The SEL$_{24h}$ is a cumulative metric that reflects the dosimetric impact of noise levels within 24 hours based on the assumption that an animal is consistently exposed to such noise levels at a fixed position. The corresponding SEL$_{24h}$ radii for low-frequency cetaceans were larger than those for peak pressure criteria, but they represent an unlikely worst-case scenario. A reported radius for SEL$_{24h}$ criteria does not mean that marine fauna travelling within this radius of the source will be injured, but rather that an animal could be exposed to the sound level associated with injury or hearing impairment (either PTS or TTS) if it remained in that location for 24 hours.

Table 1. Summary of maximum marine mammal PTS onset distances for modelled scenarios

Hearing group	Scenario 1		Scenario 2	
	Metric associated with longest distance to PTS onset	R_{max} (km)	Metric associated with longest distance to PTS onset	R_{max} (km)
Low-frequency cetaceans†	SEL$_{24h}$	3.52	SEL$_{24h}$	3.37
Mid-frequency cetaceans	—	—	—	—
High-frequency cetaceans	PK	0.20	PK	0.20

† The model does not account for shutdowns.
A dash indicates the threshold was not reached within the limits of the modelling resolution (20 m).

Turtles

- The maximum distance to PTS onset in turtles (Finneran et al. 2017) of 50 m is based on the SEL_{24h} metric, as was the distance to TTS onset of 0.88 km. As is the case with marine mammals, a reported radius for SEL_{24h} criteria does not mean that turtles travelling within this radius of the source will be injured, but rather that an animal could be exposed to the sound level associated with either PTS or TTS if it remained in that location for 24 hours.
- The distances to where the NMFS criterion (NSF 2011) for behavioural response in turtles of turtles of 166 dB re 1 µPa (SPL) and the 175 dB re 1 µPa (SPL) threshold for behavioural disturbance (McCauley et al. 2000a, McCauley et al. 2000b) could be exceeded are summarised in Table 2.

Table 2. Summary of distances to turtle behavioural response criteria (from Table 11).

SPL (L_p; dB re 1 µPa)	Distance (km)	
	Minimum	Maximum
175†	1.20	1.46
166‡	3.44	4.25

† Threshold for turtle behavioural disturbance from impulsive noise (McCauley et al. 2000a, McCauley et al. 2000b).
‡ Threshold for turtle behavioural response to impulsive noise (NSF 2011).

Fish, fish eggs, and fish larvae

- This modelling study assessed the ranges for quantitative criteria based on Popper et al. (2014) and considered both PK (seafloor and water column) and SEL_{24h} metrics associated with mortality, potential mortal injury and impairment in the following groups:
    - Fish without a swim bladder (also appropriate for sharks in the absence of other information)
    - Fish with a swim bladder that do not use it for hearing
    - Fish that use their swim bladders for hearing
    - Fish eggs and fish larvae (used also to assess effects on plankton)

Table 3 summarises the distances to injury criteria for fish, fish eggs, and fish larvae.

Table 3. Summary of maximum fish, fish eggs, and larvae injury and TTS onset distances for single impulse and SEL_{24h} modelled scenarios.

Relevant hearing group	Effect criteria	Water column		Seafloor	
		Metric associated with longest distance to criteria	R_{max} (km)	Metric associated with longest distance to criteria	R_{max} (km)
Fish: No swim bladder	Injury	SEL_{24h}	0.06	PK	0.05
	TTS	SEL_{24h}	9.13	SEL_{24h}	9.10
Fish: Swim bladder not involved in hearing and Swim bladder involved in hearing	Injury	PK	0.12	PK	0.14
	TTS	SEL_{24h}	9.13	SEL_{24h}	9.1
Fish eggs, and larvae	Injury	PK	0.12	PK	0.05

Benthic Invertebrates, Sponges, and Coral

To assist with assessing the potential effects on these receptors, the following have been determined:

- Crustaceans: the sound level of 202 dB re 1 µPa PK-PK from Payne et al. (2008) was considered for seafloor sound levels; the sound level was reached at ranges between 560 and 666 m depending on the modelled site.
- Sponges and coral: the PK sound level at the seafloor directly underneath the seismic source was estimated at all modelled sites and compared to the sound level of 226 dB re 1 µPa PK for sponges and corals (Heyward et al. 2018); it was not reached at any of the modelled sites .

1. Introduction

JASCO Applied Sciences (JASCO) performed a numerical estimation study of underwater sound levels associated with the planned Possum 3-D Marine Seismic Survey (MSS) to assist in understanding the potential acoustic impact on marine fauna including fish, marine mammals, turtles, benthic invertebrates, plankton and corals, and the 40 m contour surrounding Mermaid Reef..

JASCO's specialised Airgun Array Source Model (AASM) was used to predict acoustic signatures and spectra for three comparable arrays under initial consideration for the Possum 3-D MSS. The total volumes of each array were 2380 in^3, 2495 in^3 and 2820 in^3. AASM accounts for individual airgun volumes, airgun bubble interactions, and array geometry to yield accurate source predictions. For these three arrays, a single nominal source location within the survey area was used to compare single impulse received levels when environmental effects were considered. This allowed the representative seismic source to be determined based upon both the source signature and the survey specific environment. Based on the results of this analysis, the source determined to representative, was the 2820 in^3.

Complementary underwater acoustic propagation models were used in conjunction with the selected array signature (the 2820 in^3) to estimate sound levels considering environmental effects. Single-impulse sound fields were predicted at six defined locations within the operational area, and accumulated sound exposure fields were predicted for two representative scenarios for likely survey operations over 24 h with the representative source. A conservative sound speed profile that would be most supportive of sound propagation conditions for the potential survey period was defined and applied throughout.

The modelling methodology considered source directivity and range-dependent environmental properties. Estimated underwater acoustic levels are presented as sound pressure levels (SPL, L_p), zero-to-peak pressure levels (PK, L_{pk}), peak-to-peak pressure levels (PK-PK; $L_{pk\text{-}pk}$), and either single-impulse (i.e., per-pulse, SEL, L_E) or accumulated sound exposure levels (SEL, $L_{E,24h}$) as appropriate for different noise effect criteria.

Section 3 explains the metrics used to represent underwater acoustic fields and the impact criteria considered. Section 4 details the methodology for predicting the source levels and modelling the sound propagation, including the specifications of the seismic source and all environmental parameters the propagation models require. Section 5 presents the results, which are then discussed and summarised in Section 6.

2. Modelling Scenarios

Six standalone single impulse sites and two likely scenarios for survey operations over 24 h to assess accumulated SEL were defined. The locations of all modelled sites are provided in Table 4, with all sites and the acquisition lines shown in Figures 1–3 along with the survey boundaries. The modelling assumed that the survey vessel sailed along the survey lines at ~4.6 knots, with an impulse interval of 12.5 m. Two representative acquisition scenarios, Scenario 1 and Scenario 2, were considered for 24 hours of operation. Scenario 1 considered four sail lines and Scenario 2 scenario considered approximately 3 sail lines.

The single impulse sites and accumulated SEL scenarios were selected based on a proposed survey line plans for each acquisition area. The locations of these sites and scenarios are considered representative of the range of water depths that will be covered during Possum survey and the potential sound propagation characteristics that may arise at various locations within the Operational and Acquisition Areas. These sites were not always located on a survey line, but rather located in representative locations. The orientations of the single impulse sites and line scenarios were selected to provide the greatest sound propagation radii broadside from the seismic source in relation to receptors relevant to the impact assessment, including the Mermaid Reef and the Rowley Shoals and the Biologically Important Area for migrating pygmy blue whales. The sound field was sampled at the 40 m contour surrounding Mermaid Reef to assist with assessing the potential exposure to divers (Table 5).

For Scenario 1, modelling is based on acquisition of four lines taking ~3.7 h (each) to traverse with ~3.2 h of turn time required between the lines. For Scenario 2 two lines plus an additional partial line modelled for a 24-hour period. The first line, which is a partial segment of a full acquisition line, was modelled to take 4.8 h to traverse. The last two acquisition lines line modelled to take 6.6 h (each) to complete. The time to complete a turn was ~3.1 h per turn for Scenario 2. These scenarios accounted for 4757 impulses for Scenario 1 and 7722 impulses for Scenario 2 during the respective 24 h periods of acquisition. During line turns the seismic source was modelled as not in operation. The scenarios were based on data provided by Searcher Seismic.

The first five single impulse sites were modelled with a range dependent modelling method; however, a range independent modelling method was used exclusively to determine close range levels and thresholds for seafloor receptors at Site 6, which was located at the shallowest point within the Possum 3-D Acquisition Area. Water column PK and PK-PK levels at three representative modelled sites: Sites 1, 2 and 5, were modelled using a full-waveform range dependent modelling method.

Table 4. Location details for the single impulse modelled sites and associated SEL_{24h} scenario.

Relevant SEL_{24} Scenario	Site	Latitude (S)	Longitude (E)	UTM Zone 50		Water depth (m)	Tow direction (°)
				X (m)	Y (m)		
1	1	16° 57' 22.0023"	119° 50' 25.6849"	802522	8123112	427	0 & 180
	2	17° 12' 03.2284"	119° 50' 37.7815"	802485	8095999	375	0 & 180
	3	17° 05' 51.1411"	119° 47' 45.5615"	797558	8107519	401	0 & 180
2	4	17° 41' 43.4187"	119° 20' 07.8975"	747722	8041979	311	90 & 270
	5	17° 45' 39.2581"	119° 40' 53.5241"	784339	8034236	220	90 & 270
N/A	6†	18° 01' 42.3635"	119° 13' 22.4300"	735332	8005255	121	90

†Seafloor receptors modelled site only (VSTACK)

Table 5. Mermaid Reef 40 m contour receiver location

Latitude (S)	Longitude (E)	UTM Zone 50	
		X (m)	Y (m)
17° 05' 49.6087"	119° 39' 14.5608"	782443.323	8107777.55

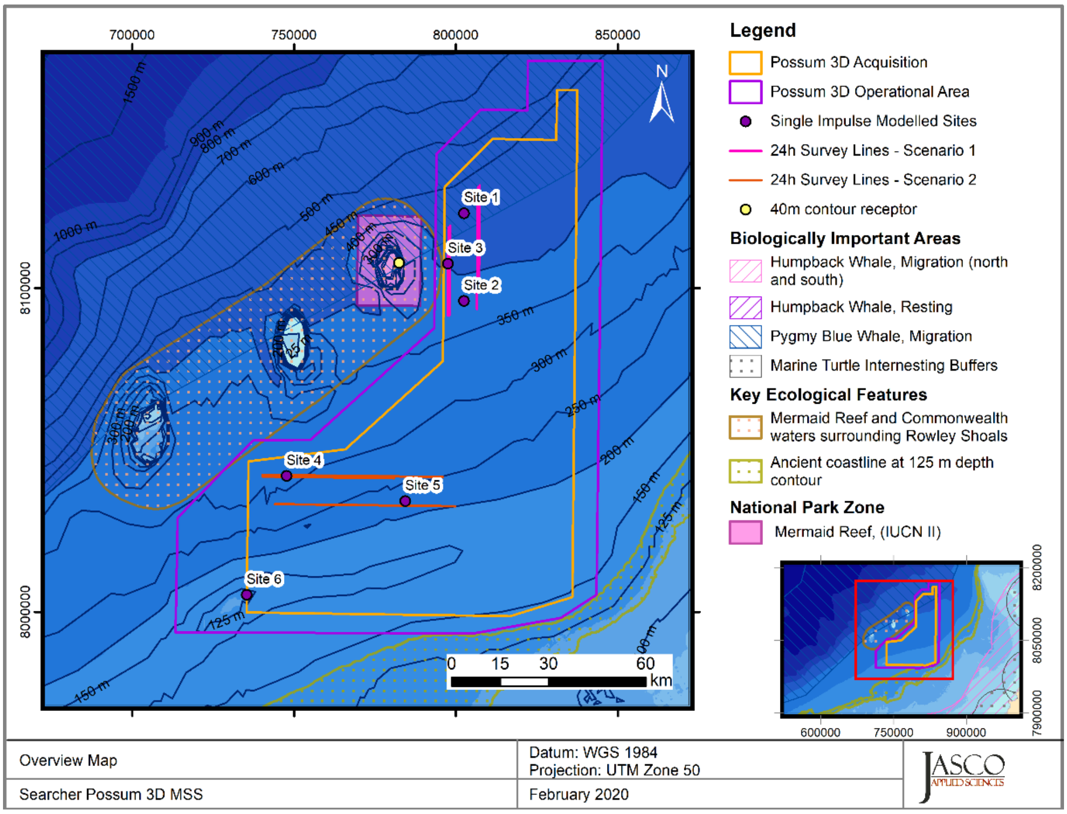

Figure 1. Overview of the modelled sites, acquisition lines, and features for the Possum 3D MSS.

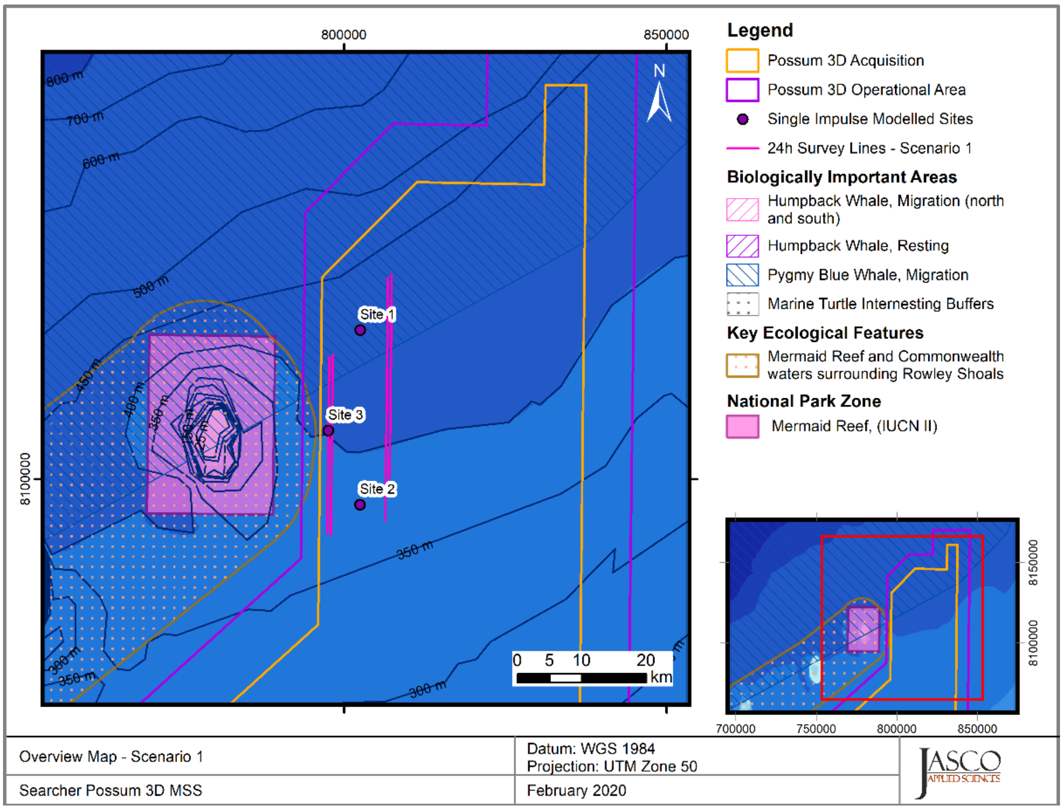

Figure 2. Overview of the Scenario 1 modelled sites and acquisition lines.

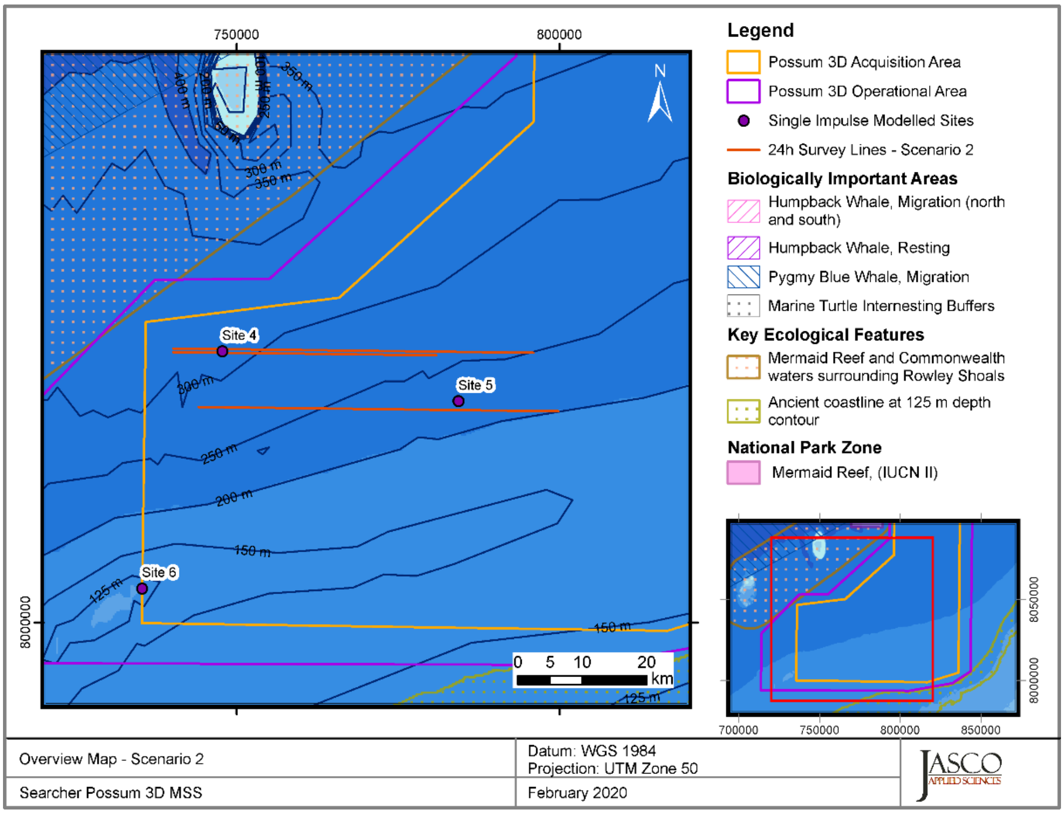

Figure 3. Overview of the Scenario 2 modelled sites and acquisition lines.

3. Noise Effect Criteria

The perceived loudness of sound, especially impulsive noise such as from seismic airguns, is not generally proportional to the instantaneous acoustic pressure. Rather, perceived loudness depends on the pulse rise-time and duration, and the frequency content. Several sound level metrics, such as PK, SPL, and SEL, are commonly used to evaluate noise and its effects on marine life (Appendix A). The period of accumulation associated with SEL is defined, with this report referencing either a “per pulse” assessment or over 24 h. Appropriate subscripts indicate any applied frequency weighting; unweighted SEL is defined as required. The acoustic metrics in this report reflect the updated ISO standard for acoustic terminology, ISO/DIS 18405:2017 (2017).

Whether acoustic exposure levels might injure or disturb marine mammals is an active research topic. Since 2007, several expert groups have developed SEL-based assessment approaches for evaluating auditory injury, with key works including Southall et al. (2007), Finneran and Jenkins (2012), Popper et al. (2014), and United States National Marine Fisheries Service (NMFS 2018). The number of studies that have investigated the level of behavioural disturbance to marine fauna by anthropogenic sound has also increased substantially.

The following noise criteria and sound levels for this study were chosen because they include standard thresholds, thresholds suggested by the best available science, and sound levels presented in literature for species with no suggested thresholds (Sections 3.1–3.4 and Appendix A):

1. Peak pressure levels (PK; L_{pk}) and frequency-weighted accumulated sound exposure levels (SEL; $L_{E,24h}$) from the U.S. National Oceanic and Atmospheric Administration (NOAA) Technical Guidance (NMFS 2018) for the onset of Permanent Threshold Shift (PTS) in marine mammals.
2. Marine mammal behavioural threshold based on the current U.S. National Marine Fisheries Service (NMFS) (2014) of 160 dB re 1 µPa (SPL; L_p) for impulsive sound sources.
3. Sound exposure guidelines for fish, fish eggs and larvae, and turtles (Popper et al. 2014).
4. Peak pressure levels (PK; L_{pk}) and frequency-weighted accumulated sound exposure levels (SEL; $L_{E,24h}$) from Finneran et al. (2017) for the onset of permanent threshold shift (PTS) and temporary threshold shift (TTS) in turtles.
5. Turtle behavioural response threshold of 166 dB re 1 µPa (SPL; L_p) (NSF 2011), as applied by the US NMFS, along with a sound level associated with behavioural disturbance 175 dB re 1 µPa (SPL; L_p) (McCauley et al. 2000a, 2000b).
6. Peak-peak pressure levels (PK-PK; $L_{pk\text{-}pk}$) at the seafloor to help assess effects of noise on crustaceans through comparing to results in Day et al. (2016a), Day et al. (2019) , Day et al. (2016b), Day et al. (2017) and Payne et al. (2008).
7. A sound level of 226 dB re 1 µPa (PK; L_{pk}) reported for comparing to Heyward et al. (2018) for sponges and corals.
8. An SPL human health assessment threshold of 145 dB re 1 µPa (SPL; L_p) for sound exposure to people swimming and diving derived from Parvin (2005), and considering Ainslie (2008).

Additionally, to assess the size of the low-power zone required under the Australian Environment Protection and Biodiversity Conservation (EPBC) Act Policy Statement 2.1, Department of the Environment, Water, Heritage and the Arts (DEWHA 2008), the distance to an unweighted per-pulse SEL of 160 dB re 1 µPa^2·s (SEL; L_E) is reported.

The following section expands on the thresholds and sound levels for marine mammals, fish, turtles, fish eggs, and fish larvae and benthic invertebrates.

3.1. Marine Mammals

The criteria applied in this study to assess possible effects of airgun noise on marine mammals are summarised in Table 6 and detailed in Sections 3.1.1 and 3.1.2, with frequency weighting explained in Appendix A.3.

Table 6. Unweighted SPL, SEL_{24h}, and PK thresholds for acoustic effects on marine mammals.

Hearing group	NMFS (2014)	NMFS (2018)			
	Behaviour	PTS onset thresholds* (received level)		TTS onset thresholds* (received level)	
	SPL (L_p; dB re 1 µPa)	Weighted SEL_{24h} ($L_{E,24h}$; dB re 1 µPa^2·s)	PK (L_{pk}; dB re 1 µPa)	Weighted SEL_{24h} ($L_{E,24h}$; dB re 1 µPa^2·s)	PK (L_{pk}; dB re 1 µPa)
Low-frequency cetaceans	160	183	219	168	213
Mid-frequency cetaceans		185	230	170	224
High-frequency cetaceans		155	202	140	196

* Dual metric acoustic thresholds for impulsive sounds: Use whichever results in the largest isopleth for calculating PTS onset. If a non-impulsive sound has the potential of exceeding the peak sound pressure level thresholds associated with impulsive sounds, these thresholds should also be considered.
L_p–denotes sound pressure level period and has a reference value of 1 µPa.
L_{pk}, flat–peak sound pressure is flat weighted or unweighted and has a reference value of 1 µPa.
L_E - denotes cumulative sound exposure over a 24-hour period and has a reference value of 1 µPa^{2}s.
Subscripts indicate the designated marine mammal auditory weighting.

3.1.1. Behavioural response

Southall et al. (2007) extensively reviewed marine mammal behavioural responses to sounds. Their review found that most marine mammals exhibited varying responses between 140 and 180 dB re 1 µPa SPL, but inconsistent results between studies made choosing a single behavioural threshold difficult. Studies varied in their lack of control groups, imprecise measurements, inconsistent metrics, and that animal responses depended on study context, which included the animal's activity state. To create meaningful quantitative data from the collected information, Southall et al. (2007) proposed a severity scale that increased with increasing sound levels.

NMFS has historically used a relatively simple sound level criterion for potentially disturbing a marine mammal. For impulsive sounds, this threshold is 160 dB re 1 µPa SPL for marine mammals (NMFS 2014) which has been applied for this report.

3.1.2. Injury and hearing sensitivity changes

There are two categories of auditory threshold shifts or hearing loss: permanent threshold shift (PTS), a physical injury to an animal's hearing organs and Temporary Threshold Shift (TTS), a temporary reduction in an animal's hearing sensitivity as the result of receptor hair cells in the cochlea becoming fatigued.

To assist in assessing the potential for injuries to marine mammals, this report applies the criteria recommended by NMFS (2018), considering both PTS and TTS, to help assess the potential for injuries to and hearing sensitivity changes in marine mammals. Appendix A.1 provides more information about the NMFS (2018) criteria.

3.2. Fish, Fish Eggs, and Fish Larvae

In 2006, the Working Group on the Effects of Sound on Fish and Turtles was formed to continue developing noise exposure criteria for fish and turtles, work begun by a panel convened by NOAA two years earlier. The resulting guidelines included specific thresholds for different levels of effects and for different groups of species (Popper et al. 2014). These guidelines defined quantitative thresholds for three types of immediate effects:

- Mortality, including injury leading to death.
- Recoverable injury, including injuries unlikely to result in mortality, such as hair cell damage and minor haematoma.
- TTS.

Masking and behavioural effects can be assessed qualitatively, by assessing relative risk rather than by specific sound level thresholds. These effects are not assessed in this report. Because the presence or absence of a swim bladder has a role in hearing, fish's susceptibility to injury from noise exposure varies depending on the species and the presence and possible role of a swim bladder in hearing. Thus, different thresholds were proposed for fish without a swim bladder (also appropriate for sharks and applied to whale sharks in the absence of other information), fish with a swim bladder not used for hearing, and fish that use their swim bladders for hearing. Turtles, fish eggs, and fish larvae are considered separately. Table 7 lists relevant effects thresholds from Popper et al. (2014). In general, any adverse effects of seismic sound on fish behaviour depends on the species, the state of the individuals exposed, and other factors. We note that, despite mortality being a possibility for fish exposed to airgun sounds, Popper et al. (2014) do not reference an actual occurrence of this effect. Since the publication of that work, newer studies have further examined the question of possible mortality. Popper et al. (2016) adds further information to the possible levels of impulsive seismic airgun sound to which adult fish can be exposed without immediate mortality. They found that the two fish species in their study, with body masses in the range 200–400 g, exposed to a single-impulse of a maximum received level of either 231 dB re 1 µPa (PK) or 205 dB re 1 µPa^2·s (SEL), remained alive for 7 days after exposure and that the probability of mortal injury did not differ between exposed and control fish.

The SEL metric integrates noise intensity over some period of exposure. Because the period of integration for regulatory assessments is not well defined for sounds that do not have a clear start or end time, or for very long-lasting exposures, it is required to define a time. Popper et al. (2014) recommend applying a standard period, where this is either defined as a justified fixed period or the duration of the activity; however, Popper et al. (2014) also included caveats about how long the fish will be exposed because they can move (or remain in location) and so can the source. Popper et al. (2014) summarises that in all TTS studies considered, fish that showed TTS recovered to normal hearing levels within 18–24 hours. Due to this, a period of accumulation of 24 hours has been applied in this study for SEL, which is similar to that applied for marine mammals in NMFS (2016, 2018).

In the discussion of the criteria, Popper et al. (2014) discuss the complications in determining a relevant period of mobile seismic surveys, as the received levels at the fish change between impulses because the source is moving, and that in reality a revised guideline based on the closest PK or the per-pulse SEL might be more useful than one based on accumulated SEL. This is because exposures at the closest point of approach (CPA) are the primary exposures contributing to a receiver's accumulated level (Gedamke et al. 2011). Additionally, several important factors determine the likelihood and duration a receiver is expected to be in close proximity to a sound source (i.e., overlap in space and time between the source and receiver). For example, accumulation time for fast moving (relative to the receiver) mobile sources is driven primarily by the characteristics of the source (i.e., speed, duty cycle; NMFS 2016, 2018).

As discussed in Popper (2018), many fish species move around, some over large distances. The author suggests that it is reasonable to think that if the sound of a seismic source becomes too loud, the fish will move away from the source because they are able to determine the direction of a sound source. If the fish moves away, the amount of energy to which it is exposed is likely to be one or a few seismic pulses, and these would not likely be loud enough to result in any effect because the fish would move away at a much lower level signal than could cause harm. Data on TTS for fish are very limited, with the only study that examined recovery from seismic impulses being Popper et al. (2005). Popper (2018) states that if this study had been conducted on wild, free-swimming fish instead of caged ones, there would have been no effect whatsoever because they were likely to have moved away from the source as it approached them, as would happen with normally free-moving demersal and pelagic fish species associated with a 3-D seismic survey in northern Australian waters, extrapolating from the Bethany 3-D assessed in Popper (2018).

Therefore, the time over which energy should be accumulated in each individual fish in the survey area should be limited to the time over which fish receives the maximum exposure, and 24 h is likely too long a period for calculating the accumulation of energy in determining potential harm (e.g., damage or TTS) (Popper 2018). Even if fish do show some TTS, recovery will start as soon as the most intense sounds end, and recovery is likely to even occur, to a limited degree, between seismic pulses. Based on very limited data, recovery within 24 h (or less) is very likely. If TTS does occur, the duration of exposure to the most intense sounds that could result in TTS will be over just a few hours. Thus, energy accumulating over longer periods than a few hours is probably inappropriate (Popper 2018).

Table 7. Criteria for seismic noise exposure for fish, adapted from Popper et al. (2014).

Type of animal	**Mortality and Potential mortal injury**	**Impairment**			**Behaviour**
		Recoverable injury	TTS	Masking	
Fish: No swim bladder (particle motion detection)	>219 dB SEL_{24h} or >213 dB PK	>216 dB SEL_{24h} or >213 dB PK	>>186 dB SEL_{24h}	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low
Fish: Swim bladder not involved in hearing (particle motion detection)	210 dB SEL_{24h} or >207 dB PK	203 dB SEL_{24h} or >207 dB PK	>>186 dB SEL_{24h}	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low
Fish: Swim bladder involved in hearing (primarily pressure detection)	207 dB SEL_{24h} or >207 dB PK	203 dB SEL_{24h} or >207 dB PK	186 dB SEL_{24h}	(N) Low (I) Low (F) Moderate	(N) High (I) High (F) Moderate
Fish eggs and fish larvae (relevant to plankton)	>210 dB SEL_{24h} or >207 dB PK	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low

Notes: Peak sound level (PK) dB re 1 µPa; SEL_{24h} dB re 1µPa^2·s. All criteria are presented as sound pressure, even for fish without swim bladders, since no data for particle motion exist. Relative risk (high, moderate, or low) is given for animals at three distances from the source defined in relative terms as near (N), intermediate (I), and far (F).

3.3. Turtles

There is a paucity of data regarding responses of turtles to acoustic exposure, and no studies of hearing loss due to exposure to loud sounds. McCauley et al. (2000a) observed the behavioural response of caged turtles—green (*Chelonia mydas*) and loggerhead (*Caretta caretta*)—to an approaching seismic airgun. For received levels above 166 dB re 1 µPa (SPL), the turtles increased their swimming activity and above 175 dB re 1 µPa they began to behave erratically, which was interpreted as an agitated state. The 166 dB re 1 µPa level has been used as the threshold level for a behavioural disturbance response by NMFS and applied in the Arctic Programmatic Environment Impact Statement (PEIS) (NSF 2011). At that time, and in the absence of any data from which to determine the sound levels that could injure an animal, TTS or PTS onset were considered possible at an SPL of 180 dB re 1 µPa (NSF 2011). Some additional data suggest that behavioural responses occur closer to an SPL of 175 dB re 1 µPa, and TTS or PTS at even higher levels (McCauley et al. 2000a, McCauley et al. 2000b), but the received levels were unknown, and the NSF (2011) PEIS maintained the earlier NMFS criteria levels of 166 and 180 dB re 1 µPa (SPL) for behavioural response and injury, respectively. Popper et al. (2014) suggested injury to turtles could occur for sound exposures above 207 dB re 1 µPa (PK) or above 210 dB re 1 µPa^2·s (SEL_{24h}). Sound levels defined by Popper et al. (2014) show that animals are very likely to exhibit a behavioural response when they are near an airgun (tens of metres), a moderate response if they encounter the source at intermediate ranges (hundreds of metres), and a low response if they are far (thousands of meters) from the airgun.

Finneran et al. (2017) presented revised thresholds for turtle injury, considering both PK and frequency weighted SEL, which have been applied in this study, along with the NMFS criterion for behavioural response (SPL of 166 dB re 1 µPa), and a criterion for behavioural disturbance (SPL of 175 dB re 1 µPa) (McCauley et al. 2000a, McCauley et al. 2000b) (Table 8).

Table 8. Acoustic effects of impulsive noise on turtles: Unweighted SPL, SEL_{24h}, and PK thresholds

NSF (2011)	McCauley et al. (2000b)	Finneran et al. (2017)			
Behaviour		PTS onset thresholds* (received level)		TTS onset thresholds* (received level)	
SPL (L_p; dB re 1 µPa)		Weighted SEL_{24h} ($L_{E,24h}$; dB re 1 µPa²·s)	PK (L_{pk}; dB re 1 µPa)	Weighted SEL_{24h} ($L_{E,24h}$; dB re 1 µPa²·s)	PK (L_{pk}; dB re 1 µPa)
160	175	204	232	189	226

* Dual metric acoustic thresholds for impulsive sounds: Use whichever results in the largest isopleth for calculating PTS onset. If a non-impulsive sound has the potential of exceeding the peak sound pressure level thresholds associated with impulsive sounds, these thresholds should also be considered.
L_p–denotes sound pressure level period and has a reference value of 1 µPa.
L_{pk}, flat–peak sound pressure is flat weighted or unweighted and has a reference value of 1 µPa.
L_E - denotes cumulative sound exposure over a 24-hour period and has a reference value of 1 µPa²s.

3.4. Benthic Invertebrates (Crustaceans and Bivalves)

Research is ongoing into the relationship between sound and its effects on crustaceans, including the relevant metrics for both effect and impact. Available literature suggests particle motion, rather than sound pressure, is a more important factor for crustacean and bivalve hearing. Water depth and seismic source size are related to the particle motion levels at the seafloor, with larger arrays and shallower water being related to higher particle motion levels, more likely relevant to effects on crustaceans and bivalves.

At the seafloor interface, crustaceans and bivalves are subject to particle motion stimuli from several acoustic or acoustically-induced waves. These include the particle motion associated with an impinging sound pressure wave in the water column (the incident, reflected, and transmitted portions), substrate acoustic waves, and interface waves of the Scholte type. However, it is unclear which aspect(s) of these waves is/are most relevant to the animals, either when they normally sense the environment or their physiological responses to loud sounds so there is not enough information to establish similar criteria and thresholds as done for marine mammals and fish. Including recent research, such as Day et al. (2016b), current literature does not clearly define an appropriate metric or identify relevant levels (pressure or particle motion) for an assessment. This includes the consideration of what particle motion levels lead to a behavioural response, or mortality. Therefore, at this stage, we cannot propose authoritative thresholds to inform the impact assessment. However, levels can be determined for pressure metrics presented in literature to assist the assessment.

For crustaceans, a PK-PK sound level of 202 dB re 1 µPa (Payne et al. 2008) is considered to be associated with no impact, and therefore applied in the assessment. Additionally for context related to different levels of potential impairment, the PK-PK sound levels determined for crustaceans in Day et al. (2016b), 209–212 dB re 1 µPa and 213 dB re 1 µPa from Day et al. (2019), are also included.

4. Methods

4.1. Acoustic Source Model

The pressure signature of the individual airguns and the composite 1/3-octave-band point-source equivalent directional levels (i.e., source levels) of the seismic sources were modelled with JASCO's Airgun Array Source Model (AASM). Although AASM accounts for notional pressure signatures of each seismic source with respect to the effects of surface-reflected signals on bubble oscillations and inter-bubble interactions, the surface-reflected signal (known as surface ghost) is not included in the far-field source signatures. The acoustic propagation models account for those surface reflections, which are a property of the propagating medium rather than the source.

AASM considers:

- Array layout.
- Volume, tow depth, and firing pressure of each airgun.
- Interactions between different airguns in the array.

All seismic sources considered were modelled over AASM's full frequency range, up to 25 kHz. Appendix B details this model.

4.2. Parameter Overview

The specifications of the seismic source and the environmental parameters used in the propagation models are described in detail in Appendix D. A single sound speed profile for July was considered in this modelling study; this was identified as the seasonal period that would provide the farthest propagation (Appendix D.3.2) due to the presence of a slight upward refracting sound speed profile.

Seabed sediments in the survey acquisition area were modelled as single seabed type. The seabed was modelled as a succession from soft to hard sediments (unconsolidated sediment transitioning to more compact and cemented sediments deeper below the seafloor, Table D-1).

4.3. Sound Propagation Models

Three sound propagation models were used to predict the acoustic field around the seismic source:

- Combined range-dependent parabolic equation and Gaussian beam acoustic ray-trace model (MONM-BELLHOP, 5 Hz to 25 kHz).
- Full Waveform Range-dependent Acoustic Model (FWRAM, 5 Hz to 1024 Hz).
- Wavenumber integration model (VSTACK, 5 Hz to 1024 Hz).

The models were used in combination to characterise the acoustic fields at short and long ranges in terms of SEL, SPL, PK, and PK-PK. Appendix C details each model. MONM-BELLHOP was used to calculate SEL of a 360° area around each source location. FWRAM was used to model synthetic seismic pulses and to generate a generalised range-dependent SEL to SPL conversion function for the considered modelled sites. The range-dependent conversion function was applied to predicted per-pulse SEL results from MONM-BELLHOP to estimate SPL values. FWRAM was also used to calculate water column PK and PK-PK levels at three representative modelled sites: Sites 1, 2 and 5.

VSTACK was used to calculate close range PK and PK-PK levels along transects at the seafloor from the loudest direction of the seismic source at the shallowest modelled sites within the survey area (Sites 5 and 6).

4.4. Accumulated SEL

During a seismic survey, new sound energy is introduced into the environment with each pulse from the seismic source. While some impact criteria are based on the per-pulse energy released, others, such as the marine mammal and fish SEL criteria used in this report (Sections 3.1–3.4) account for the total acoustic energy marine fauna is subjected to over a specified period of time, defined in this report as 24 h. An accurate assessment of the accumulated sound energy depends not only on the parameters of each seismic pulse impulse, but also on the number of impulses delivered in a period and the relative positions of the impulses.

When there are many seismic pulses, it becomes computationally prohibitive to perform sound propagation modelling for every single event. The distance between the consecutive seismic impulses is small enough, however, that the environmental parameters that influence sound propagation are virtually the same for many impulse points. The acoustic fields can, therefore, be modelled for a subset of seismic pulses and estimated at several adjacent ones. After sound fields from representative impulse locations are calculated, they are adjusted to account for the source position for nearby impulses.

Although estimating the cumulative sound field with the described approach is not as precise as modelling sound propagation at every impulse location, small-scale, site-specific sound propagation features tend to blur and become less relevant when sound fields from adjacent impulses are summed. Larger scale sound propagation features, primarily dependent on water depth, dominate the cumulative field. The accuracy of the present method acceptably reflects those large-scale features, thus providing a meaningful estimate of a wide area SEL field in a computationally feasible framework.

To produce the map of accumulated received sound level distributions and calculate distances to specified sound level thresholds, the maximum-over-depth level was calculated at each sampling point within the modelled region. The radial grids of maximum-over-depth and seafloor sound levels for each impulse were then resampled (by linear triangulation) to produce a regular Cartesian grid. The sound field grids from all impulses were summed (Equation A-5) to produce the cumulative sound field grid with cell sizes of 20 m. The contours and threshold ranges were calculated from these flat Cartesian projections of the modelled acoustic fields. The single-impulse SEL fields were computed over model grids approximately 200 × 200 km in range, which encompasses the full area of the cumulative grid (the entire survey area).

The unweighted (fish and turtles) and frequency-weighted (mammals) SEL_{24h} results were rendered as contour maps, including contours that focus on the relevant criteria-based thresholds. Only contours at ranges larger than the nearfield of the seismic source were rendered.

4.5. Geometry and Modelled Regions

To assess sound levels with MONM-BELLHOP, the sound field modelling calculated propagation losses up to distances of 100 km from the source in each cardinal direction, with a horizontal separation of 20 m between receiver points along the modelled radials. The sound fields were modelled with a horizontal angular resolution of $\Delta\theta = 2.5°$ for a total of N = 144 radial planes. Receiver depths were chosen to span the entire water column over the modelled areas, from 2 m to a maximum of 2000 m, with step sizes that increased with depth. To supplement the MONM results, high-frequency results for propagation loss were modelled using Bellhop for frequencies from 1.25 to 25 kHz. The MONM and Bellhop results were combined to produce results for the full frequency range of interest.

FWRAM was run to 100 km, but along only four radials (fore and aft endfire, and port and starboard broadside) for computational efficiency. This was done to compute SEL-to-SPL conversions (Appendix D.2) but also to quantify water column PK and PK-PK. The horizontal range step is dependent on frequency and ranges from 50 m at lower frequencies to 10 m above 800 Hz.

The maximum modelled range for VSTACK was 1000 m and a variable receiver range increment that increased away from the source was used, which increased from 10 to 25 m. Received levels were computed for receivers at the seafloor.

5. Results

5.1. Acoustic Source Levels and Directivity

AASM (Section 4.1) was used to predict the horizontal and vertical overpressure signatures and corresponding power spectrum levels for the seismic source, with results provided in Appendix B.2 along with the horizontal directivity plots.

Preliminary source modelling was conducted to determine the source with the highest equivalent far-field acoustic output of three source arrays which might be used for the Possum 3-D MSS. The loudest arrays were coupled with single impulse propagation modelling (Appendix E), to determine the array most likely to produce the largest ranges to thresholds. This was determined to be a 2820 in^3 seismic source with a 6 m tow depth (see Appendix D.4 for details on this source)

Table 9 shows the PK and per-pulse SEL source levels in the horizontal-plane broadside (perpendicular to the tow direction), endfire (along the tow direction), and vertical directions. The vertical source level that accounts for the "surface ghost" (the out of phase reflected pulse from the water surface) is also presented to make it easier to compare the output of other seismic source models.

Figure B-1 shows the broadside, endfire, and vertical overpressure signature and corresponding power spectrum levels for the source. The signature consists of a strong primary peak, related to the initial release of high-pressure air, followed by a series of pulses associated with bubble oscillations. Most energy was produced at frequencies below 500 Hz. Frequency-dependent peaks and nulls in the spectrum result from interference among airguns in the source and correspond with the volumes and relative locations of the airguns to each other.

Table 9. Far-field source level specifications for the 2820 in^3 seismic source, for a 6 m tow depth. Source levels are for a point-like acoustic source with equivalent far-field acoustic output in the specified direction. Sound level metrics are per-pulse and unweighted.

Direction	Peak source pressure level ($L_{S,pk}$) (dB re 1 μPa m)	Per-pulse source SEL ($L_{S,E}$) (dB 1 μPa^{2}m^{2}s)	
		10–2000 Hz	2000–25000 Hz
Broadside	248.8	224.4	186.0
Endfire	244.8	223.0	186.6
Vertical	254.9	227.9	194.3
Vertical (surface affected source level)	254.9	230.6	197.3

5.2. Per-pulse Sound Fields

5.2.1. Tabulated Results

Tables 10–14 list per-pulse results for the 2820 in³ seismic source towed at 6 m are presented for SPL, SEL, PK, and PK-PK, including seafloor PK and PK-PK. The received sound levels at the 40 m contour surrounding Mermaid Reef (Table 5) when the source is active at the closest site, Site 3, is 147.4 dB re 1 µPa (SPL).

5.2.1.1. Entire Water Column

Table 10. Maximum (R_{max}) and 95% ($R_{95\%}$) horizontal distances (in km) from the 2820 in^3 seismic source to modelled maximum-over-depth unweighted per-pulse SEL isopleths from the five modelled single impulse sites, with water depth indicated.

Per-pulse SEL (L_E; dB re 1 µPa²·s)	Site 1 (427 m)		Site 2 (375 m)		Site 3 (401 m)		Site 4 (312 m)		Site 5 (220 m)	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
190	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
180	0.14	0.12	0.14	0.12	0.14	0.12	0.14	0.12	0.14	0.12
170	0.48	0.42	0.84	0.46	0.52	0.44	0.86	0.74	0.8	0.68
160†	2.86	2.29	3.14	2.42	2.94	2.32	3.11	2.74	3.98	3.26
150	14.2	11.9	14.8	12.0	14.3	11.2	14.3	11.8	14.5	11.6
140	41.6	34.4	39.4	31.0	41.6	33.0	40.5	29.4	42.7	34.1
130	87.9	72.2	86.9	62.2	79.7	62.8	85.8	59.1	>100	/
120	>100	/	>100	/	>100	/	>100	/	>100	/

† Low power zone assessment criteria DEWHA (2008).
A slash indicates that $R_{95\%}$ radius to threshold is not reported when the R_{max} is greater than the maximum modelling extent.

Table 11. Maximum (R_{max}) and 95% ($R_{95\%}$) horizontal distances (in km) from the 2820 in^3 seismic source to modelled maximum-over-depth SPL isopleths from the five modelled single impulse sites, with water depth indicated.

SPL (L_p; dB re 1 µPa)	Site 1 (427 m)		Site 2 (375 m)		Site 3 (401 m)		Site 4 (312 m)		Site 5 (220 m)	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.04	0.04	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04
190	0.12	0.10	0.12	0.10	0.12	0.10	0.12	0.10	0.12	0.10
180	0.40	0.34	0.42	0.37	0.40	0.36	0.74	0.42	0.72	0.63
175#	1.28	1.10	1.24	1.04	1.28	1.08	1.20	1.00	1.46	0.96
170	2.13	1.72	2.28	1.92	2.32	1.79	2.46	2.05	2.91	2.38
166†	3.46	2.82	3.44	2.86	3.58	2.76	4.18	3.27	4.25	3.60
160‡	6.98	5.82	6.94	5.89	6.80	5.71	7.60	6.44	8.48	6.82
150	22.4	18.8	23.2	18.9	23.4	18.4	23.6	18.5	23.9	18.4
145*	37.2	30.7	37.7	30.2	38.2	31.3	39.5	29.0	42.5	33.8
140	61.0	48.1	53.3	43.5	58.9	45.3	59.8	38.4	71.1	58.3
130	>100	/	>100	/	95.0	74.0	>100	/	>100	/

Threshold for turtle behavioural disturbance from impulsive noise (McCauley et al. 2000a).
† Threshold for turtle behavioural response to impulsive noise (NSF 2011).
‡ Marine mammal behavioural threshold for impulsive sound sources (NMFS 2014).
* Human health assessment threshold derived from Parvin (2005)
A slash indicates that $R_{95\%}$ radius to threshold is not reported when the R_{max} is greater than the maximum modelling extent.

Table 12. Maximum (R_{max}) horizontal distances (km) from the 2820 in^3 array to modelled maximum-over-depth peak pressure level (PK) thresholds based on the NOAA Technical Guidance (NMFS 2018) for marine mammals, and Popper et al. (2014) for fish and Finneran et al. (2017) for turtles, at three modelled sites (Table 4), with water depth indicated.

Hearing group	PK threshold (L_{pk}; dB re 1 µPa)	Distance R_{max} (km)		
		Site 1 (427 m)	Site 2 (375 m)	Site 5 (220 m)
Low-frequency cetaceans (PTS)	219	0.03	0.03	0.03
Low-frequency cetaceans (TTS)	213	0.06	0.06	0.06
Mid-frequency cetaceans (PTS)	230	—	—	—
Mid-frequency cetaceans (TTS)	224	—	—	—
High-frequency cetaceans (PTS)	202	0.20	0.20	0.20
High-frequency cetaceans (TTS)	196	0.38	0.38	0.38
Turtles (PTS)	232	—	—	—
Turtles (TTS)	226	—	—	—
Fish: No swim bladder (also applied to sharks)	213	0.06	0.06	0.06
Fish: Swim bladder not involved in hearing, Swim bladder involved in hearing Fish eggs, and larvae	207	0.12	0.12	0.12

A dash indicates the threshold is not reached within the limits of the modelling resolution (20 m).

5.2.1.2. Seafloor

Table 13. Maximum (R_{max}) horizontal distances (in m) from the 2820 in^3 array to modelled seafloor peak pressure level thresholds (PK) from two single-impulse modelling sites (Table 4), with water depth indicated.

Hearing group/animal type	PK threshold (L_{pk}; dB re 1 µPa)	Distance R_{max} (m)	
		Site 5 (220 m)	Site 6 (121 m)
Sound levels for sponges and corals†	226	*	*
Fish: No swim bladder (also applied to sharks)	213	*	46
Fish: Swim bladder not involved in hearing, Swim bladder involved in hearing Fish eggs, and larvae	207	100	144

† Heyward et al. (2018)
An asterisk indicates that the sound level was not reached.

Table 14. Maximum (R_{max}) horizontal distances (in m) from the 2820 in^3 seismic source to modelled seafloor peak-peak pressure levels (PK-PK) from two single-impulse modelling sites (Table 4), with water depth indicated. Results included in relation to benthic invertebrates (Section 3.4).

PK-PK (L_{pk-pk}; dB re 1 µPa)	**Distance R_{max} (m)**	
	Site 5 (220 m)	Site 6 (121 m)
213[a,b,c]	87	141
212[b,c]	114	153
210[a,b]	178	205
209[a,b]	217	344
202[d]	666	560

[a] Day et al. (2019), lobster
[b] Day et al. (2016a), lobster and scallops
[c] Day et al. (2017), scallops.
[d] Payne et al. (2008), lobster, no impact threshold.

5.2.2. Sound Field Maps and Graphs

5.2.2.1. Sound Level Contour Maps

Figures 4–8 show maps of the estimated sound fields, threshold contours, and isopleths of interest for the per-pulse SPL sound fields at all modelled sites (Table 4). The 145 dB re 1 µPa isopleth is shown at the sites closest to Mermaid Reef only (Sites 1–3).

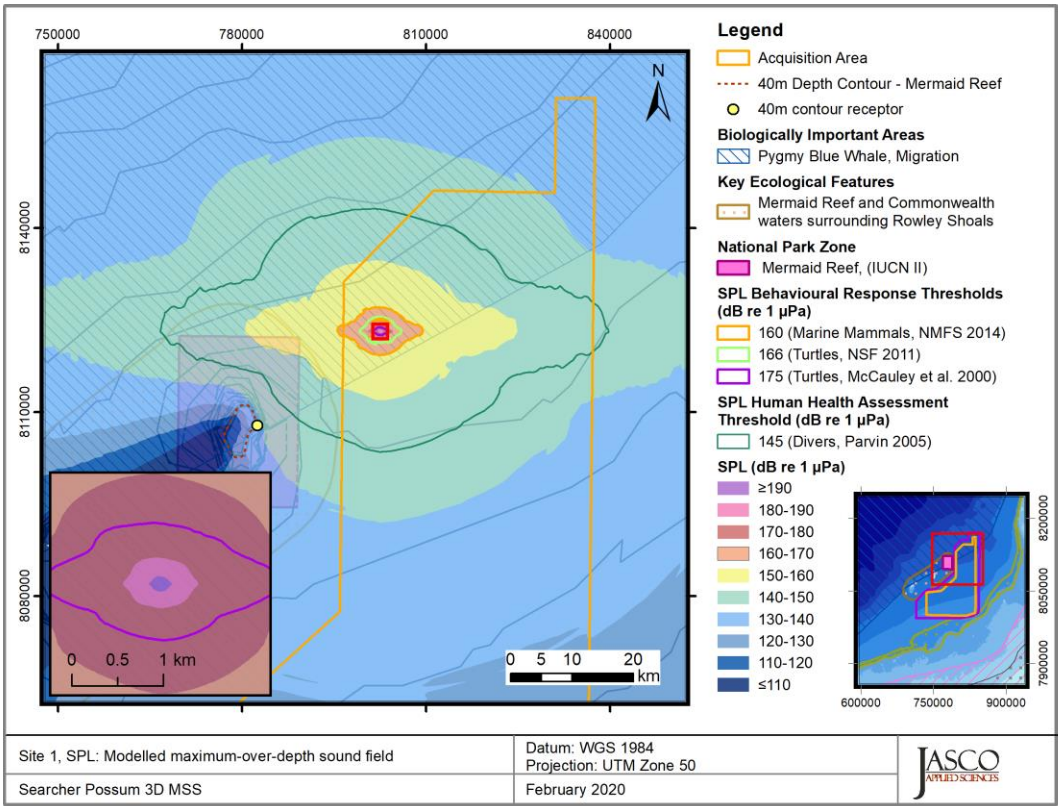

Figure 4. *Site 1, SPL:* Sound level contour map showing unweighted maximum-over-depth results.

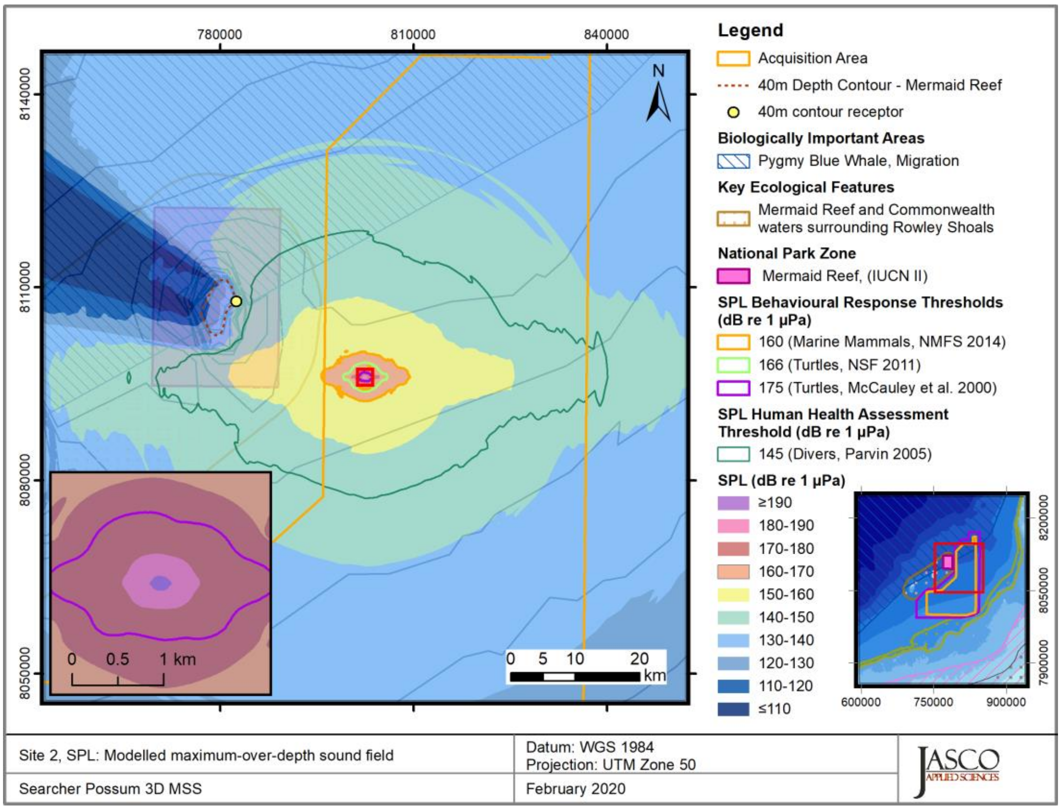

Figure 5. *Site 2, SPL:* Sound level contour map showing unweighted maximum-over-depth results.

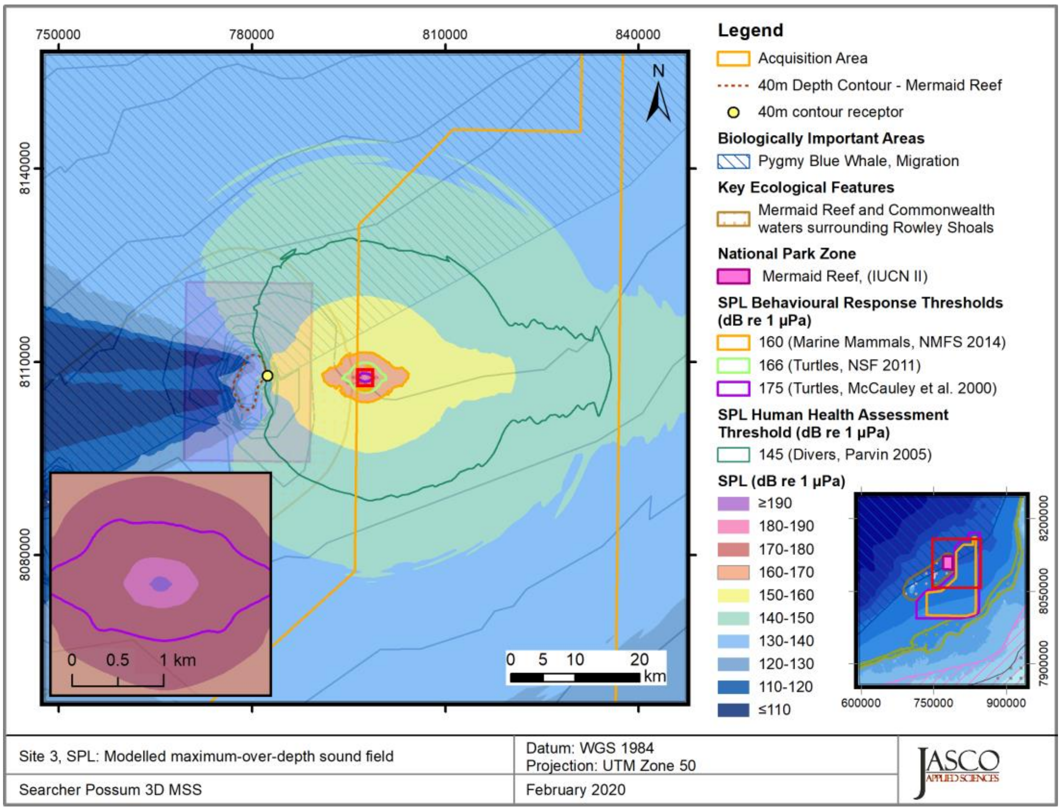

Figure 6. *Site 3, SPL:* Sound level contour map showing unweighted maximum-over-depth results.

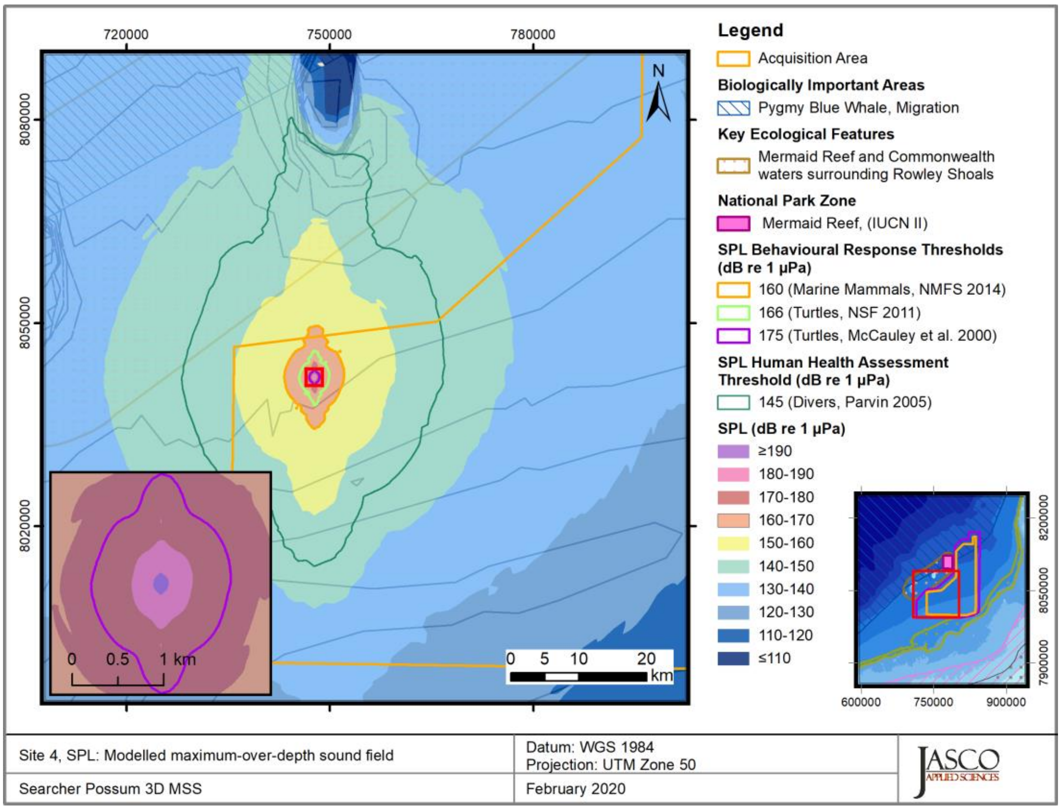

Figure 7. *Site 4, SPL:* Sound level contour map showing unweighted maximum-over-depth results

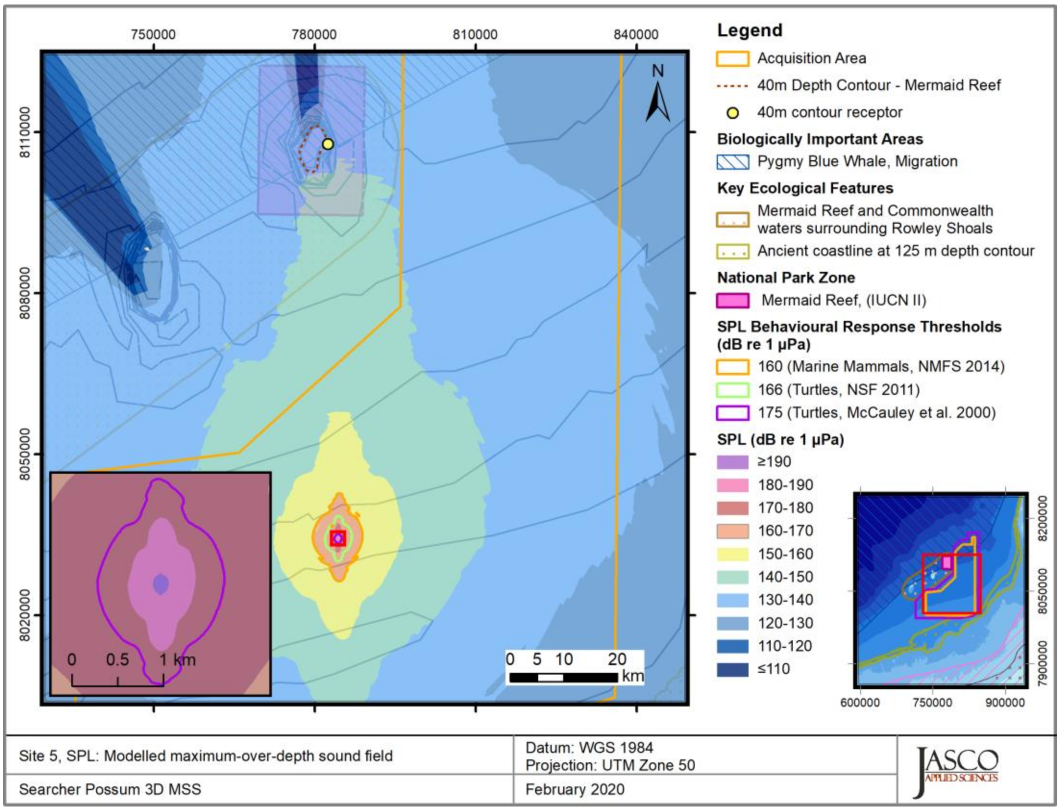

Figure 8. *Site 5, SPL:* Sound level contour map showing unweighted maximum-over-depth results

5.2.2.2. Vertical Slices of Modelled Sound Fields

Figures 9–13 show vertical slices of the SPL sound fields for the 2820 in³ seismic source.

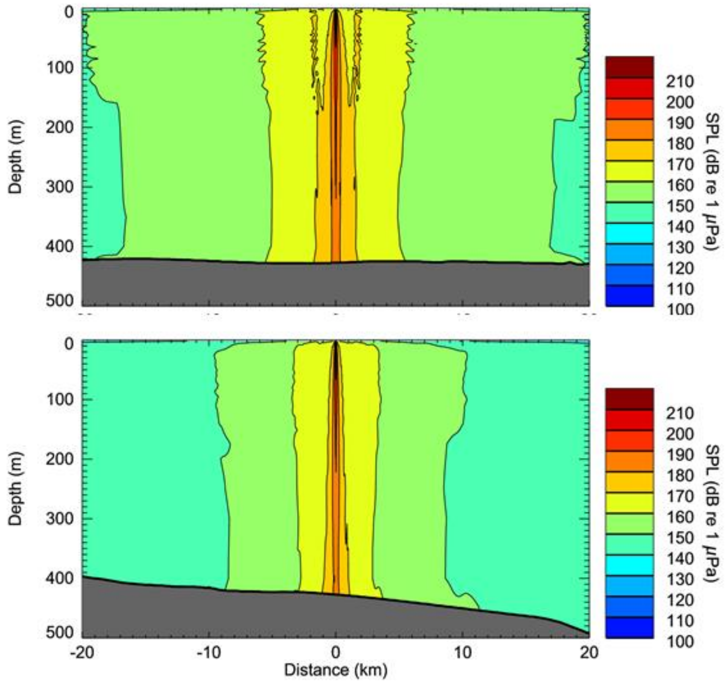

Figure 9. *Site 1, SPL*: Vertical slice of the predicted SPL for the 2820 in³ seismic source. Levels are shown along the broadside (top) and endfire (bottom) directions.

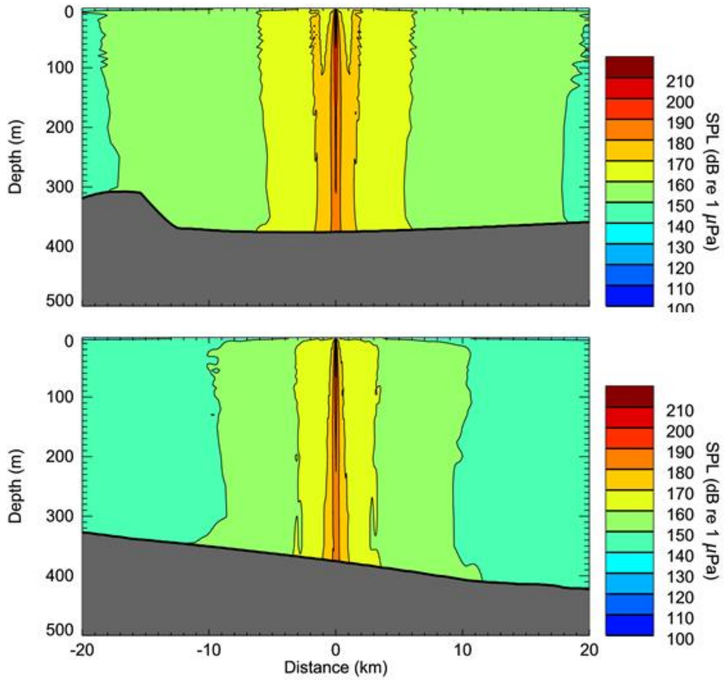

Figure 10. *Site 2, SPL*: Vertical slice of the predicted SPL for the 2820 in³ seismic source. Levels are shown along the broadside (top) and endfire (bottom) directions.

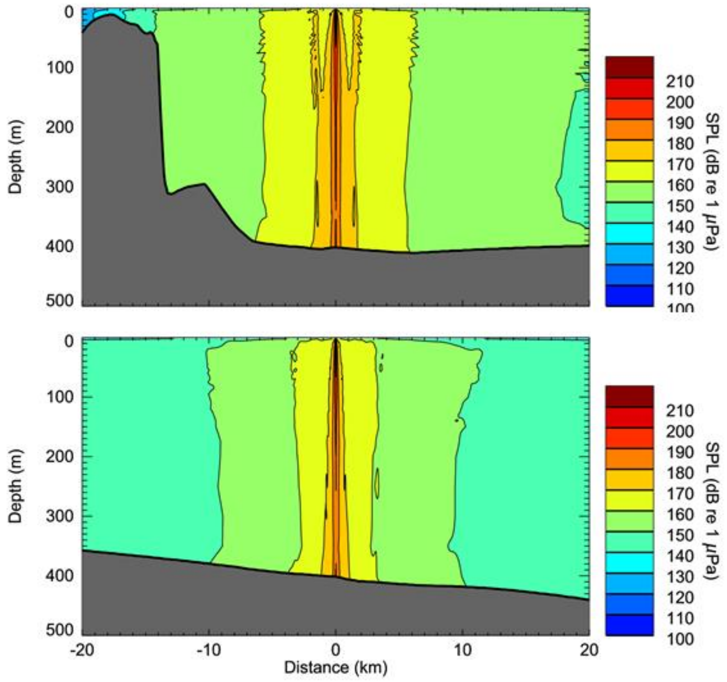

Figure 11. *Site 3 SPL*: Vertical slice of the predicted SPL for the 2820 in^3 seismic source. Levels are shown along the broadside (top) and endfire (bottom) directions.

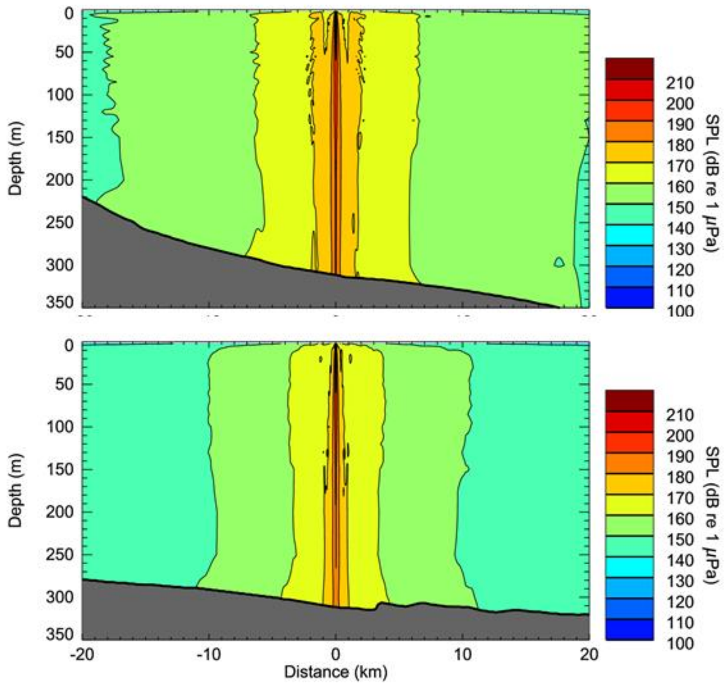

Figure 12. *Site 4, SPL*: Vertical slice of the predicted SPL for the 2820 in^3 seismic source. Levels are shown along the broadside (top) and endfire (bottom) directions.

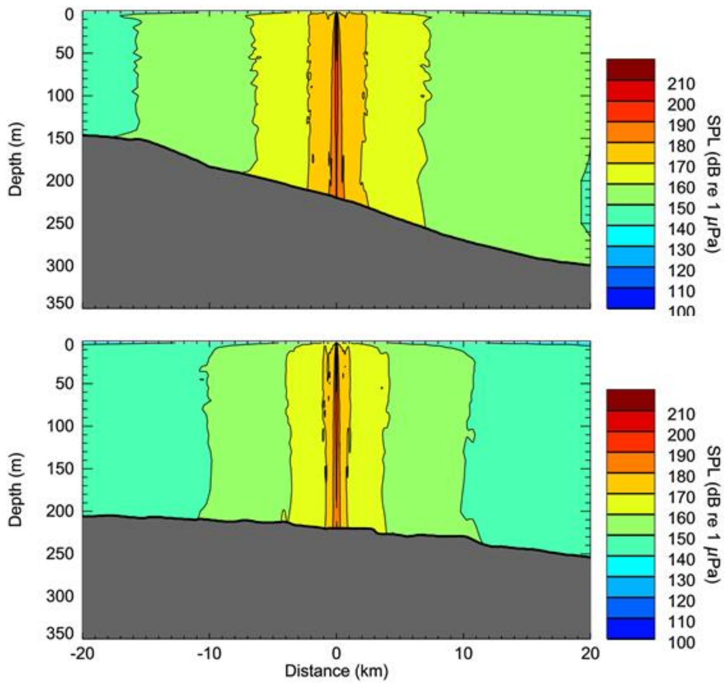

Figure 13. *Site 5, SPL*: Vertical slice of the predicted SPL for the 2820 in^3 seismic source. Levels are shown along the broadside (top) and endfire (bottom) directions.

5.3. Multiple Pulse Sound Fields

The SEL_{24h} results for the proposed survey are presented for Scenario 1 and Scenario 2. Tables 15 and 16 show the estimated ranges to the appropriate cumulative exposure criterion contour for the various marine fauna groups considered and the corresponding ensonified areas. The ranges in this section are the perpendicular distance from the survey line to the relevant isopleth. Estimates of the maximum-over-depth sound fields, including threshold contours relating to marine mammals and fish, are presented in Figures 14 and 16, while estimates of the sound field at the seafloor and threshold contours relevant to fish are presented in Figures 15 and 17.

5.3.1. Tabulated Results

Table 15. Maximum-over-depth distances (in km) to frequency-weighted SEL_{24h} based marine mammal PTS and TTS thresholds NMFS (2018) and turtles (Finneran et al. 2017).

Hearing group	Threshold for SEL_{24h} ($L_{E,24h}$; dB re 1 µPa²·s)	Scenario 1		Scenario 2	
		R_{max} (km)	Area (km²)	R_{max} (km)	Area (km²)
PTS					
Low-frequency cetaceans	183	3.52	276	3.37	384
Mid-frequency cetaceans	185	—	—	—	—
High-frequency cetaceans	155	0.06	2.99	0.05	2.44
Turtles	204	0.06	3.7	0.06	3.14
TTS					
Low-frequency cetaceans	168	62.9	6572	62.4	6912
Mid-frequency cetaceans	170	0.05	0.28	—	—
High-frequency cetaceans	140	0.30	65.7	0.33	73.9
Turtles	189	0.88	100	0.88	144

A dash indicates the threshold was not reached within the limits of the modelling resolution (20 m).

Table 16. Distances to SEL_{24h} based fish criteria in the water column.

Marine fauna group	Threshold for SEL_{24h} ($L_{E,24h}$; dB re 1 µPa²·s)	Maximum-over-depth			
		Scenario 1		Scenario 2	
		R_{max} (km)	Area (km²)	R_{max} (km)	Area (km²)
Mortality and potential mortal injury					
I	219	0.06	3.7	0.06	3.14
II, fish eggs and fish larvae	210	0.06	3.7	0.06	3.84
III	207	0.06	3.7	0.06	3.84
Fish recoverable injury					
I	216	0.06	3.7	0.06	3.14
II, III	203	0.06	3.82	0.06	4.29
Fish TTS					
I, II, III	186	9.08	878	9.13	1230

Fish I–No swim bladder; Fish II–Swim bladder not involved with hearing; Fish III–Swim bladder involved with hearing.

Table 17. Distances to SEL_{24h} based fish criteria at the seafloor.

Marine fauna group	Threshold for SEL_{24h} ($L_{E,24h}$; dB re 1 µPa²·s)	Seafloor			
		Scenario 1		Scenario 2	
		R_{max} (km)	Area (km²)	R_{max} (km)	Area (km²)
Mortality and potential mortal injury					
I	219	*	*	*	*
II, fish eggs and fish larvae	210	*	*	*	*
III	207	*	*	*	*
Fish recoverable injury					
I	216	*	*	*	*
II, III	203	*	*	*	*
Fish TTS					
I, II, III	186	9.08	877	9.10	1227

Fish I–No swim bladder; Fish II–Swim bladder not involved with hearing; Fish III–Swim bladder involved with hearing.
An asterisk indicates that the threshold was not reached.

5.3.2. Sound Field Maps

Figures 14–17 show the maps of the estimated sound fields, threshold contours, and isopleths of interest for the SEL_{24h} sound fields for the two considered scenarios (Figure 1).

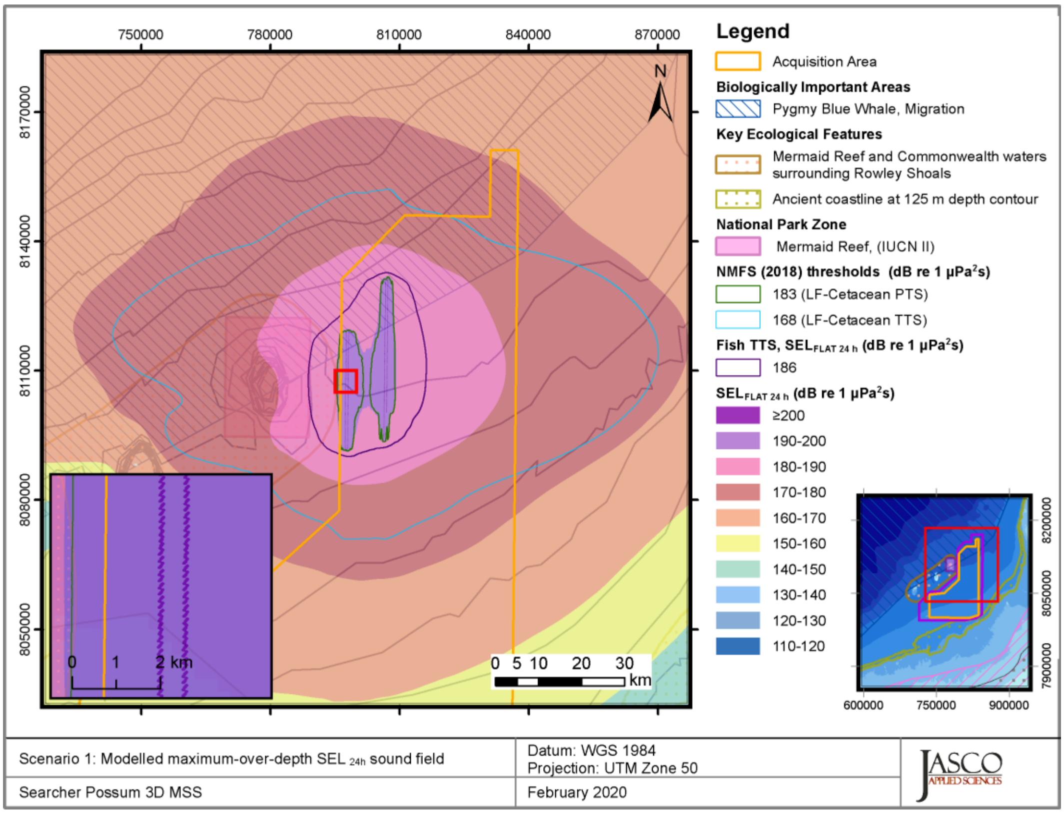

Figure 14. *Scenario 1*: Sound level contour map showing unweighted maximum-over-depth SEL_{24h} results, along with isopleths for low-frequency cetaceans and fish TTS.Thresholds for mid- and high-frequency cetacean and Turtle PTS and TTS were not shown as thresholds were not reached or threshold contours were not large enough to display graphically.

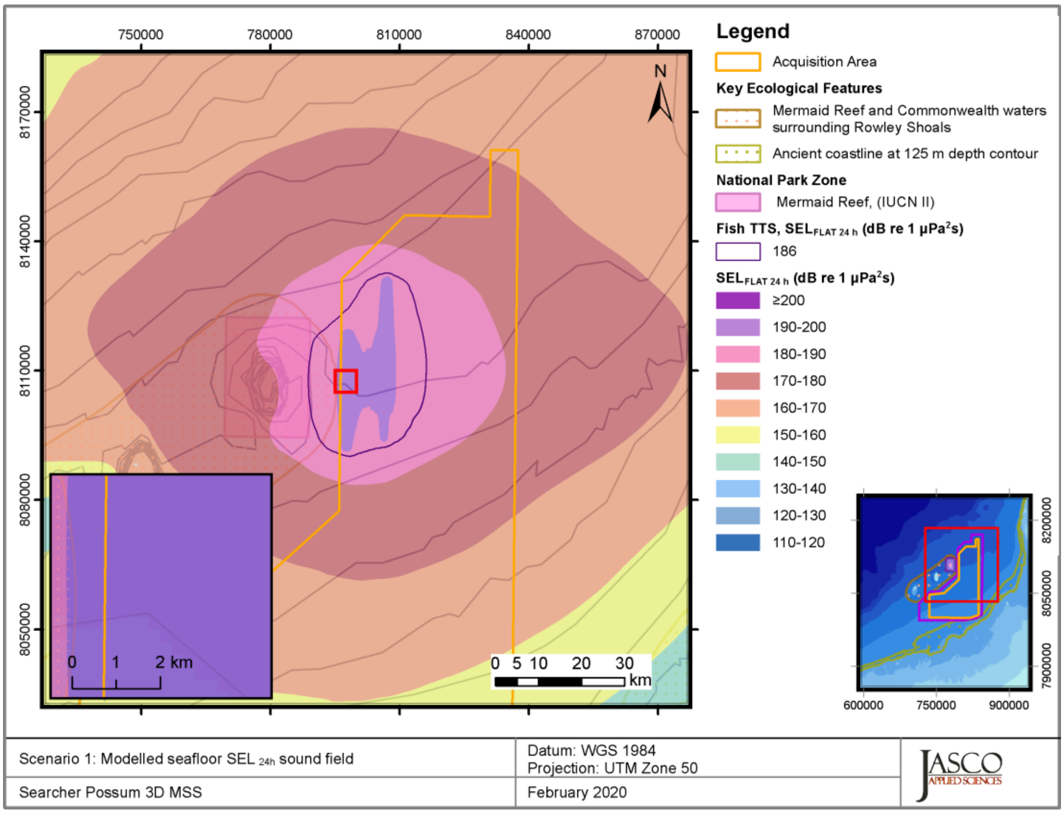

Figure 15. *Scenario 1:* Sound level contour map showing unweighted seafloor SEL_{24h} results, along with the isopleth for fish TTS.

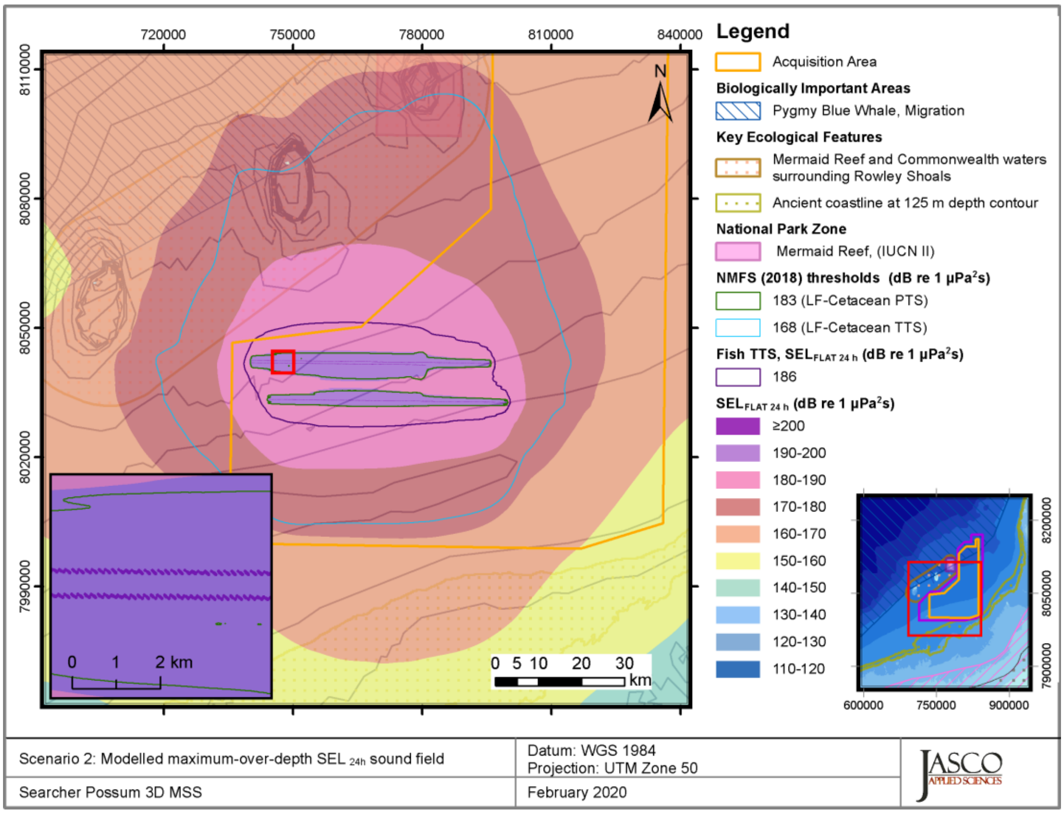

Figure 16. *Scenario 2:* Sound level contour map showing unweighted maximum-over-depth SEL_{24h} results, along with isopleths for low-frequency cetaceans and fish TTS. Thresholds for mid- and high-frequency cetacean and Turtle PTS and TTS were not shown as thresholds were not reached or threshold contours were not large enough to display graphically.

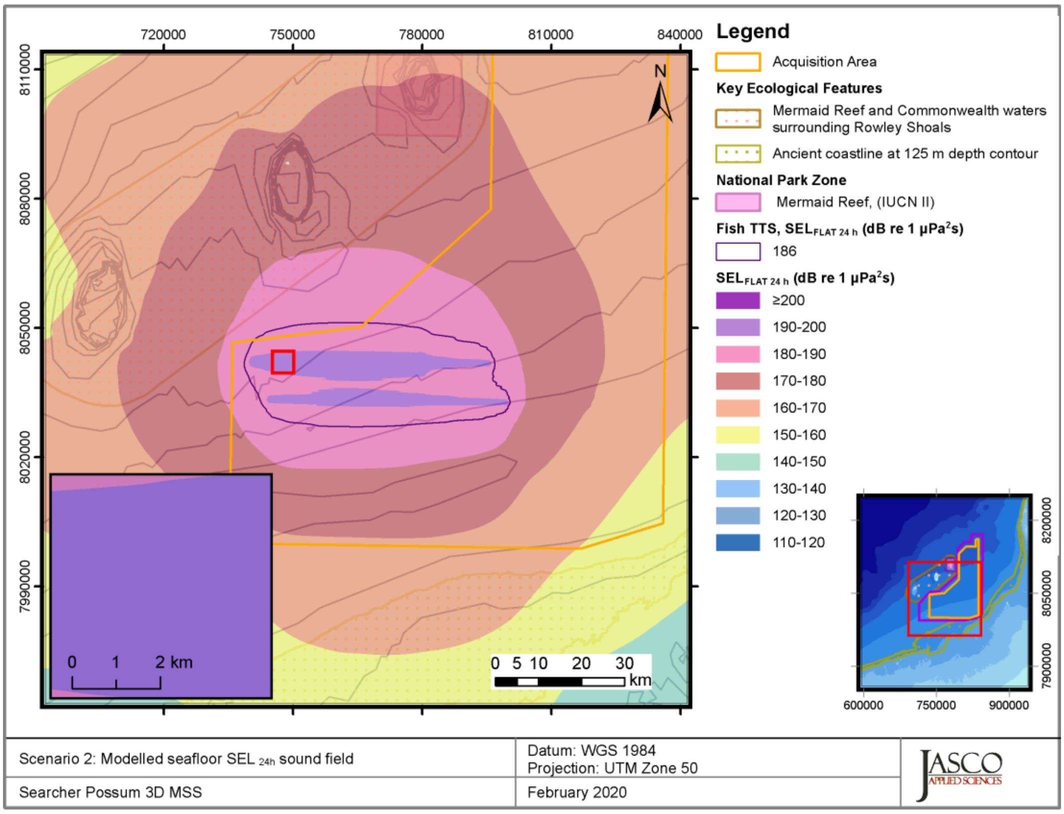

Figure 17. *Scenario 2:* Sound level contour map showing unweighted seafloor SEL_{24h} results, along with the isopleth for fish TTS.

6. Discussion

6.1. Overview and Source Levels

This modelling study predicted underwater sound levels associated with the planned Possum MSS. The underwater sound field was modelled for a 2820 in^3 seismic source (Appendix B), selected as a representative option based on a comparison of a 2380 in^3, 2495 in^3 and a 2820 in^3 seismic source for operation within the survey Acquisition Area.

Most acoustic energy from the seismic source is output at lower frequencies, in the tens to hundreds of hertz. The array had a pronounced broadside directivity for 1/3-octave-bands between approximately 159 to about 251 Hz (Appendix B.2), which caused a noticeable axial bulge in the modelled acoustic footprints.

The overall broadband (10–25000 Hz) unweighted per-pulse SEL source level of the 2820 in^3 seismic source operating at 6 m depth was 224.5 dB 1 μPa^{2}m^{2}s in the broadside direction and 223.0 dB 1 μPa^{2}m^{2}s in the endfire direction. The peak pressure level (PK) in the same directions was 232.5 and 244.8 dB re 1 μPa m, respectively (Table 9).

An analysis of seasonal sound speed profiles, the results of which are presented in Appendix D.3.2, indicated that July was the month most conducive to sound propagation due to the presence of a upward refracting layer near the sea surface; as such it was selected to ensure a conservative estimation of distances to received sound level thresholds over the potential survey periods; modelling also accounted for site-specific bathymetric variations (Appendix D.3.1) and local geoacoustic properties (Appendix D.3.3).

6.2. Per-Pulse Sound Fields

The sound speed profile for July (Figure D-6) was primarily consistent with a deep ocean profile with a sounds channel axis at 1000 m and a slight upward refracting layer, which extended to approximately 80 m from the sea surface. The slight upward refracting layer in the sound speed profile, will only effective trap frequencies above 262 Hz (Jensen et al. 2011). The presence of this layer has the potential to trap levels at higher frequencies which would otherwise dissipate more rapidly in range due to propagation, absorption, and seabed losses.

At all modelling sites, the distances to identified isopleths were greater in the broadside direction than in the endfire direction, this is apparent in all footprint maps in Section 5.2.2. This was primarily due to the directionality of the array. However, the acoustic footprints were significantly influenced by changes in the bathymetry, particularly around the shallow areas and coral atolls of the Rowley Shoals, see Figures 1 or D-5 for a regional bathymetric map. These atolls rise from up from approximately 400 m water depth to just below the sea-surface (or above for Mermaid Reef) and are a significant geographic feature adjacent to the Possum 3–D MSS.

The Possum 3–D MSS is located within the North West Transition Province (NWT) of the North West Marine Region of Australia (Baker et al. 2008) and the water depths ranging from approximately 100 to 400 m with in the survey operational area are consistent with upper slope and shelf break marine environments (Baker et al. 2008). Where the atolls are not present along a propagation path, generally larger lobes of sound energy extend along azimuths where the water depth is near constant or increasing. Furthermore, sources located in deep water have a lower “cut-off frequency (f_c)” than sources in shallower water. The cut-off frequency is a single number that describes how much acoustic energy can propagate with minimal loss between then sea-surface and seafloor interfaces. For a given acoustic signal, frequencies below f_c are subject to higher loss compared to frequencies above the f_c (Jensen et al. 2011). For all modelling sites, the cut-off frequency varied from approximately 7-25 Hz, which allows for more, low-frequency energy to propagate in the water column compared to the same source in shallower water near the continental shelf. For seismic source the majority of the high amplitude energy is concentrated at low frequencies. Furthermore, this low frequency energy can be trapped within the downward refracting portion of the sound speed profile and can propagation for long distances especially in the offshore direction if unobstructed. This effect can be enhanced energy propagates into deep enough water to be trapped in the sound channel.

Where an atoll is present along a propagation path it can block the propagation of acoustic energy. This can be observed in the footprint maps and cross-sections in Section 5.2.2. The steep bathymetric gradient (relative to the water depth) serves to strip propagating sound energy from the water column and enhance transmission into the seabed, resulting in an increase in loss as sound propagates upslope. The rate of loss is primarily dependent, the magnitude of the water depth change, the bathymetric gradient and the geoacoustic properties of the seabed (Jensen et al. 2011). These parameters have been incorporated into the acoustic models to provide a realistic estimate of the levels received with the shallow water near Rowley Shoals (e.g. Mermaid Reef Commonwealth Marine Reserve, Section 5.2, see Figures 6 or 11)

The distances to PK and PK-PK based criteria (Section 3.2 and 3.4) for fish, benthic crustaceans and bivalves at the seafloor did not change consistently with depth as any correlation between water depth and threshold distance is related to complex patterns of surface and seabed reflections that affect sound propagation. Considering the deep-water environment throughout the acquisition area, the number of modelled sites presenting seafloor results provide a good representation for levels received by seabed receptors, as PK and PK-PK thresholds are reached at further distances in shallow water environments.

6.3. Multiple Pulse Sound Fields

The accumulated SEL over 24 hours of seismic operation was modelled considering two representative scenarios with realistic acquisition patterns for the Possum 3-D seismic survey. The modelling predicted the accumulation of sound energy, considering the change in location and the azimuth of the source at each pulse point, which were used to assess possible injury in marine mammals and the SEL_{24h} based fish and marine mammal criteria. The results were presented as maps of the accumulated exposure levels and tabulated values of ranges to threshold levels and exposure areas for the given effects criteria (Section 5.3).

As discussed above in Section 6.2, the footprints and range maxima for all accumulated SEL thresholds depend directionality of the array and the occurrence of the bathymetric features. For survey lines that run parallel to the shelf break energy that is transmitted into the water column in the offshore direction can be trapped in the sound channel and propagate with minimal loss. This effect is manifested in the extended isopleths and R_{max} distances to thresholds in the offshore direction shown Figures 14 and 16. Furthermore, as levels generally decay away from the source the rate of decay decreases with range, propagation effects of this nature can further reduce the decay rate and allow lower levels to persist to longer ranges. However as is the case for the per-pulse modelled sound fields, the occurrence of an atoll can block propagating energy, which results isopleths bending around these features.

6.4. Summary

The study findings pertaining to each metric and criteria for various marine species of interest are summarised below with references to the result location.

Marine mammal injury and behaviour

- The maximum distance where the NMFS (2014) marine mammal behavioural response criterion of 160 dB re 1 µPa (SPL) could be exceeded varied between 6.80 and 8.48 km (Sites 3 and 5), provided in Table 11.
- The results for the criteria applied for marine mammal Permanent Threshold Shift (PTS), NMFS (2018), consider both metrics within the criteria (PK and SEL_{24h}). Table 18 summarises the maximum distances for PTS (as required by the criteria), along with the associated metric and the location of the results within this report.
- The SEL_{24h} is a cumulative metric that reflects the dosimetric impact of noise levels within 24 hours based on the assumption that an animal is consistently exposed to such noise levels at a fixed position. The corresponding SEL_{24h} radii for low-frequency cetaceans were larger than those for peak pressure criteria, but they represent an unlikely worst-case scenario. More

realistically, marine mammals (and fish) would not stay in the same location for 24 hours. Therefore, a reported radius for SEL_{24h} criteria does not mean that marine fauna travelling within this radius of the source will be injured, but rather that an animal could be exposed to the sound level associated with injury or hearing impairment (either PTS or TTS) if it remained in that location for 24 hours.

Table 18. Summary of maximum marine mammal PTS onset distances for modelled scenarios (PK values from Table 12 and SEL_{24h} values from Table 15)

Hearing group	Scenario 1		Scenario 2	
	Metric associated with longest distance to PTS onset	R_{max} (km)	Metric associated with longest distance to PTS onset	R_{max} (km)
Low-frequency cetaceans†	SEL_{24h}	3.52	SEL_{24h}	3.37
Mid-frequency cetaceans	—	—	—	—
High-frequency cetaceans	PK	0.20	PK	0.20

† The model does not account for shutdowns.
A dash indicates the threshold was not reached within the limits of the modelling resolution (20 m).

Turtles

- The maximum distance to PTS onset in turtles (Finneran et al. 2017) of 50 m is based on the SEL_{24h} metric, as was the distance to TTS onset of 0.88 km. As is the case with marine mammals, a reported radius for SEL_{24h} criteria does not mean that turtles travelling within this radius of the source will be injured, but rather that an animal could be exposed to the sound level associated with either PTS or TTS if it remained in that location for 24 hours. For context, the PK metric turtle impairment criteria (PTS and TTS) from Finneran et al. (2017) was not exceeded at a distance greater than 20 m (horizontal modelling resolution for FWRAM) from the acoustic centre of the source.
- The distances to where the NMFS criterion (NSF 2011) for behavioural response in turtles of turtles of 166 dB re 1 µPa (SPL) and the 175 dB re 1 µPa (SPL) threshold for behavioural disturbance (McCauley et al. 2000a, McCauley et al. 2000b) could be exceeded are summarised in Table 19.

Table 19. Summary of distances to turtle behavioural response criteria (from Table 11).

SPL (L_p; dB re 1 µPa)	Distance (km)	
	Minimum	Maximum
175†	1.20	1.46
166‡	3.44	4.25

† Threshold for turtle behavioural disturbance from impulsive noise (McCauley et al. 2000a, McCauley et al. 2000b).
‡ Threshold for turtle behavioural response to impulsive noise (NSF 2011).

Fish, fish eggs, and fish larvae

- This modelling study assessed the ranges for quantitative criteria based on Popper et al. (2014) and considered both PK (seafloor and water column) and SEL_{24h} metrics associated with mortality and potential mortal injury and impairment in the following groups:
  - Fish without a swim bladder (also appropriate for sharks in the absence of other information)
  - Fish with a swim bladder that do not use it for hearing
  - Fish that use their swim bladders for hearing
  - Fish eggs and fish larvae

Table 20 summarises the distances to injury criteria for fish, fish eggs, and fish larvae along with the relevant metric and the location of the information within this report.

Table 20. Summary of maximum fish, fish eggs, and larvae injury and TTS onset distances for single impulse and SEL_{24h} modelled scenarios (PK values from Tables 12 and 13 and SEL_{24h} values from Tables 16 and 17).

Relevant hearing group	Effect criteria	Water column		Seafloor	
		Metric associated with longest distance to criteria	R_{max} (km)	Metric associated with longest distance to criteria	R_{max} (km)
Fish: No swim bladder	Injury	PK and SEL_{24h}	0.06	PK	0.05
	TTS	SEL_{24h}	9.13	SEL_{24h}	9.10
Fish: Swim bladder not involved in hearing and Swim bladder involved in hearing	Injury	PK	0.12	PK	0.14
	TTS	SEL_{24h}	9.13	SEL_{24h}	9.1
Fish eggs, and larvae	Injury	PK	0.12	PK	0.05

Benthic Invertebrates, Sponges, and Coral

To assist with assessing the potential effects on these receptors, the following have been determined:

- Crustaceans: the sound level of 202 dB re 1 µPa PK-PK from Payne et al. (2008) was considered for seafloor sound levels; the sound level was reached at ranges between 560 and 666 m depending on the modelled site (Table 14).
- Sponges and coral: the PK sound level at the seafloor directly underneath the seismic source was estimated at all modelled sites and compared to the sound level of 226 dB re 1 µPa PK for sponges and corals (Heyward et al. 2018); it was not reached at any of the modelled sites (Table 13).

Glossary

1/3-octave
One third of an octave. Note: A one-third octave is approximately equal to one decidecade (1/3 oct ≈ 1.003 ddec; ISO 2017).

1/3-octave-band
Frequency band whose bandwidth is one one-third octave. Note: The bandwidth of a one-third octave-band increases with increasing centre frequency.

90%-energy time window
The time interval over which the cumulative energy rises from 5 to 95% of the total pulse energy. This interval contains 90% of the total pulse energy. Symbol: T_{90}.

azimuth
A horizontal angle relative to a reference direction, which is often magnetic north or the direction of travel. In navigation it is also called bearing.

broadband sound level
The total sound pressure level measured over a specified frequency range. If the frequency range is unspecified, it refers to the entire measured frequency range.

broadside direction
Perpendicular to the travel direction of a source. Compare with endfire direction.

cavitation
A rapid formation and collapse of vapor cavities (i.e., bubbles or voids) in water, most often caused by a rapid change in pressure. Fast-spinning vessel propellers typically cause cavitation, which creates a lot of noise.

cetacean
Any animal in the order Cetacea. These are aquatic, mostly marine mammals and include whales, dolphins, and porpoises.

compressional wave
A mechanical vibration wave in which the direction of particle motion is parallel to the direction of propagation. Also called primary wave or P-wave.

decibel (dB)
One-tenth of a bel. Unit of level when the base of the logarithm is the tenth root of ten, and the quantities concerned are proportional to power (ANSI S1.1-1994 R2004).

endfire direction
Parallel to the travel direction of a source. See also broadside direction.

ensonified
Exposed to sound.

far-field
The zone where, to an observer, sound originating from an array of sources (or a spatially distributed source) appears to radiate from a single point. The distance to the acoustic far-field increases with frequency.

frequency
The rate of oscillation of a periodic function measured in cycles-per-unit-time. The reciprocal of the period. Unit: hertz (Hz). Symbol: *f*. 1 Hz is equal to 1 cycle per second.

hearing group
Groups of marine mammal species with similar hearing ranges. Commonly defined functional hearing groups include low-, mid-, and high-frequency cetaceans, pinnipeds in water, and pinnipeds in air.

geoacoustic
Relating to the acoustic properties of the seabed.

hertz (Hz)
A unit of frequency defined as one cycle per second.

high-frequency (HF) cetacean
The functional cetacean hearing group that represents those odontocetes (toothed whales) specialized for hearing high frequencies.

impulsive sound
Sound that is typically brief and intermittent with rapid (within a few seconds) rise time and decay back to ambient levels (NOAA 2013, ANSI S12.7-1986 R2006). For example, seismic airguns and impact pile driving.

low-frequency (LF) cetacean
The functional cetacean hearing group that represents mysticetes (baleen whales) specialized for hearing low frequencies.

mean-square sound pressure spectral density
Distribution as a function of frequency of the mean-square sound pressure per unit bandwidth (usually 1 Hz) of a sound having a continuous spectrum (ANSI S1.1-1994 R2004). Unit: $\mu Pa^2/Hz$.

mid-frequency (MF) cetacean
The functional cetacean hearing group that represents those odontocetes (toothed whales) specialized for mid-frequency hearing.

octave
The interval between a sound and another sound with double or half the frequency. For example, one octave above 200 Hz is 400 Hz, and one octave below 200 Hz is 100 Hz.

parabolic equation method
A computationally efficient solution to the acoustic wave equation that is used to model transmission loss. The parabolic equation approximation omits effects of back-scattered sound, simplifying the computation of transmission loss. The effect of back-scattered sound is negligible for most ocean-acoustic propagation problems.

peak pressure level (PK)
The maximum instantaneous sound pressure level, in a stated frequency band, within a stated period. Also called zero-to-peak pressure level. Unit: decibel (dB).

peak-to-peak pressure level (PK-PK)
The difference between the maximum and minimum instantaneous pressure levels. Unit: decibel (dB).

permanent threshold shift (PTS)
A permanent loss of hearing sensitivity caused by excessive noise exposure. PTS is considered auditory injury.

point source
A source that radiates sound as if from a single point (ANSI S1.1-1994 R2004).

pressure, acoustic
The deviation from the ambient hydrostatic pressure caused by a sound wave. Also called overpressure. Unit: pascal (Pa). Symbol: p.

received level (RL)
The sound level measured (or that would be measured) at a defined location.

rms
root-mean-square.

signature
Pressure signal generated by a source.

sound
A time-varying pressure disturbance generated by mechanical vibration waves travelling through a fluid medium such as air or water.

sound exposure
Time integral of squared, instantaneous frequency-weighted sound pressure over a stated time interval or event. Unit: pascal-squared second ($Pa^2 \cdot s$) (ANSI S1.1-1994 R2004).

sound exposure level (SEL)
A cumulative measure related to the sound energy in one or more pulses. Unit: dB re 1 $\mu Pa^2 \cdot s$. SEL is expressed over the summation period (e.g., per-pulse SEL [for airguns], single-strike SEL [for pile drivers], 24-hour SEL).

sound exposure spectral density
Distribution as a function of frequency of the time-integrated squared sound pressure per unit bandwidth of a sound having a continuous spectrum (ANSI S1.1-1994 R2004). Unit: $\mu Pa^2 \cdot s/Hz$.

sound field
Region containing sound waves (ANSI S1.1-1994 R2004).

sound intensity
Sound energy flowing through a unit area perpendicular to the direction of propagation per unit time.

sound speed profile
The speed of sound in the water column as a function of depth below the water surface.

source level (SL)
The sound level measured in the far-field and scaled back to a standard reference distance of 1 metre from the acoustic centre of the source. Unit: dB re 1 µPa m (pressure level) or dB re 1 $\mu Pa^2 \cdot s \cdot m^2$ (exposure level).

spectral density level
The decibel level ($10 \cdot \log_{10}$) of the spectral density of a given parameter such as SPL or SEL, for which the units are dB re 1 $\mu Pa^2/Hz$ and dB re 1 $\mu Pa^2 \cdot s/Hz$, respectively.

spectrum
An acoustic signal represented in terms of its power, energy, mean-square sound pressure, or sound exposure distribution with frequency.

surface duct
The upper portion of a water column within which the sound speed profile gradient causes sound to refract upward and therefore reflect off the surface resulting in relatively long-range sound propagation with little loss.

temporary threshold shift (TTS)
Temporary loss of hearing sensitivity caused by excessive noise exposure.

thermocline
The depth interval near the ocean surface that experiences temperature gradients due to warming or cooling by heat conduction from the atmosphere and by warming from solar heating.

transmission loss (TL)
The decibel reduction in sound level between two stated points that results from sound spreading away from an acoustic source subject to the influence of the surrounding environment. Also referred to as propagation loss.

wavelength
Distance over which a wave completes one cycle of oscillation. Unit: metre (m). Symbol: λ.

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Appendix A. Acoustic Metrics

A.1. Pressure Related Acoustic Metrics

Underwater sound pressure amplitude is measured in decibels (dB) relative to a fixed reference pressure of p_0 = 1 μPa. Because the perceived loudness of sound, especially pulsed sound such as from seismic airguns, pile driving, and sonar, is not generally proportional to the instantaneous acoustic pressure, several sound level metrics are commonly used to evaluate sound and its effects on marine life. Here we provide specific definitions of relevant metrics used in the accompanying report. Where possible, we follow the American National Standard Institute and International Organization for Standardization definitions and symbols for sound metrics (e.g., ISO 2017, ANSI R2013), but these standards are not always consistent.

The zero-to-peak sound pressure, or peak sound pressure (PK or $L_{p,\mathrm{pk}}$; dB re 1 µPa), is the decibel level of the maximum instantaneous acoustic pressure in a stated frequency band attained by an acoustic pressure signal, $p(t)$:

$$L_{p,\mathrm{pk}} = 10\log_{10}\frac{\max|p^2(t)|}{p_0^2} = 20\log_{10}\frac{\max|p(t)|}{p_0} \tag{A-1}$$

PK is often included as a criterion for assessing whether a sound is potentially injurious; however, because it does not account for the duration of an acoustic event, it is generally a poor indicator of perceived loudness.

The peak-to-peak sound pressure (PK-PK or $L_{p,\mathrm{pk\text{-}pk}}$; dB re 1 µPa) is the difference between the maximum and minimum instantaneous sound pressure, possibly filtered in a stated frequency band, attained by an impulsive sound, $p(t)$:

$$L_{p,\mathrm{pk\text{-}pk}} = 10\log_{10}\frac{[\max(p(t)) - \min(p(t))]^2}{p_0^2} \tag{A-2}$$

The sound pressure level (SPL or L_p; dB re 1 µPa) is the root-mean-square (rms) pressure level in a stated frequency band over a specified time window (T; s). It is important to note that SPL always refers to an rms pressure level and therefore not instantaneous pressure:

$$L_p = 10\log_{10}\left(\frac{1}{T}\int_T g(t)\,p^2(t)\,dt \Big/ p_0^2\right) \tag{A-3}$$

where $g(t)$ is an optional time weighting function. In many cases, the start time of the integration is marched forward in small time steps to produce a time-varying SPL function. For short acoustic events, such as sonar pulses and marine mammal vocalizations, it is important to choose an appropriate time window that matches the duration of the signal. For in-air studies, when evaluating the perceived loudness of sounds with rapid amplitude variations in time, the time weighting function $g(t)$ is often set to a decaying exponential function that emphasizes more recent pressure signals. This function mimics the leaky integration nature of mammalian hearing. For example, human-based fast time-weighted SPL ($L_{p,\mathrm{fast}}$) applies an exponential function with time constant 125 ms. A related simpler approach used in underwater acoustics sets $g(t)$ to a boxcar (unity amplitude) function of width 125 ms; the results can be referred to as $L_{p,\mathrm{boxcar\ 125ms}}$. Another approach, historically used to evaluate SPL of impulsive signals underwater, defines $g(t)$ as a boxcar function with edges set to the times corresponding to 5% and 95% of the cumulative square pressure function encompassing the duration of an impulsive acoustic event. This calculation is applied individually to each impulse signal, and the results have been referred to as 90% SPL ($L_{p,90\%}$).

The sound exposure level (SEL or L_E; dB re 1 µPa²·s) is the time-integral of the squared acoustic pressure over a duration (T):

$$L_E = 10\log_{10}\left(\int_T p^2(t)\,dt \Big/ T_0 p_0^2\right) \tag{A-4}$$

where T_0 is a reference time interval of 1 s. SEL continues to increase with time when non-zero pressure signals are present. It is a dose-type measurement, so the integration time applied must be carefully considered for its relevance to impact to the exposed recipients.

SEL can be calculated over a fixed duration, such as the time of a single event or a period with multiple acoustic events. When applied to pulsed sounds, SEL can be calculated by summing the SEL of the N individual pulses. For a fixed duration, the square pressure is integrated over the duration of interest. For multiple events, the SEL can be computed by summing (in linear units) the SEL of the N individual events:

$$L_{E,N} = 10\log_{10}\sum_{i=1}^{N} 10^{\frac{L_{E,i}}{10}} \tag{A-5}$$

Because the SPL(T_{90}) and SEL are both computed from the integral of square pressure, these metrics are related numerically by the following expression, which depends only on the duration of the time window T:

$$L_p = L_E - 10\log_{10}(T) \tag{A-6}$$

$$L_{p90} = L_\mathrm{E} - 10\log_{10}(T_{90}) - 0.458 \tag{A-7}$$

where the 0.458 dB factor accounts for the 10% of pulse SEL missing from the SPL(T_{90}) integration time window.

Energy equivalent SPL (L_eq; dB re 1 µPa) denotes the SPL of a stationary (constant amplitude) sound that generates the same SEL as the signal being examined, $p(t)$, over the same time period, T:

$$L_\mathrm{eq} = 10\log_{10}\left(\frac{1}{T}\int_T p^2(t)\,dt \Big/ p_0^2\right) \tag{A-8}$$

The equations for SPL and the energy-equivalent SPL are numerically identical. Conceptually, the difference between the two metrics is that the SPL is typically computed over short periods (typically of one second or less) and tracks the fluctuations of a non-steady acoustic signal, whereas the L_eq reflects the average SPL of an acoustic signal over time periods typically of one minute to several hours.

If applied, the frequency weighting of an acoustic event should be specified, as in the case of weighted SEL (e.g., $L_{E,\mathrm{LF,24h}}$; see Appendix A.3) or auditory-weighted SPL ($L_{p,\mathrm{ht}}$). The use of fast, slow, or impulse exponential-time-averaging or other time-related characteristics should also be specified.

In the present report, audiogram-weighted, fast-averaged SPL ($L_{p,\mathrm{ht,F}}$) is defined by the exponential function from Plomp and Bouman (1959):In the present report, audiogram-weighted, fast-averaged SPL ($L_{p,\mathrm{ht,F}}$) is defined by the exponential function from Plomp and Bouman (1959):

$$L_{p,\mathrm{ht}} = L_{E,\mathrm{ht,per\text{-}pulse}} - 10\log_{10}(d/0.9)\,,$$
$$L_{p,\mathrm{ht,F}} = L_{p,\mathrm{ht}} + 10\log_{10}\frac{1-e^{-d/\tau}}{1-e^{-T/\tau}} \tag{A-9}$$

where d is the duration in seconds, τ is the time constant of 0.125 s representing marine mammal auditory integration time, $L_{p,\mathrm{ht}}$ is the audiogram-weighted SPL over pulse duration, and T is the pulse repetition period. This metric accounts for the hearing sensitivity of specific species through frequency weighting, and results in reduced perceived loudness (i.e., sensation level) for pulses shorter than auditory integration time (τ).

A.2. Marine Mammal Impact Criteria

It has been long recognised that marine mammals can be adversely affected by underwater anthropogenic noise. For example, Payne and Webb (1971) suggested that communication distances of fin whales are reduced by shipping sounds. Subsequently, similar concerns arose regarding effects of other underwater noise sources and the possibility that impulsive sources—primarily airguns used in seismic surveys—could cause auditory injury. This led to a series of workshops held in the late 1990s, conducted to address acoustic mitigation requirements for seismic surveys and other underwater noise sources (NMFS 1998, ONR 1998, Nedwell and Turnpenny 1998, HESS 1999, Ellison and Stein 1999). In the years since these early workshops, a variety of thresholds have been proposed for both injury and disturbance. The following sections summarize the recent development of thresholds; however, this field remains an active research topic.

A.2.1. Injury

In recognition of shortcomings of the SPL-only based injury criteria, in 2005 NMFS sponsored the Noise Criteria Group to review literature on marine mammal hearing to propose new noise exposure criteria. Some members of this expert group published a landmark paper (Southall et al. 2007) that suggested assessment methods similar to those applied for humans. The resulting recommendations introduced dual acoustic injury criteria for impulsive sounds that included peak pressure level thresholds and SEL_{24h} thresholds, where the subscripted 24h refers to the accumulation period for calculating SEL. The peak pressure level criterion is not frequency weighted whereas the SEL_{24h} is frequency weighted according to one of four marine mammal species hearing groups: low-, mid- and high-frequency cetaceans (LF, MF, and HF cetaceans, respectively) and Pinnipeds in Water (PINN). These weighting functions are referred to as M-weighting filters (analogous to the A-weighting filter for human; Appendix A.3). The SEL_{24h} thresholds were obtained by extrapolating measurements of onset levels of Temporary Threshold Shift (TTS) in belugas by the amount of TTS required to produce Permanent Threshold Shift (PTS) in chinchillas. The Southall et al. (2007) recommendations do not specify an exchange rate, which suggests that the thresholds are the same regardless of the duration of exposure (i.e., it implies a 3 dB exchange rate).

Wood et al. (2012) refined Southall et al.'s (2007) thresholds, suggesting lower injury values for LF and HF cetaceans while retaining the filter shapes. Their revised thresholds were based on TTS-onset levels in harbour porpoises from Lucke et al. (2009), which led to a revised impulsive sound PTS threshold for HF cetaceans of 179 dB re 1 $\mu Pa^2 \cdot s$. Because there were no data available for baleen whales, Wood et al. (2012) based their recommendations for LF cetaceans on results obtained from MF cetacean studies. In particular they referenced Finneran and Schlundt (2010) research, which found mid-frequency cetaceans are more sensitive to non-impulsive sound exposure than Southall et al. (2007) assumed. Wood et al. (2012) thus recommended a more conservative TTS-onset level for LF cetaceans of 192 dB re 1 $\mu Pa^2 \cdot s$.

As of 2017, an optimal approach is not apparent. There is consensus in the research community that an SEL-based method is preferable either separately or in addition to an SPL-based approach to assess the potential for injuries. In August 2016, after substantial public and expert input into three draft versions and based largely on the above-mentioned literature (NOAA 2013, 2015, 2016), NMFS finalised technical guidance for assessing the effect of anthropogenic sound on marine mammal hearing (NMFS 2016). The guidance describes injury criteria with new thresholds and frequency weighting functions for the five hearing groups described by Finneran and Jenkins (2012). The latest revision to this work was published in 2018; with the criteria defined in NMFS (2018) applied in this report.

A.3. Marine Mammal Frequency Weighting

The potential for noise to affect animals depends on how well the animals can hear it. Noises are less likely to disturb or injure an animal if they are at frequencies that the animal cannot hear well. An exception occurs when the sound pressure is so high that it can physically injure an animal by non-auditory means (i.e., barotrauma). For sound levels below such extremes, the importance of sound components at particular frequencies can be scaled by frequency weighting relevant to an animal's sensitivity to those frequencies (Nedwell and Turnpenny 1998, Nedwell et al. 2007).

A.3.1. Marine mammal frequency weighting functions

In 2015, a U.S. Navy technical report by Finneran (2015) recommended new auditory weighting functions. The overall shape of the auditory weighting functions is similar to human A-weighting functions, which follows the sensitivity of the human ear at low sound levels. The new frequency-weighting function is expressed as:

$$G(f) = K + 10\log_{10}\left[\left(\frac{(f/f_{lo})^{2a}}{\left[1+(f/f_{lo})^2\right]^a\left[1+(f/f_{hi})^2\right]^b}\right)\right] \tag{A-10}$$

Finneran (2015) proposed five functional hearing groups for marine mammals in water: low-, mid-, and high-frequency cetaceans, phocid pinnipeds, and otariid pinnipeds. The parameters for these frequency-weighting functions were further modified the following year (Finneran 2016) and were adopted in NOAA's technical guidance that assesses noise impacts on marine mammals (NMFS 2016, NMFS 2018). Table A-1 lists the frequency-weighting parameters for each hearing group; Figure A-1 shows the resulting frequency-weighting curves.

Table A-1. Parameters for the auditory weighting functions used in this project as recommended by NMFS (2018).

Hearing group	a	b	f_{lo} (Hz)	f_{hi} (kHz)	K (dB)
Low-frequency cetaceans (baleen whales)	1.0	2	200	19,000	0.13
Mid-frequency cetaceans (dolphins, plus toothed, beaked, and bottlenose whales)	1.6	2	8,800	110,000	1.20
High-frequency cetaceans (true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* and *L. australis*)	1.8	2	12,000	140,000	1.36

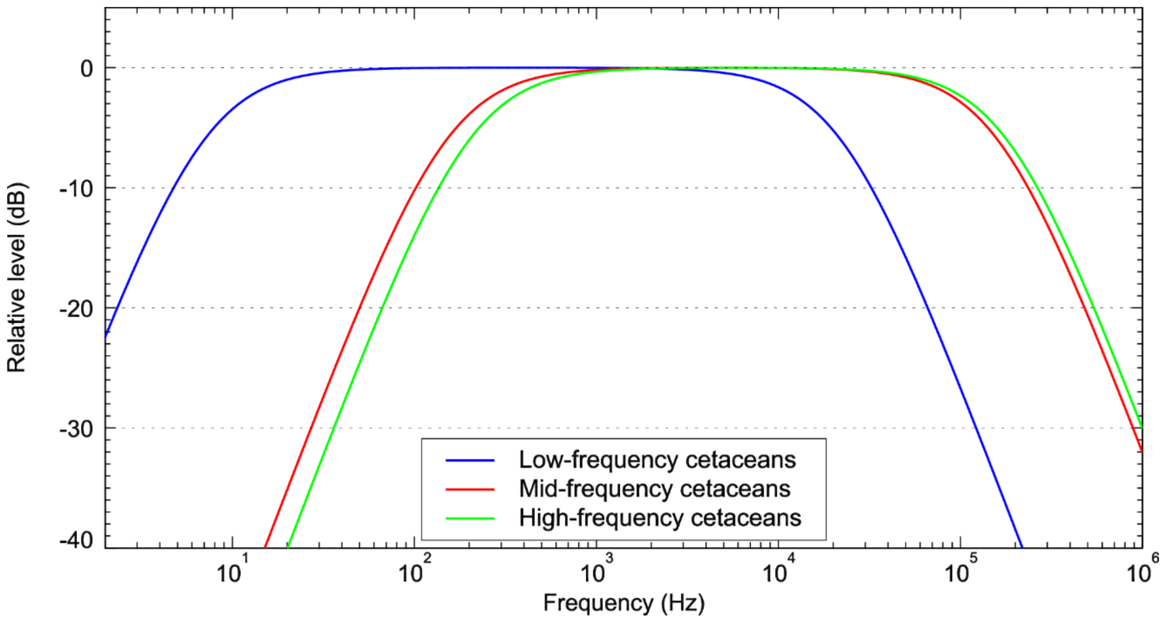

Figure A-1. Auditory weighting functions for functional marine mammal hearing groups used in this project as recommended by NMFS (2018).

Appendix B. Acoustic Source Model

B.1. Airgun Array Source Model

The source levels and directivity of the seismic source were predicted with JASCO's Airgun Array Source Model (AASM). AASM includes low- and high-frequency modules for predicting different components of the seismic source spectrum. The low-frequency module is based on the physics of oscillation and radiation of airgun bubbles, as originally described by Ziolkowski (1970), that solves the set of parallel differential equations that govern bubble oscillations. Physical effects accounted for in the simulation include pressure interactions between airguns, port throttling, bubble damping, and generator-injector (GI) gun behaviour discussed by Dragoset (1984), Laws et al. (1990), and Landro (1992). A global optimisation algorithm tunes free parameters in the model to a large library of airgun source signatures.

While airgun signatures are highly repeatable at the low frequencies, which are used for seismic imaging, their sound emissions have a large random component at higher frequencies that cannot be predicted using a deterministic model. Therefore, AASM uses a stochastic simulation to predict the high-frequency (800−25,000 Hz) sound emissions of individual airguns, using a data-driven multiple-regression model. The multiple-regression model is based on a statistical analysis of a large collection of high quality seismic source signature data recently obtained from the Joint Industry Program (JIP) on Sound and Marine Life (Mattsson and Jenkerson 2008). The stochastic model uses a Monte-Carlo simulation to simulate the random component of the high-frequency spectrum of each airgun in an array. The mean high-frequency spectra from the stochastic model augment the low-frequency signatures from the physical model, allowing AASM to predict airgun source levels at frequencies up to 25,000 Hz.

AASM produces a set of "notional" signatures for each array element based on:

- Array layout
- Volume, tow depth, and firing pressure of each airgun
- Interactions between different airguns in the array

These notional signatures are the pressure waveforms of the individual airguns at a standard reference distance of 1 m; they account for the interactions with the other airguns in the array. The signatures are summed with the appropriate phase delays to obtain the far-field source signature of the entire array in all directions. This far-field array signature is filtered into 1/3-octave-bands to compute the source levels of the array as a function of frequency band and azimuthal angle in the horizontal plane (at the source depth), after which it is considered a directional point source in the far field.

A seismic array consists of many sources and the point source assumption is invalid in the near field where the array elements add incoherently. The maximum extent of the near field of an array (R_{nf}) is:

$$R_{\mathrm{nf}} < \frac{l^2}{4\lambda} \tag{B-1}$$

where λ is the sound wavelength and l is the longest dimension of the array (Lurton 2002, §5.2.4). For example, a seismic source length of l = 21 m yields a near-field range of 147 m at 2 kHz and 7 m at 100 Hz. Beyond this R_{nf} range, the array is assumed to radiate like a directional point source and is treated as such for propagation modelling.

The interactions between individual elements of the array create directionality in the overall acoustic emission. Generally, this directionality is prominent mainly at frequencies in the mid-range between tens of hertz to several hundred hertz. At lower frequencies, with acoustic wavelengths much larger than the inter-airgun separation distances, the directionality is small. At higher frequencies, the pattern of lobes is too finely spaced to be resolved and the effective directivity is less.

B.2. Array Source Levels and Directivity

Figure B-1 shows the broadside (perpendicular to the tow direction), endfire (parallel to the tow direction), and vertical overpressure signature and corresponding power spectrum levels for the 2820 in^3 array (Appendix D.4).

Horizontal 1/3-octave-band source levels are shown as a function of band centre frequency and azimuth (Figure B-2).

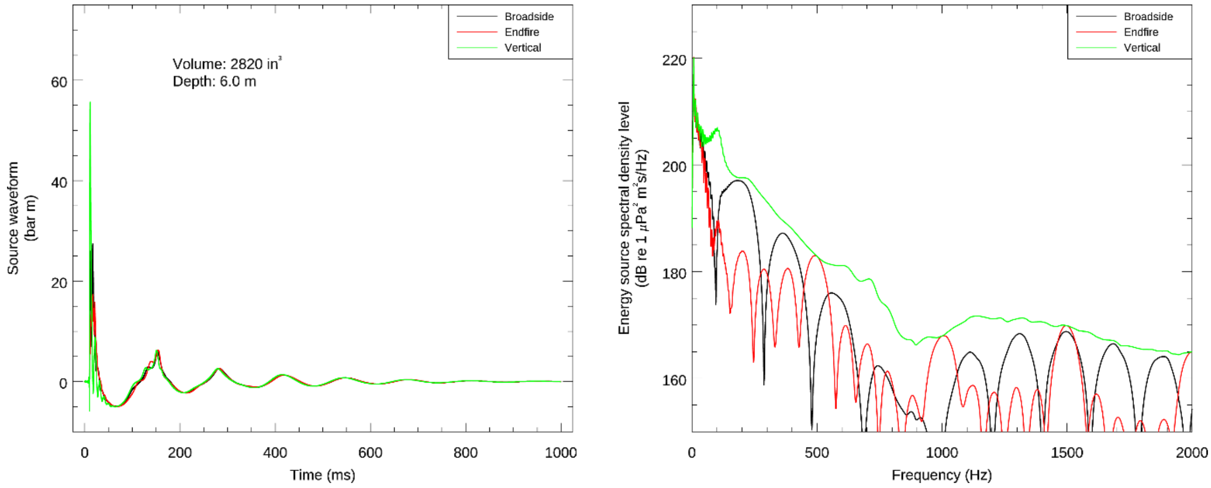

Figure B-1. Predicted source level details for the 2820 in^3 array at 6 m towed depth.(Left) the overpressure signature and (right) the power spectrum for in-plane horizontal (broadside), perpendicular (endfire), and vertical directions.

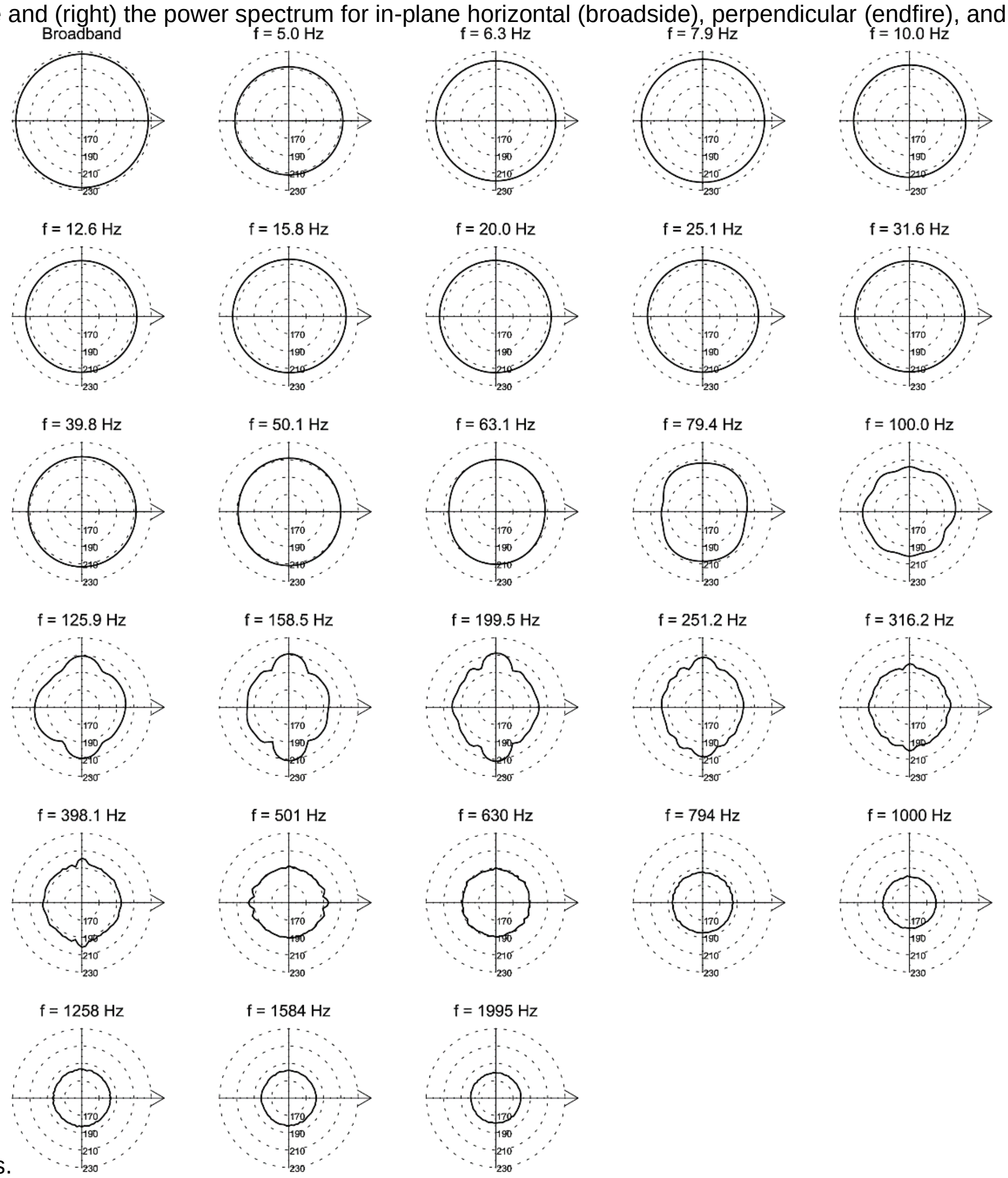

Figure B-2. Directionality of the predicted horizontal source levels for the 2820 in^3 seismic source, 5 Hz to 2 kHz. Source levels (in dB re 1 $\mu Pa^2 \cdot s\ m^2$) are shown as a function of azimuth for the centre frequencies of the 1/3-octave-bands modelled; frequencies are shown above the plots. The perpendicular direction to the frame is to the right. Tow depth is 6 m (see Figure B-1).

Appendix C. Sound Propagation Models

C.1. MONM-BELLHOP

Long-range sound fields were computed using JASCO's Marine Operations Noise Model (MONM). Compared to VSTACK, MONM less accurately predicts steep-angle propagation for environments with higher shear speed but is well suited for effective longer-range estimation. This model computes sound propagation at frequencies of 10 Hz to 1.25 kHz via a wide-angle parabolic equation solution to the acoustic wave equation (Collins 1993) based on a version of the U.S. Naval Research Laboratory's Range-dependent Acoustic Model (RAM), which has been modified to account for a solid seabed (Zhang and Tindle 1995). MONM computes sound propagation at frequencies > 1.25 kHz via the BELLHOP Gaussian beam acoustic ray-trace model (Porter and Liu 1994).

The parabolic equation method has been extensively benchmarked and is widely employed in the underwater acoustics community (Collins et al. 1996). MONM accounts for the additional reflection loss at the seabed, which results from partial conversion of incident compressional waves to shear waves at the seabed and sub-bottom interfaces, and it includes wave attenuations in all layers. MONM incorporates the following site-specific environmental properties: a bathymetric grid of the modelled area, underwater sound speed as a function of depth, and a geoacoustic profile based on the overall stratified composition of the seafloor.

This version of MONM accounts for sound attenuation due to energy absorption through ion relaxation and viscosity of water in addition to acoustic attenuation due to reflection at the medium boundaries and internal layers (Fisher and Simmons 1977). The former type of sound attenuation is significant for frequencies higher than 5 kHz and cannot be neglected without noticeably affecting the model results.

MONM computes acoustic fields in three dimensions by modelling transmission loss within two-dimensional (2-D) vertical planes aligned along radials covering a 360° swath from the source, an approach commonly referred to as N×2-D. These vertical radial planes are separated by an angular step size of $\Delta\theta$, yielding N = 360°/$\Delta\theta$ number of planes (Figure C-1).

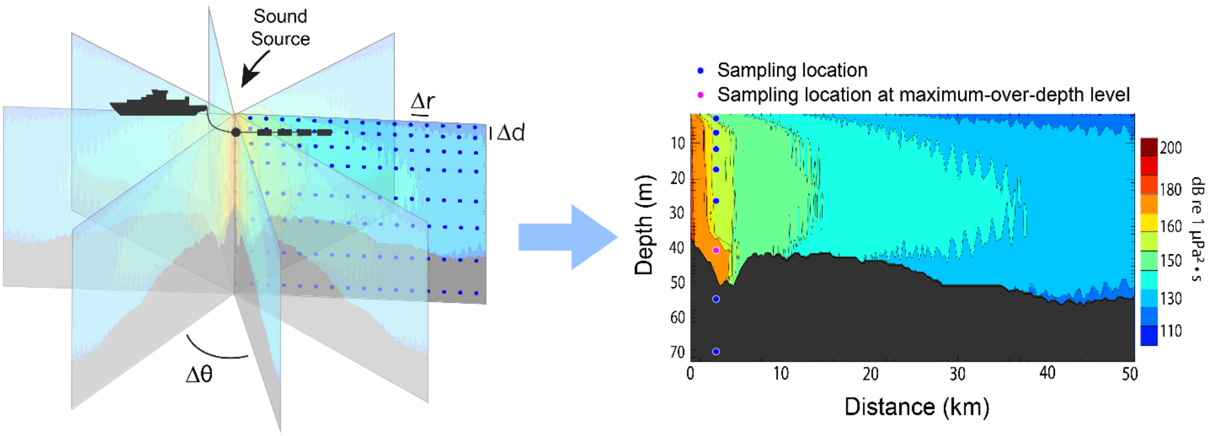

Figure C-1. The N×2-D and maximum-over-depth modelling approach used by MONM.

MONM treats frequency dependence by computing acoustic transmission loss at the centre frequencies of 1/3-octave-bands. Sufficiently many 1/3-octave-bands, starting at 10 Hz, are modelled to include most of the acoustic energy emitted by the source. At each centre frequency, the transmission loss is modelled within each of the N vertical planes as a function of depth and range from the source. The 1/3-octave-band received per-pulse SEL are computed by subtracting the band transmission loss values from the directional source level in that frequency band. Composite broadband received per-pulse SEL are then computed by summing the received 1/3-octave-band levels.

The received per-pulse SEL sound field within each vertical radial plane is sampled at various ranges from the source, generally with a fixed radial step size. At each sampling range along the surface, the sound field is sampled at various depths, with the step size between samples increasing with depth below the surface. The step sizes are chosen to provide increased coverage near the depth of the source and at depths of interest in terms of the sound speed profile. For areas with deep water, sampling is not performed at depths beyond those reachable by marine mammals. The received per-pulse SEL at a surface sampling location is taken as the maximum value that occurs over all samples within the water column, i.e., the maximum-over-depth received per-pulse SEL. These maximum-over-depth per-pulse SEL are presented as colour contours around the source.

An inherent variability in measured sound levels is caused by temporal variability in the environment and the variability in the signature of repeated acoustic impulses (sample sound source verification results is presented in Figure C-2). While MONM's predictions correspond to the averaged received levels, cautionary estimates of the threshold radii are obtained by shifting the best fit line (solid line, Figure C-2) upward so that the trend line encompasses 90% of all the data (dashed line, Figure C-2).

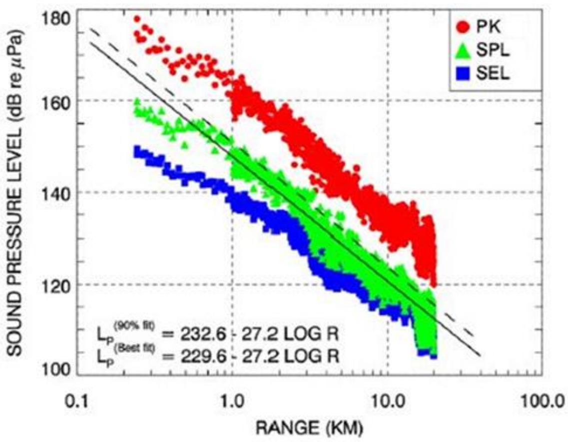

Figure C-2. PK and SPL and per-pulse SEL versus range from a 20 in^3 seismic source. Solid line is the least squares best fit to SPL. Dashed line is the best fit line increased by 3.0 dB to exceed 90% of all SPL values (90th percentile fit) (Ireland et al. 2009, Figure 10).

C.2. Full Waveform Range-dependent Acoustic Model: FWRAM

For impulsive sounds from the seismic source, time-domain representations of the pressure waves generated in the water are required to calculate SPL and PK. Furthermore, the seismic source must be represented as a distributed source to accurately characterise vertical directivity effects in the near-field zone. For this study, synthetic pressure waveforms were computed using FWRAM, which is a time-domain acoustic model based on the same wide-angle parabolic equation (PE) algorithm as MONM. FWRAM computes synthetic pressure waveforms versus range and depth for range-varying marine acoustic environments, and it takes the same environmental inputs as MONM (bathymetry, water sound speed profile, and seafloor geoacoustic profile). Unlike MONM, FWRAM computes pressure waveforms via Fourier synthesis of the modelled acoustic transfer function in closely spaced frequency bands. FWRAM employs the array starter method to accurately model sound propagation from a spatially distributed source (MacGillivray and Chapman 2012).

Besides providing direct calculations of the PK and SPL, the synthetic waveforms from FWRAM can also be used to convert the SEL values from MONM to SPL.

C.3. Wavenumber Integration Model

Sound pressure levels near the seismic source were modelled using JASCO's VSTACK wavenumber integration model. VSTACK computes synthetic pressure waveforms versus depth and range for arbitrarily layered, range-independent acoustic environments using the wavenumber integration approach to solve the exact (range-independent) acoustic wave equation. This model is valid over the full angular range of the wave equation and can fully account for the elasto-acoustic properties of the sub-bottom. Wavenumber integration methods are extensively used in the field of underwater acoustics and seismology where they are often referred to as reflectivity methods or discrete wavenumber methods. VSTACK computes sound propagation in arbitrarily stratified water and seabed layers by decomposing the outgoing field into a continuum of outward-propagating plane cylindrical waves. Seabed reflectivity in the model is dependent on the seabed layer properties: compressional and shear wave speeds, attenuation coefficients, and layer densities. The output of the model can be post-processed to yield estimates of the SEL, SPL, and PK.

VSTACK accurately predicts steep-angle propagation in the proximity of the source, but it is computationally slow at predicting sound pressures at large distances due to the need for smaller wavenumber steps with increasing distance. Additionally, VSTACK assumes range-invariant bathymetry with a horizontally stratified medium (i.e., a range-independent environment) which is azimuthally symmetric about the source. VSTACK is thus best suited to modelling the sound field near the source.

Appendix D. Methods and Parameters

This section describes the specifications of the seismic source that was used at all sites and the environmental parameters used in the propagation models.

D.1. Estimating Range to Thresholds Levels

Sound level contours were calculated based on the underwater sound fields predicted by the propagation models, sampled by taking the maximum value over all modelled depths above the sea floor for each location in the modelled region. The predicted distances to specific levels were computed from these contours. Two distances relative to the source are reported for each sound level: 1) R_{max}, the maximum range to the given sound level over all azimuths, and 2) $R_{95\%}$, the range to the given sound level after the 5% farthest points were excluded (see examples in Figure D-1).

The $R_{95\%}$ is used because sound field footprints are often irregular in shape. In some cases, a sound level contour might have small protrusions or anomalous isolated fringes. This is demonstrated in the image in Figure D-1(a). In cases such as this, where relatively few points are excluded in any given direction, R_{max} can misrepresent the area of the region exposed to such effects, and $R_{95\%}$ is considered more representative. In strongly asymmetric cases such as shown in Figure D-1(b), on the other hand, $R_{95\%}$ neglects to account for significant protrusions in the footprint. In such cases R_{max} might better represent the region of effect in specific directions. Cases such as this are usually associated with bathymetric features affecting propagation. The difference between R_{max} and $R_{95\%}$ depends on the source directivity and the non-uniformity of the acoustic environment.

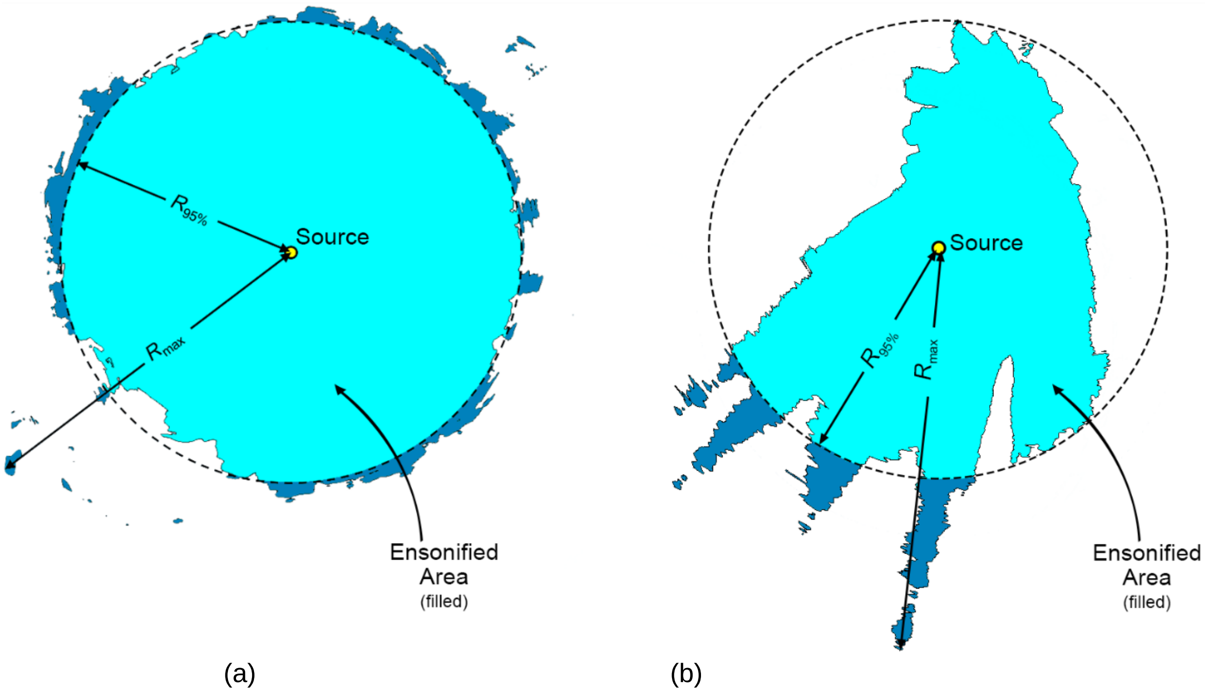

Figure D-1. Sample areas ensonified to an arbitrary sound level with R_{max} and $R_{95\%}$ ranges shown for two different scenarios. (a) Largely symmetric sound level contour with small protrusions. (b) Strongly asymmetric sound level contour with long protrusions. Light blue indicates the ensonified areas bounded by $R_{95\%}$; darker blue indicates the areas outside this boundary which determine R_{max}.

D.2. Estimating SPL from Modelled SEL Results

The per-pulse SEL of sound pulses is an energy-like metric related to the dose of sound received over a pulse's entire duration. The pulse SPL on the other hand, is related to its intensity over a specified time interval. Seismic pulses typically lengthen in duration as they propagate away from their source, due to seafloor and surface reflections, and other waveguide dispersion effects. The changes in pulse length, and therefore the time window considered, affect the numeric relationship between SPL and SEL. This study has applied a fixed window duration to calculate SPL (T_{fix} = 125 ms; see Appendix A.1), as implemented in Martin et al. (2017b). Full-waveform modelling was used to estimate SPL, but this type of modelling is computationally intensive, and can be prohibitively time consuming when run at high spatial resolution over large areas.

For the current study, FWRAM (Appendix C.2) was used to model synthetic seismic pulses over the frequency range 5–1024 Hz. This was performed along all broadside and endfire radials at three sites. FWRAM uses Fourier synthesis to recreate the signal in the time domain so that both the SEL and SPL from the source can be calculated. The differences between the SEL and SPL were extracted for all ranges and depths that corresponded to those generated from the high spatial-resolution results from MONM. A 125 ms fixed time window positioned to maximize the SPL over the pulse duration was applied. The resulting SEL -to-SPL offsets were averaged in 0.02 km range bins along each modelled radial and depth, and the 90th percentile was selected at each range to generate a generalised range-dependent conversion function for each site. The range- dependent conversion function was averaged between the two sites and applied to predicted per-pulse SEL results from MONM to model SPL values. Figures D-2–D-4 show the conversion offsets for Sites 1,2 and 5; the spatial variation is caused by changes in the received airgun pulse as it propagates from the source.

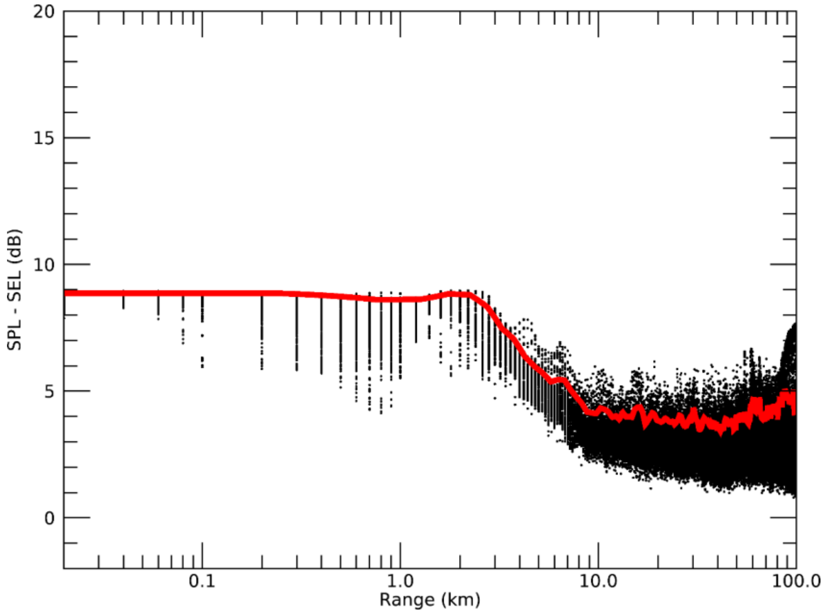

Figure D-2. *Site 1*: Range-and-depth-dependent conversion offsets for converting SEL to SPL for seismic pulses. Slices are shown for the 2820 in^3 seismic source. Black lines are the modelled differences between SEL and SPL across different radials and receiver depths; the solid red line is the 90th percentile of the modelled differences at each range.

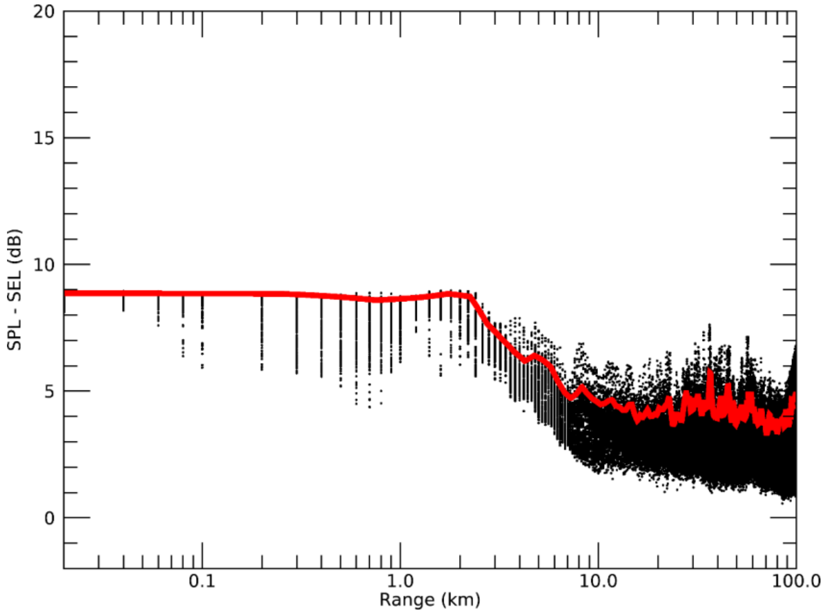

Figure D-3. *Site 2*: Range-and-depth-dependent conversion offsets for converting SEL to SPL for seismic pulses. Slices are shown for the 2820 in^3 seismic source. Black lines are the modelled differences between SEL and SPL across different radials and receiver depths; the solid red line is the 90th percentile of the modelled differences at each range.

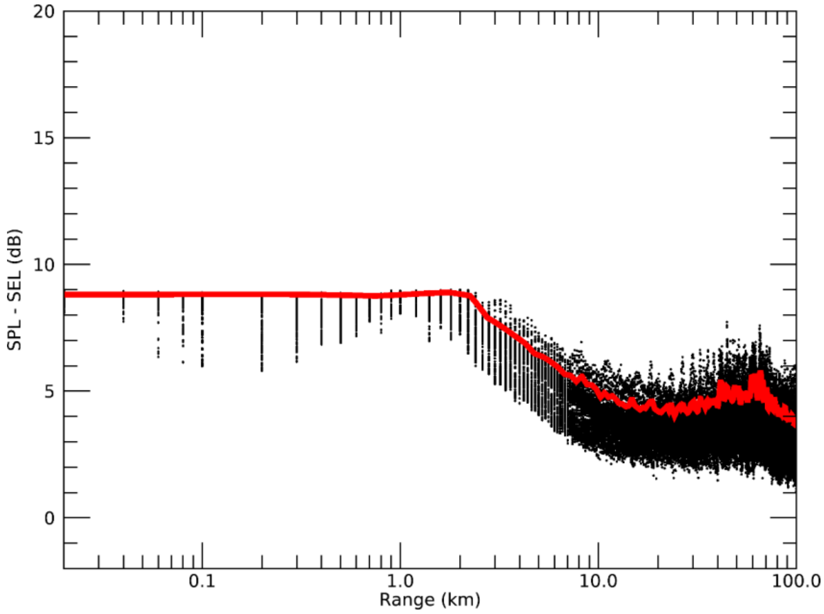

Figure D-4. *Site 5*: Range-and-depth-dependent conversion offsets for converting SEL to SPL for seismic pulses. Slices are shown for the 2820 in^3 seismic source. Black lines are the modelled differences between SEL and SPL across different radials and receiver depths; the solid red line is the 90th percentile of the modelled differences at each range.

D.3. Environmental Parameters

D.3.1. Bathymetry

Water depths throughout the modelled area were extracted from the Australian Bathymetry and Topography Grid, a 9 arc-second grid rendered for Australian waters (Whiteway 2009) for the region shown in Figure 1. Bathymetry data were extracted and re-gridded onto a Universal Transverse Mercator (UTM) coordinate projection (Zone 50) with a regular grid spacing of 100 × 100 m to generate the bathymetry in Figure D-5.

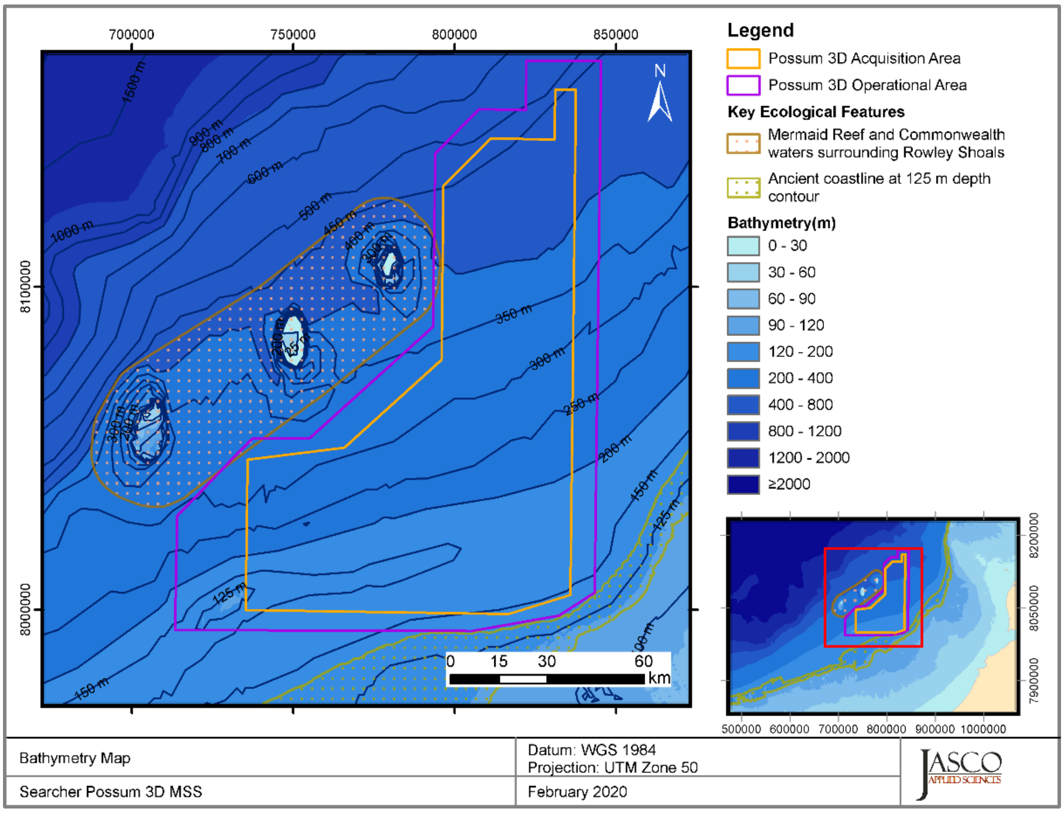

Figure D-5. Bathymetry map of the modelling area.

D.3.2. Sound speed profile

The sound speed profiles for the modelled sites were derived from temperature and salinity profiles from the U.S. Naval Oceanographic Office's Generalized Digital Environmental Model V 3.0 (GDEM; Teague et al. 1990, Carnes 2009). GDEM provides an ocean climatology of temperature and salinity for the world's oceans on a latitude-longitude grid with 0.25° resolution, with a temporal resolution of one month, based on global historical observations from the U.S. Navy's Master Oceanographic Observational Data Set (MOODS). The climatology profiles include 78 fixed depth points to a maximum depth of 6800 m (where the ocean is that deep). The GDEM temperature-salinity profiles were converted to sound speed profiles according to Coppens (1981).

Mean monthly sound speed profiles were derived from the GDEM profiles within a 100 km box radius encompassing all modelling sites. The July sound speed profile is expected to be most favourable to longer-range sound propagation during the proposed survey time frame. As such, July was selected for sound propagation modelling to ensure precautionary estimates of distances to received sound level thresholds. Figure D-6 shows the resulting profile used as input to the sound propagation modelling.

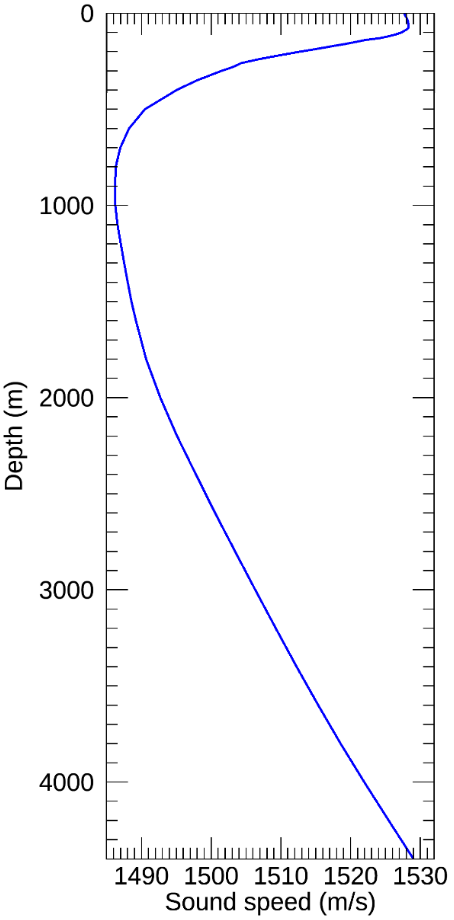

Figure D-6. The final sound speed profile (July) used for the modelling showing the entire water column. The profile was calculated from temperature and salinity profiles from GDEM V 3.0 (GDEM; Teague et al. 1990, Carnes 2009).

D.3.3. Geoacoustics

Geoacoustic parameters used for modelling at Sites 1–6 are located within the North West Transition Province (NWT) of the North West Marine Region of Australia (Baker et al. 2008), which is dominated by fine calcareous sand, fine muddy sand and sandy mud. The geoacoustic parameters used for all modelling sites were derived from sedimentary grain size measurements from the Australian Government's Marine Sediments (MARS) database (Heap 2009).

The samples from the MARS database indicate that on average, the surficial grain size components with 40% fine sand fraction and a 60% mud fraction are present throughout the modelled area of the Possum 3–D MSS. The surficial grain size is consistent with a sandy mud carbonate sediment which was been assumed throughout the modelled area. Furthermore, the grainsize distributions and associated geoacoustic model have been estimated and derived to provide precautionary estimates of seabed reflectivity and underwater sound levels in the spatially heterogeneous environments

A representative grain size were used in the grain-shearing model proposed by Buckingham (2005) to estimate the geoacoustic parameters required by the sound propagation models. Core information from IODP Cruise 356 (Gallagher et al. 2017) was used to determine the deeper stratigraphy and to estimate the thickness of un-lithified sediment. The geoacoustic parameters from Duncan et al. (2009) were used for the cemented sediments at the bottom of the un-lithified stack. Table D-1 lists the parameters used for modelling.

Table D-1. Geoacoustic profile for the Sites 1–6. Each parameter varies linearly within the stated range.

Depth below seafloor (m)	Predicted lithology	Density (g/cm³)	Compressional wave		Shear wave	
			Speed (m/s)	Attenuation (dB/λ)	Speed(m/s)	Attenuation (dB/λ)
0–10	Calcareous sandy mud (unconsolidated)	2.0	1600-1759	0.07-0.69		
10–20		2.0	1759-1811	0.69-0.86		
20–50	Calcareous sandy mud (Compact)	2.0	1811-1907	0.86-1.13	285	3.65
50–320		2.0	1907-2260	1.13-1.86		
>320	Cemented Limestone (Calcarenite)	2.4	2800	0.1		

D.4. Seismic Sources

The layout of the 2820 in³, 2495 in³ and 2380 in³ seismic sources used for modelling in this study and considered in Appendix B and Appendix E are provided in Figures D-7 to D-9. Details of the airgun parameters are provided in Tables D-2 to D-4.

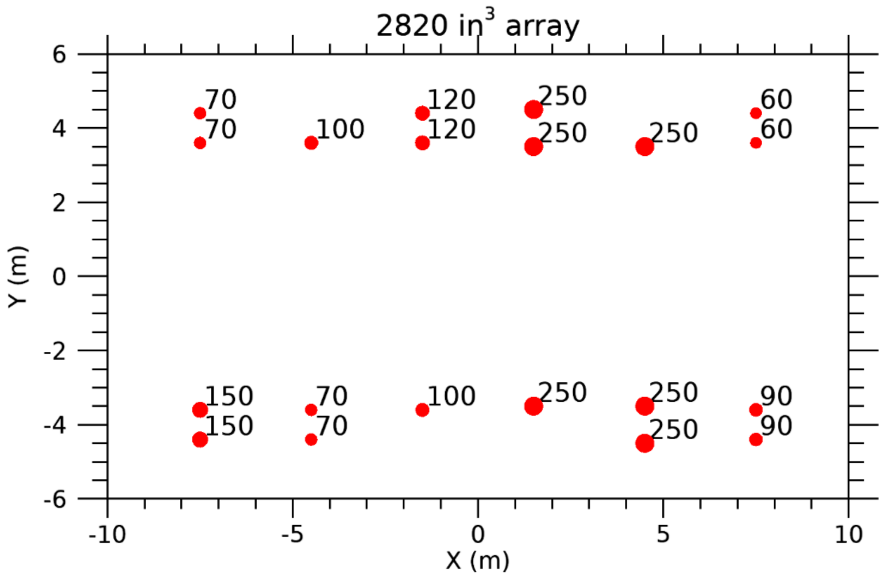

Figure D-7. Layout of the modelled 2820 in³ array. Tow depth is 6 m. The labels indicate the firing volume (in cubic inches) for each airgun. Also see Table D-2.

Table D-2. Layout of the modelled 2820 in³ array. Tow depth is 6 m. Firing pressure for all guns is 2000 psi. Also see Figure D-7.

Gun	*x* (m)	*y* (m)	*z* (m)	Volume (in³)	Gun	*x* (m)	*y* (m)	*z* (m)	Volume (in³)
1	7.5	-4.4	6.0	90	13	7.5	3.6	6.0	60
2	7.5	-3.6	6.0	90	14	7.5	4.4	6.0	60
3	4.5	-4.5	6.0	250	15	4.5	3.5	6.0	250
4	4.5	-3.5	6.0	250	17	1.5	3.5	6.0	250
6	1.5	-3.5	6.0	250	18	1.5	4.5	6.0	250
8	-1.5	-3.6	6.0	100	19	-1.5	3.6	6.0	120
9	-4.5	-4.4	6.0	70	20	-1.5	4.4	6.0	120
10	-4.5	-3.6	6.0	70	21	-4.5	3.6	6.0	100
11	-7.5	-4.4	6.0	150	23	-7.5	3.6	6.0	70
12	-7.5	-3.6	6.0	150	24	-7.5	4.4	6.0	70

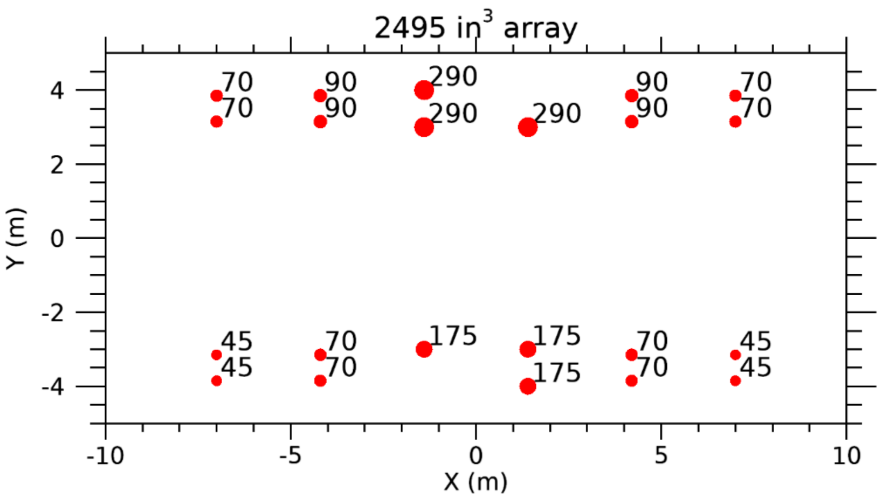

Figure D-8. Layout of the modelled 2495 in³ array. Tow depth is 6 m. The labels indicate the firing volume (in cubic inches) for each airgun. Also see Table D-3.

Table D-3. Layout of the modelled 2495 in^3 array. Tow depth is 6 m. Firing pressure for all guns is 2000 psi. Also see Figure D-8.

Gun	x (m)	y (m)	z (m)	Volume (in^3)	Gun	x (m)	y (m)	z (m)	Volume (in^3)
1	7.0	-3.9	6.0	45	13	7.0	3.2	6.0	70
2	7.0	-3.2	6.0	45	14	7.0	3.9	6.0	70
3	4.2	-3.9	6.0	70	15	4.2	3.2	6.0	90
4	4.2	-3.2	6.0	70	16	4.2	3.9	6.0	90
5	1.4	-4.0	6.0	175	17	1.4	3.0	6.0	290
6	1.4	-3.0	6.0	175	19	-1.4	3.0	6.0	290
8	-1.4	-3.0	6.0	175	20	-1.4	4.0	6.0	290
9	-4.2	-3.9	6.0	70	21	-4.2	3.2	6.0	90
10	-4.2	-3.2	6.0	70	22	-4.2	3.9	6.0	90
11	-7.0	-3.9	6.0	45	23	-7.0	3.9	6.0	70
12	7.0	-3.9	6.0	45	24	-7.0	3.9	6.0	70

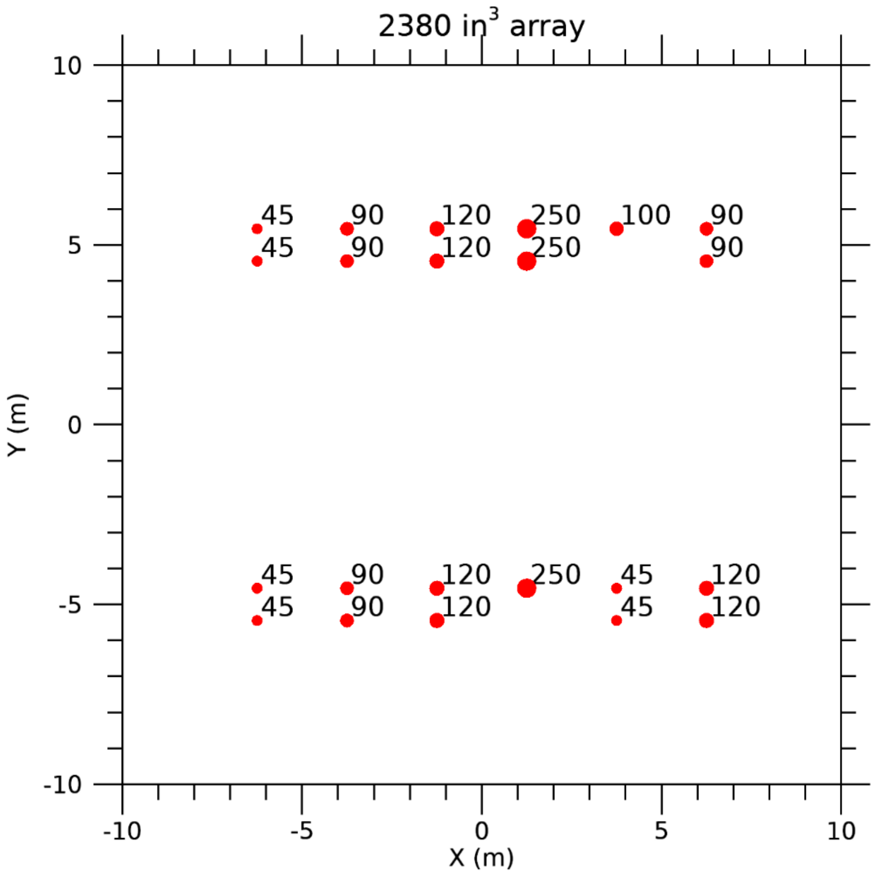

Figure D-9. Layout of the modelled 2380 in^3 array. Tow depth is 6 m. The labels indicate the firing volume (in cubic inches) for each airgun. Also see Table D-4.

Table D-4. Layout of the modelled 2380 in^3 array. Tow depth is 6 m. Firing pressure for all guns is 2000 psi. Also see Figure D-9.

Gun	*x* (m)	*y* (m)	*z* (m)	Volume (in^3)	Gun	*x* (m)	*y* (m)	*z* (m)	Volume (in^3)
1	6.3	-5.5	6.0	120	13	6.3	4.6	6.0	90
2	6.3	-4.6	6.0	120	14	6.3	5.5	6.0	90
3	3.8	-5.5	6.0	45	16	3.8	5.5	6.0	100
4	3.8	-4.6	6.0	45	17	1.3	4.6	6.0	250
6	1.3	-4.6	6.0	250	18	1.3	5.5	6.0	250
7	-1.3	-5.5	6.0	120	19	-1.3	4.6	6.0	120
8	-1.3	-4.6	6.0	120	20	-1.3	5.5	6.0	120
9	-3.8	-5.5	6.0	90	21	-3.8	4.6	6.0	90
10	-3.8	-4.6	6.0	90	22	-3.8	5.5	6.0	90
11	-6.3	-5.5	6.0	45	23	-6.3	4.6	6.0	45
12	-6.3	-4.6	6.0	45	24	-6.3	5.5	6.0	45

D.5. Model Validation Information

Predictions from JASCO's Airgun Array Source Model (AASM) and propagation models (MONM, FWRAM and VSTACK) have been validated against experimental data from a number of underwater acoustic measurement programs conducted by JASCO globally, including the United States and Canadian Artic, Canadian and southern United States waters, Greenland, Russia and Australia (Hannay and Racca 2005, Aerts et al. 2008, Funk et al. 2008, Ireland et al. 2009, O'Neill et al. 2010, Warner et al. 2010, Racca et al. 2012a, Racca et al. 2012b, Matthews and MacGillivray 2013, Martin et al. 2015, Racca et al. 2015, Martin et al. 2017a, Martin et al. 2017b, Warner et al. 2017, MacGillivray 2018, McPherson et al. 2018, McPherson and Martin 2018).

In addition, JASCO has conducted measurement programs associated with a significant number of anthropogenic activities which have included internal validation of the modelling (including McCrodan et al. 2011, Austin and Warner 2012, McPherson and Warner 2012, Austin and Bailey 2013, Austin et al. 2013, Zykov and MacDonnell 2013, Austin 2014, Austin et al. 2015, Austin and Li 2016, Martin and Popper 2016).

Appendix E. Seismic Source Comparison

E.1. Acoustic Source Levels and Directivity

Three different seismic sources were considered for preliminary source analysis and selecting a representative seismic source, the total volumes were 2380 in^3, 2495 in^3 and 2820 in^3. The results from AASM for these sources are provided in Table E-1.

Table E-1. Far-field source level specifications for 2380 in^3, 2495 in^3 and 2820 in^3 seismic sources, for a 6 m tow depth. Source levels are for a point-like acoustic source with equivalent far-field acoustic output in the specified direction. Sound level metrics are per-pulse and unweighted.

Total volume (in^3)	Direction	Peak source pressure level ($L_{S,pk}$) (dB re 1 µPa m)	Per-pulse source SEL ($L_{S,E}$) (dB 1 µPa²m²s)
			10–25000 Hz
2380	Broadside	248.7	224.1
2495		248.8	224.3
2820		248.8	224.5
2380	Endfire	245.8	223.2
2495		244.8	222.4
2820		244.8	223.0
2380	Vertical	255.1	227.5
2495		254.7	227.6
2820		254.9	227.9

E.2. Per-pulse sound field comparison

FWRAM was used to characterise the acoustic fields in terms of SEL, SPL and zero-to-peak sound pressure level (PK) metrics (as per Appendix A.1) for each source, which allows for a comparison of the three sources in a representative environment. Modelling was performed along all broadside and endfire radials for the three the seismic sources considered above. The synthetic seismic pulses over a frequency range of 5–1024 Hz.

Figures E-1 to E-3 present the maximum-over-depth for all radials for SEL, SPL, and PK metrics as a function of range. The three sources produced the very similar per-pulse levels when comparing the three metrics. The differences in SEL and SPL between these arrays will result in similar isopleths for energy based assessments (i.e., the SEL_{24h} assessment) and isopleths to behavioural disturbance. However, 2820 in^3 does produce the highest broadside far-field source level and has the largest total array volume was therefore selected as the representative source for modelling in this study an was selected as a part of a precautionary approach.

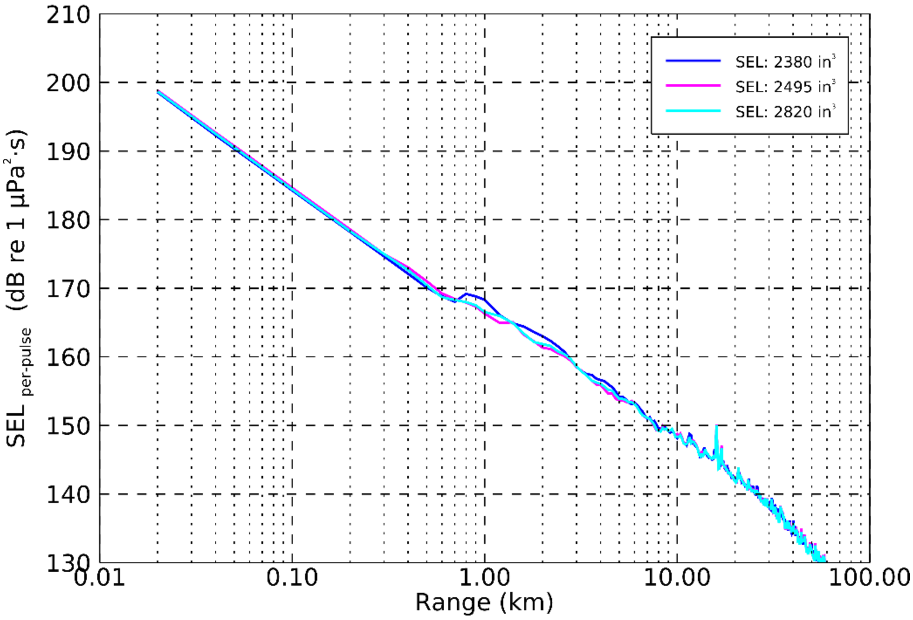

Figure E-1. *SEL*: Maximum-over-depth predicted for the 2380 in^3, 2495 in^3 and 2820 in^3 sources from FWRAM. Levels are the maximum over all the broadside and endfire and directions.

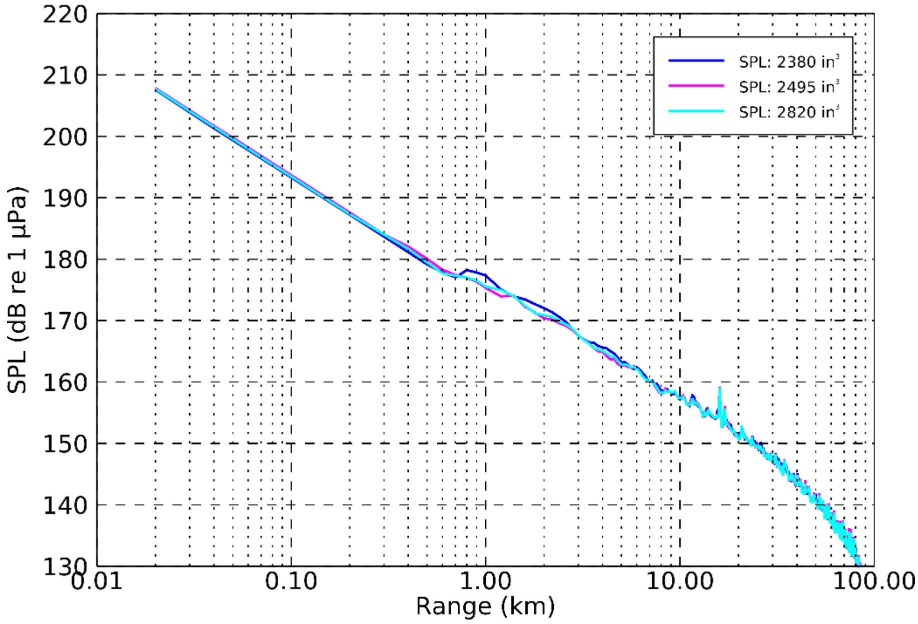

Figure E-2. *SPL*: Maximum-over-depth predicted for the 2380 in^3, 2495 in^3 and 2820 in^3 sources from FWRAM. Levels are the maximum over all the broadside and endfire and directions.

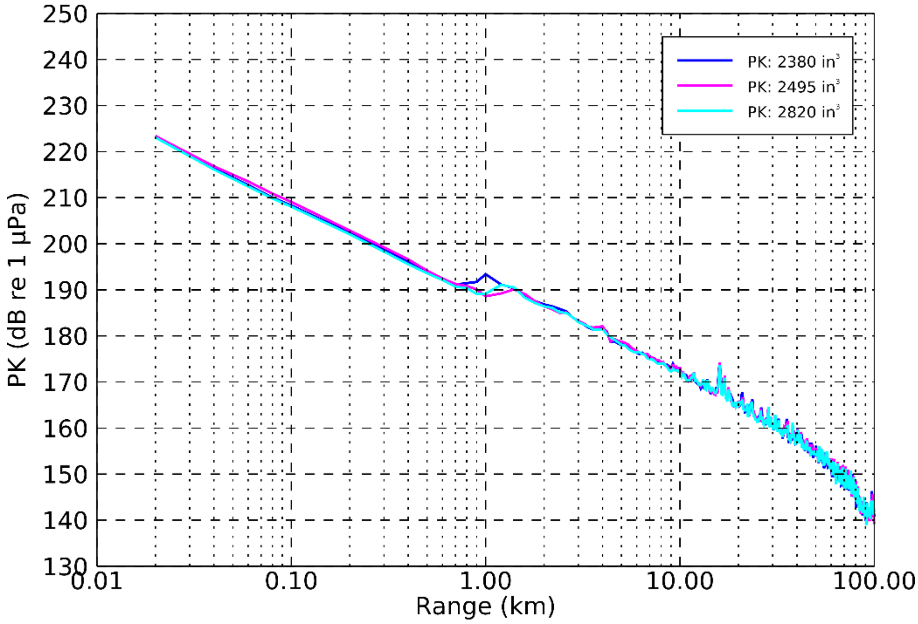

Figure E-3. *PK*: Maximum-over-depth predicted PK for the 2380 in^3, 2495 in^3 and 2820 in^3 sources from FWRAM. Levels are the maximum over all the broadside and endfire and directions.

APPENDIX D IUCN MANAGEMENT PRINCIPLES

Australian IUCN Reserve Management Principles for Commonwealth Marine Protected Areas

COMMONWEALTH
MARINE PROTECTED AREAS
Benefits for All

In 1994 The World Conservation Union (IUCN) published the Guidelines for Protected Area Management Categories.

The IUCN identified seven international categories which form the basis for the Australian IUCN Reserve Management Principles.

All seven categories are important. The number assigned to a category does not reflect its importance: all categories are needed for conservation and sustainable development. The categories do represent varying degrees of human intervention.

Protected areas are established to meet objectives consistent with national and local goals and needs, such as those established by Australia's Oceans Policy. Once these objectives are identified for a particular marine protected area (MPA), an IUCN category is assigned. The assigned category is that one which most closely aligns with the objectives of the MPA.

Activities considered appropriate in each reserve must be consistent with the Australian IUCN Reserve Management Principles and are decided in a case by case assessment, based on all the information available for a specific reserve and in a way that provides stakeholders with opportunities to be involved in these decisions in an open and transparent way.

The *Environment Protection and Biodiversity Conservation Act 1999* provides that:

- the proclamation of a Commonwealth reserve must assign the reserve to an IUCN category and may also assign an IUCN category to any zones
- the Minister must be satisfied that the reserve or zone has the characteristics listed in the Act
- the reserve or zone should be managed in accordance with the Australian IUCN Reserve Management Principles
- the management plan for each Commonwealth reserve must also assign the reserve to an IUCN category.

This booklet provides the IUCN definition of each protected area management category and the Australian IUCN Reserve Management Principles for each category as set out in the Environment Protection and Biodiversity Conservation (EPBC) Regulations.

Strict Nature Reserve

IUCN 1994 DESCRIPTION

Category IA: Strict Nature Reserve: Protected Area managed mainly for science

Area of land and/or sea possessing some outstanding or representative ecosystems, geological or physiological features and/or species, available primarily for scientific research and/or environmental monitoring.

Australian IUCN reserve management principles

(Schedule 8 of the EPBC Regulations 2000)

1.01 The reserve or zone should be managed primarily for scientific research or environmental monitoring based on the following principles.

1.02 Habitats, ecosystems and native species should be preserved in as undisturbed a state as possible.

1.03 Genetic resources should be maintained in a dynamic and evolutionary state.

1.04 Established ecological processes should be maintained.

1.05 Structural landscape features or rock exposures should be safeguarded.

1.06 Examples of the natural environment should be secured for scientific studies, environmental monitoring and education, including baseline areas from which all avoidable access is excluded

1.07 Disturbance should be minimised by careful planning and execution of research and other approved activities.

1.08 Public access should be limited to the extent it is consistent with these principles.

Wilderness Area

IUCN 1994 DESCRIPTION

Category IB: Wilderness Area: Protected Area managed mainly for wilderness protection

Large area of unmodified or slightly modified land and/or sea, retaining its natural character and influence, without permanent or significant habitation, which is protected and managed so as to preserve its natural condition.

Australian IUCN reserve management principles

(Schedule 8 of the EPBC Regulations 2000)

2.01 The reserve or zone should be protected and managed to preserve its unmodified condition based on the following principles.

2.02 Future generations should have the opportunity to experience, understand and enjoy reserves or zones that have been largely undisturbed by human action over a long period of time.

2.03 The essential attributes and qualities of the environment should be maintained over the long term.

2.04 Public access should be provided at levels and of a type that will best serve the physical and spiritual well-being of visitors and maintain the wilderness qualities of the reserve or zone for present and future generations.

2.05 Indigenous human communities living at low density and in balance with the available resources should be able to maintain their lifestyle.

National Park

IUCN 1994 DESCRIPTION

Category II: National Park: Protected Area managed mainly for ecosystem conservation and recreation.

Natural area of land and/or sea, designated to (a) protect the ecological integrity of one or more ecosystems for this and future generations, (b) exclude exploitation or occupation inimical to the purposes of designation of the area, and (c) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible.

Australian IUCN reserve management principles

(Schedule 8 of the EPBC Regulations 2000)

3.01 The reserve or zone should be protected and managed to preserve its natural condition according to the following principles.

3.02 Natural and scenic areas of national and international significance should be protected for spiritual, scientific, educational, recreational or tourist purposes.

3.03 Representative examples of physiographic regions, biotic communities, genetic resources, and native species should be perpetuated in as natural a state as possible to provide ecological stability and diversity.

3.04 Visitor use should be managed for inspirational, educational, cultural and recreational purposes at a level that will maintain the reserve or zone in a natural or near natural state.

3.05 Management should seek to ensure that exploitation or occupation inconsistent with these principles does not occur.

3.06 Respect should be maintained for the ecological, geomorphologic, sacred and aesthetic attributes for which the reserve or zone was assigned to this category.

3.07 The needs of indigenous people should be taken into account, including subsistence resource use, to the extent that they do not conflict with these principles.

3.08 The aspirations of traditional owners of land within the reserve or zone, their continuing land management practices, the protection and maintenance of cultural heritage and the benefit the traditional owners derive from enterprises, established in the reserve or zone, consistent with these principles should be recognised and taken into account.

Natural Monument

IUCN 1994 DESCRIPTION

Category III: Natural Monument: Protected Area managed for conservation of specific natural features.

Area containing one or more specific natural or natural/cultural feature which is of outstanding value because of its inherent rarity, representative or aesthetic qualities or cultural significance.

Australian IUCN reserve management principles

(Schedule 8 of the EPBC Regulations 2000)

4.01 The reserve or zone should be protected and managed to preserve its natural or cultural features based on the following principles.

4.02 Specific outstanding natural features should be protected or preserved in perpetuity because of their natural significance, unique or representational quality or spiritual connotations.

4.03 Opportunities for research, education, interpretation and public appreciation should be provided to an extent consistent with these principles.

4.04 Management should seek to ensure that exploitation or occupation inconsistent with these principles does not occur.

4.05 People with rights or interests in the reserve or zone should be entitled to benefits derived from activities in the reserve or zone that are consistent with these principles.

Habitat/Species Management Area

IUCN 1994 DESCRIPTION

Category IV: Habitat/Species Management Area: Protected Area managed mainly for conservation through management intervention.

Area of land and/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species.

Australian IUCN reserve management principles

(Schedule 8 of the EPBC Regulations 2000)

5.01 The reserve or zone should be managed primarily, including (if necessary) through active intervention, to ensure the maintenance of habitats or to meet the requirements of collections or specific species based on the following principles.

5.02 Habitat conditions necessary to protect significant species, groups or collections of species, biotic communities or physical features of the environment should be secured and maintained, if necessary through specific human manipulation.

5.03 Scientific research and environmental monitoring that contribute to reserve management should be facilitated as primary activities associated with sustainable resource management.

5.04 The reserve or zone may be developed for public education and appreciation of the characteristics of habitats, species or collections and of the work of wildlife management.

5.05 Management should seek to ensure that exploitation or occupation inconsistent with these principles does not occur.

5.06 People with rights or interests in the reserve or zone should be entitled to benefits derived from activities in the reserve or zone that are consistent with these principles.

5.07 If the reserve or zone is declared for the purpose of a botanic garden, it should also be managed for the increase of knowledge, appreciation and enjoyment of Australia's plant heritage by establishing, as an integrated resource, a collection of living and herbarium specimens of Australian and related plants for study, interpretation, conservation and display.

Protected Landscape/Seascape

IUCN 1994 DESCRIPTION

Category v: Protected Landscape/Seascape: Protected Areas managed mainly for landscape/seascape conservation and recreation.

Area of land, with coast and seas as appropriate, where the interaction of people and nature over time has produced an area of distinct character with significant aesthetic, cultural and/or ecological value, and often with high biological diversity. Safeguarding the integrity of this traditional interaction is vital to the protection, maintenance and evolution of such an area.

Australian IUCN reserve management principles

(Schedule 8 of the EPBC Regulations 2000)

6.01 The reserve or zone should be managed to safeguard the integrity of the traditional interactions between people and nature based on the following principles.

6.02 The harmonious interaction of nature and culture should be maintained through the protection of landscape or seascape and the continuation of traditional uses, building practices and social and cultural manifestations.

6.03 Lifestyles and economic activities that are in harmony with nature, and the preservation of the social and cultural fabric of the communities in the reserve or zone concerned should be supported.

6.04 The diversity of landscape, seascape and habitat, and of associated species and ecosystems, should be maintained.

6.05 Land and sea uses and activities that are inappropriate in scale or character should not occur.

6.06 Opportunities for public enjoyment should be provided through recreation and tourism appropriate in type and scale to the essential qualities of the reserve or zone.

6.07 Scientific and educational activities, that will contribute to the long-term well-being of resident populations and to the development of public support for the environmental protection of similar areas, should be encouraged.

6.08 Benefits to the local community, and contributions to its well-being, through the provision of natural products and services should be sought and promoted if they are consistent with these principles.

Managed Resource Protected Area

IUCN 1994 DESCRIPTION

Category VI: Managed Resource Protected Areas: Protected Area managed mainly for the sustainable use of natural ecosystems.

Area containing predominantly unmodified natural systems, managed to ensure long term protection and maintenance of biological diversity, while providing at the same time a sustainable flow of natural products and services to meet community needs.

Australian IUCN reserve management principles

(Schedule 8 of the EPBC Regulations 2000)

7.01 The reserve or zone should be managed mainly for the sustainable use of natural ecosystems based on the following principles.

7.02 The biological diversity and other natural values of the reserve or zone should be protected and maintained in the long term.

7.03 Management practices should be applied to ensure ecologically sustainable use of the reserve or zone.

7.04 Management of the reserve or zone should contribute to regional and national development to the extent that this is consistent with these principles.

In addition, under Schedule 8 of the EPBC Regulations, the general administrative principles enshrine the following principles in relation to all Commonwealth reserves:

1. Community participation
2. Effective and adaptive management
3. Precautionary principle
4. Minimum impact
5. Ecologically sustainable use
6. Transparency of decision-making
7. Joint management

FURTHER INFORMATION:

IUCN 1994 *Guidelines for Protected Area Management Categories* Gland, Switzerland

Environment Protection and Biodiversity Conservation Act 1999

Environment Protection and Biodiversity Conservation Regulations 2000

Environment Australia web address
www.ea.gov.au/coasts/mpa/index.html

Environment Australia Community Information Unit:
Free call 1800 803 772

ISBN 0642548536

Natural Heritage Trust

Helping Communities Helping Australia

A Commonwealth Government Initiative

APPENDIX E STAKEHOLDER CONSULTATION REGISTER

ID	Company/Stakeholder	Comms Date (To)	Comms Date (From)	Comms Type	Comms Content (redacted)	Assessment of Claims	Status
	Community						
2	80 Mile Beach Caravan Park	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
30	Care for Hedland	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
38	De Grey Station	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
80	Pardoo Station	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
85	Port Hedland Chamber of Commerce	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
86	Port Hedland Game Fishing Club	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
89	Port Hedland Seafarers Centre	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
90	Port Hedland Volunteer Marine Rescue	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
91	Port Hedland Yacht Club	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
			25/12/2019 03:25	Email	Confirmation of receipt and out of office notification returning 13 Jan 2020 alternative contact and email provided for urgent matters		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
	ENGO						
13	Australian Fishing Trade Association	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
16	Australian Marine Conservation Society	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
			25/12/2019 03:25	Email	Confirmation of receipt, out of office notification returning 6th January 2020		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
31	Centre for Whale Research WA	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
35	Conservation Council of WA	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
46	Environs Kimberley	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
55	International Fund for Animal Welfare	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
		19/05/2020 12:01		Email	Opt Out Form received		
131	Wilderness Society	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		25/12/2019 03:25		Email	Confirmation of receipt, Out of Office notification returning 6/1/2020		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
132	World Wildlife Fund	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
	Fishing - Commercial						
	Fishing - Commercial (North West Slope Trawl)						
135	AUSTFISH PTY LTD	3/06/2021 11:50		Email	Invitation for consultation eMail and updated extension to July 2023 Flyer (F004)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		17/06/2021 13:48		Phone Call	Phone call confirmed original contact email address is correct, provided second address for communications and confirmed receipt of notification of proposed survey.		
		17/06/2021 14:14		Email	Thanking for confirming email, resend and cc second email address for Invitation for consultation eMail and updated extension to July 2023 Flyer (F004)		
		17/06/2021 14:14		Email	Thanking for confirming email, resend and cc second email address for Invitation for consultation eMail and updated extension to July 2023 Flyer (F004)		
6	AUSTRAL FISHERIES PTY LTD	25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)		CLOSED
		25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)		

ID	Company/Stakeholder	Comms Date (To)	Comms Date (From)	Comms Type	Comms Content (redacted)	Assessment of Claims	Status
		25/12/2019 03:02		Email	Currently on annual leave returning to desk Monday 6th Jan 2020. Austral office phone number provided.	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
7	Stakeholder ID 7	25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)	See Stakeholder ID130 same contact.	CLOSED
48	Stakeholder ID 48	25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)	See Stakeholder ID130 same contact.	CLOSED
50	GNTM PTY LTD	24/12/2019 02:30		Post	Initial notification Fisheries Flyer (F002)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Post	Invitation for consultation updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Post	Invitation for consultation Letter (D001) and updated extension to July 2023 Flyer (F004)		
92	RAPTIS FISHING LICENCES PTY LTD	25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)		
			25/12/2019 03:02	Email	Currently on annual leave returning to the office on Monday 6th January 2020		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
99	Stakeholder ID 99	25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)	See Stakeholder ID130 - same contact.	CLOSED
		25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)		
136	Stakeholder ID 136	25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
114	W.A. SEAFOOD EXPORTERS PTY LTD	25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
130	Stakeholder ID 130	25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)	Acknowledged stakeholders interests are with North West Slope Trawl and noted concerns regarding displacement off the fishing grounds, disruption of supply to market and unknown negative impact on the target species. Searcher requested further information on fisheries interests, specific times in the area or diving activities for further consideration and survey planning. Continued efforts to contact stakeholder by email and phone with no response. WAFIC advised they are working on behalf of Stakeholder ID130. Noted Stakeholder ID130's fishing efforts concentrated to North of the survey, between August to April, therefore fishing activity overlap with the survey window likely to be between December to April. Searcher forwarded survey timing, acoustic modelling access and offered to work together to identify the best window of opportunity to minimise disruption to fishing schedule. Searcher requested on water contact details to assist with communications. Stakeholder ID130 raised concerns regarding impact of the Possum survey on their fishery resource (primarily scampi) and potential impacts to their commercial catch. Searcher has responded with information from a thorough review based on best science available with more details available in Appendix E: Evaluation of Environmental Impact on Crustaceans: The seismic survey has the potential to cause statocyst damage in crustaceans, however these impacts are likely to be partially recoverable after successive moulting (Day et al 2019). The modelling from JASCO (2020) for the Possum 3D MSS survey shows that noise at the seabed that could cause statocyst damage to crustaceans is predicted to 141m either side of each sail line in shallower waters. However, as the vessel moves into deeper water, this propagation distance at the seabed will become smaller. The sail lines for the survey are planned to be separated by 112.5 m therefore, dependent on depth, most or all the seabed within the survey could be affected by noise levels that could induce statocyst injury in crustaceans. However, there is no evidence to suggest that lethal levels of noise will be emitted from the seismic source. The predicted minor impacts to crustaceans are not expected to have an impact on the broader crustacean populations in the region for the following reasons: • The minor statocyst impacts are not expected to be lethal and are predicted to repair through time • No other sub-lethal effects are known to occur • Effects on behaviour are very unlikely • The area of seabed exposed is extremely small in the context of the very large and the likely inter-connected crustacean populations of the north west Australian waters (Wilson 2013) that are likely to be inherently resilient to such a small perturbation. Scampi key spawning period is identified to be September - October control measures have been proposed to mitigate the impact to scampi from underwater noise including : • Reduction of the operational and acquisition areas to reduce overlap with commercial fishing areas • Use of the smallest array size that will achieve the survey objectives • Spatial and Temporal Survey design changes to reduce Stakeholder ID130's displacement off the fishing grounds • Avoidance of identified spawning period for scampi (Sept-Oct) As the proposed survey area overlaps an extremely small portion, 9,221 km (2.33%) of the North West Slope Trawl (Scampi) Fishery (NWSTF) management area, with over 97% of the fishery unaffected by the survey, it is reasonably predicted that the Possum 3D survey is unlikely to affect the overall catch rates of scampi in the North West Slope Trawl fishery and any effects to stocks in the 2.33% of the NWSTF fishery are unlikely to be permanent In consideration of impacts to commercial catch, Searcher have provided Stakeholder ID 130 with the adopted definitive version of the Collaborative Seismic Environment Plan Adjustment Protocol (CSEP) currently ratified and agreed with all commercial fishing peak industry bodies, including WAFIC. The CSEP details an evidence-based process for commercial fishers to make a claim for loss of catch, displacement or gear damage within an Adjustment	CLOSED
		25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)		
			27/12/2019 07:13	Email	Feedback form received: Possible negative impact to commercial activities; our operations been overridden by the survey, displacement off the fishing grounds and disruption to our supply into the market (loss of market place) also the unknown negative impact on the target species. Map of location of fishing with vessel tracked.		
		30/01/2020 11:07		Email	Thanking and acknowledging response. We have your interests listed against the "North West Slope Trawl Fishery", if you could possibly confirm and advise whether you have any other commercial license interests in the area, any diving activities or specific times that you usually fish in the proposed Possum 3D area that may also require further consideration and planning to be addressed. We also thank you for the attached image showing vessel tracking. As there appears to be a number of different vessels shown could you possibly confirm whether there is a specific track that is relevant or if this shows a group of vessels under Stakeholder ID136 and Stakeholder ID130s control please. We will be in touch shortly with further information available for your perusal, including more detailed information from our sound modelling. Our sincere thanks in advance for your time and continued communications. We look forward to being able to consult and work with you to the best possible outcome for all parties.		
			31/01/2020 07:43	Email	CC'd in email from Stakeholder ID 130 to WAFIC regarding WAFIC's email response to Searcher dated 30 Jan 2020 14:00		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		1/04/2020 20:06		Email	Thanking and acknowledging response to be included in further updates. Confirming Searcher sent a request to you for information regarding your activities in the vicinity of the Possum 3D MSS and have to date not received a reply. We do however note that your vessel "name redacted" has fishing effort concentrated to the northern area of the survey. If you or your representative could possibly contact us at your earliest convenience in order for us to work with you to work toward identifying a possible window of opportunity within the environmental constraints of our survey. The survey duration is expected to require a maximum of 70 days with the current and most likely acquisition window identified as between December 2020 and end April 2021 OR December 2021 and end April 2022. Please see the attached flyer for more information. The Possum 3D MSS Acoustic Modelling Report is available for your perusal from the updated link at the top of Feedback form or click here. Our sincere thanks in advance for your time and anticipated communications. We look forward to being able to consult and work with you to the best possible outcome for all parties.		
		15/04/2020 14:08		Phone	Left message to return call and requesting contact details for Stakeholder ID 130 in order to consider their vessel movements in the survey design.		
		15/04/2020 14:12		Phone	No answer, rang out		
		15/04/2020 14:25		Phone	Left message to return call and requesting contact details for representative in order to consider their vessel movements in the survey design.		
		15/04/2020 15:15		Phone	No answer, rang out		
		15/05/2020 15:12		Email	Invitation for consultation and updated extension to July 2023 Flyer (F004). I have called on the below numbers and left a message to contact Searcher representative via mobile (number redacted) to try to consult with Stakeholder ID130 representative in order for Searcher to work toward identifying a suitable window of opportunity, considering your possible fishing activities and within the environmental, temporal and spatial constraints of our proposed survey to provide the best possible outcome for all parties. Numbers noted in email.		
		16/05/2020 10:36		Email	Follow up email from WAFIC, have I missed / forgotten something? Keen to receive Searcher's reply to the query on behalf of Stakeholder ID130 in the email below.		

ID	Company/Stakeholder	Comms Date (To)	Comms Date (From)	Comms Type	Comms Content (redacted)	Assessment of Claims	Status
		16/05/2020 12:05		Email	I can confirm receipt of your emails dated Tuesday, 26 May 2020 9:38 AM and today Thursday, 16 July 2020 10:36 and apologise for not replying earlier. We are currently working through some items that are integral for the response to your earlier email. As such we wished to provide you with the best and most accurate data and thought it prudent not to offer information that may change or was not ratified. We understand that this is difficult times for all industries and wish to remain supportive of our broader communities. We will come back to you shortly with a response and look forward to working with you to the best possible outcome for all parties.	Area, a copy of which is available on the NERA website (NERA 2021). Although automatic read reply was received, no direct response has been received at the time of EP submission and WAFIC have no further comment at this time on behalf of Stakeholder ID 130 for the Possum 3D MSS. No further response from stakeholder. Searcher considers consultation efforts to be adequate however Searcher will continue to address any future comments should they arise, provide notifications and pursue on water contact details for communications regarding simultaneous activities and appropriate sharing of ocean access.	
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
			19/05/2020 15:54	Email	WAFIC responded on behalf of Stakeholder ID130 : WAFIC Executive Officer is currently working with Stakeholder ID130 (one of the major fishers in the North West Slope Trawl fishery). We have additional feedback from Stakeholder ID130's regarding the proposed Searcher Seismic Possum survey, I hope to have the full response to you tomorrow.		
		19/05/2020 18:12		Email	Email to WAFIC CC'd to Stakeholder ID130: thanking WAFIC for assistance, that's really great news, I've been trying to contact Stakeholder ID130's representative but have been unable to get through to date, unusual and difficult times for all to be sure. We would be happy to consult with either yourself or a Stakeholder ID130 representative in order for Searcher to work toward identifying a suitable window of opportunity, considering Stakeholder ID130's possible fishing activities and within the environmental, temporal and spatial constraints of our proposed survey. I will respond to your previous email separately however I have attached a newly updated Flyer (F004). Due to NOPTA and associated bodies regarding the COVID-19 pandemic as a force majeure event they have made a decision to allow a 12 month suspension and extension of permit title conditions and as such Searcher Seismic Pty Ltd (Searcher) is considering extending its Possum 3D MSS Environment Plan validity to July 2023. Please note there is no change to the: • maximum expected survey duration being one 70 day acquisition. • window of opportunity of the survey which will take place in one operational window, between Dec and end April, (2020/21 or 2021/22 or 2022/23) detailed in attached "F004-Invitation for Consultation" Flyer. Our sincere thanks in advance for your time and anticipated communications. We look forward to being able to consult and work with you to the best possible outcome for all parties.		
			26/05/2020 09:38	Email	WAFIC CC'd to Stakeholder ID130: Further to WAFIC's ongoing contact with you and the proposed Searcher Seismic Possum 3D marine seismic survey.WAFIC has been contacted by representative of Stakeholder ID130 (ID99 & ID48). Stakeholder ID130's are one of the major operators in the North West Slope Trawl Fishery and are genuinely concerned regarding the potential impact of the Possum survey on their fishery resource (primarily scampi) and potential impacts to their commercial catch.Stakeholder ID130's representative has provided confidential commercial information showing their vessel plots, please see the map below left. When compared with the Possum fact sheet map on the right there is a clear overlay between considerable commercial fishing activity in the North West Slope Trawl fishery and the Possum MSS operational area.The broader Mermaid Reef area is a key fishing location for Stakeholder ID130's. There are no distinct seasonal patterns as the North West Slope Trawl fishery is a 12 month calendar fishery, vessels are active off and on throughout the full 12 month calendar year. The water depth parameters are from 200 metres up to 750 metres with the majority of trawl activity in 250 to 550 metre range.By and large representative has indicated very broadly speaking, they have a history of most activity in Mermaid Reef / Possum MSS operational area but on occasion can be more focussed on their fishing between August to April.We are not at all confident that the proposed mitigations provided by Searcher Seismic are enough.We are greatly concerned that scampi, an animal which does not move and lives just under the mud line in burrows will be potentially significantly impacted (very little formal science on this specie) and on top of this, potential impacts on Stakeholder ID130's catchability etc.WAFIC reiterates from our most recent email of 6th May 2019 that Searcher Seismic, as a member of the Collaborative Seismic EP project with the associated Commercial Fisheries Adjustment Protocol formally include in this Possum 3D MSS and future marine seismic surveys an evidence based adjustment protocol for potentially affected commercial fishers.Noting the information below, Stakeholder ID130 are very keen to receive your feedback and how you are going to protect their environmental and business interests.		
			16/07/2020 10:36	Email	WAFIC CC'd to Stakeholder ID130: Please see the email below of 26th May. I do not have a reply in the WAFIC records, have I missed / forgotten something? Keen to receive Searcher's reply to the query on behalf of Stakeholder ID130 in the email below		
		16/07/2020 12:05		Email	Searcher to WAFIC, CC'd to Stakeholder ID130 Thank you for your call this morning. I can confirm receipt of your emails dated Tuesday, 26 May 2020 9:38 AM and today Thursday, 16 July 2020 10:36 and apologise for not replying earlier. We are currently working through some items that are integral for the response to your earlier email. As such we wished to provide you with the best and most accurate data and thought it prudent not to offer information that may change or was not ratified. We understand that this is difficult times for all industries and wish to remain supportive of our broader communities. We will come back to you shortly with a response and look forward to working with you to the best possible outcome for all parties.		
			17/08/2020 09:41		WAFIC CC'd to Stakeholder ID130: Further to the email trail below and appreciate from our last telephone contact (similar time as the last email in mid-July) was that you were still working on this EP. Noting the concerns expressed by Stakeholder ID130 and the potential impacts on their commercial operations, are you in position to provide an update please as to the status of this survey and EP? We are currently working through some items that are integral for the response to your earlier email. As such we wished to provide you with the best and most accurate data and thought it prudent not to offer information that may change or was not ratified. We understand that this is difficult times for all industries and wish to remain supportive of our broader communities. We will come back to you shortly with a response and look forward to working with you to the best possible outcome for all parties.		
		15/02/2021 11:19			Email to WAFIC CC'd to Stakeholder ID130: I'm afraid that in this climate there are a lot of dynamics at play and we would much prefer to come back to you with concrete information which is unfortunately not yet ratified. As soon as we have something tangible to present a notification will go out to all stakeholders and please be assured that we will be working with you to provide the best outcome for all parties.		
		15/02/2021 12:17			READ RECEIPT received for email dated 15/02/2021 11:19:00		

ID	Company/Stakeholder	Comms Date (To)	Comms Date (From)	Comms Type	Comms Content (redacted)	Assessment of Claims	Status
		21/06/2021 16:55			Proposed extension to July 2023, confirmation of compensation model as produced in consultation with NERA and as requested by WAFIC a response to concerns around the impacts to scampi as below: Acoustic modelling has been undertaken by JASCO Applied Services (Australia) Pty. Ltd. (JASCO) on behalf of Searcher for the Possum 3D MSS Searcher. A full discussion of the results is provided in the EP; a preliminary summary is provided here. Details of Environmental Impact on Crustaceans: Physical injury: Physical injury in the form of statocyst damage, which could influence reflexes in crustaceans on the seabed, could occur at the distances from the source outlined in Table 2. The evidence suggests from lobster exposed to seismic noise, that these effects could last for at least a year after exposure (Day et al 2019). However, statocysts are shed when crustaceans moult and although the damage received to individual statocysts in this experiment did not repair, it is expected that the development of new setae may correct the damage (Day et al 2019). Sub-lethal effects: At the lowest level of exposure detailed in Table 2 (202 dB re 1 µPa; pk-pk), American lobster did not show any sub-lethal effects (Payne et al 2008). Based on this evidence it is reasonable to infer that crustaceans, including scampi, are unlikely to suffer sublethal effects beyond the physical injury effect zone detailed in Table 2. Behaviour: Thresholds for seismic noise effects on behaviour of crustaceans have not been developed in the scientific literature. However, Christian et al (2003) showed that crabs monitored by video camera and telemetry tags did not show any changes in movement or behaviour when exposed to received noise level of 197 to 237 dB re 1 µPa – a noise level that is predicted to occur only about 100m from the source for the Possum 3D MSS seismic survey (JASCO, 2020). Similarly, Andriguetto-Filho et al (2005) showed that fishing yields of a shrimp species were unchanged after exposure to seismic noise in shallow waters and Celi et al (2013) showed shrimp did not respond behaviourally to low frequency noise. For the Possum 3D MSS survey, noise levels are predicted to attenuate below 197 dB re 1 µPa within 100m. This is a very conservative and reasonable inference that aligns with the evidence of behaviour effects outlined above and the noise modelling results presented in Table 2. Reproduction/Spawning: A detailed scientific study with an excellent experimental design that exposed berried female rock lobster to seismic noise showed that embryos and larvae were not affected (Day et al 2016). Embryos in early stage development were exposed to noise levels between 209 – 212 dB dB re 1 µPa SPL while still attached to the berried females. The study tracked both the success of hatching, and the survival and fitness of the larvae once hatched and found that seismic noise had no effects (Day et al 2016). Based on this evidence and the similarity in reproductive mode in scampi (a key fishery within the operational area), effects from seismic noise on reproduction in scampi is highly unlikely. Furthermore, since seismic noise is unlikely to influence behaviour (discussed above) seismic activity is also unlikely to influence spawning behaviour. Evaluation of Environmental Impact on Crustaceans: The seismic survey has the potential to cause statocyst damage in crustaceans as detailed above, however these impacts are likely to be partially recoverable after successive moulting (Day et al 2019). The modelling from JASCO (2020) for the Possum 3D MSS survey shows that noise at the seabed that could cause statocyst damage to crustaceans is predicted to 141m either side of each sail line in shallower waters. However, as the vessel moves into deeper water, this propagation distance at the seabed will become smaller, as shown by the difference in propagation distance between sites 5 and 6 (Table 2). The sail lines for the survey are planned to be separated by 112.5 m therefore, dependent on depth, most or all the seabed within the survey could be affected by noise levels that could induce statocyst injury in crustaceans. However, there is no evidence to suggest that lethal levels of noise will be emitted from the seismic source. The predicted minor impacts to crustaceans are not expected to have an impact on the broader crustacean populations in the region for the following reasons: • The minor statocyst impacts are not expected to be lethal and are predicted to repair through time • No other sub-lethal effects are known to occur • Effects on behaviour are very unlikely • The area of seabed exposed is extremely small in the context of the very large and the likely inter-connected crustacean populations of the north west Australian waters (Wilson 2013) that are likely to be inherently resilient to such a small perturbation. Scampi spawning patterns are summarised in Table 1; the key spawning period is identified to be September - October. Proposed control measures to mitigate the impact to scampi from underwater noise include: • Reduction of the operational and acquisition areas to reduce overlap with commercial fishing areas • Use of the smallest array size that will achieve the survey objectives • Most efficient survey design possible to reduce survey time • Avoidance of identified spawning period for scampi (Sept-Oct) The Possum 3D MSS operational area overlaps 9,221 km (2.33%) of the North West Slope Trawl (Scampi) Fishery (NWSTF) management area, and it is possible that fishing operations may occur within the vicinity of the proposed survey activities. The potential impacts of the seismic survey on crustaceans, including scampi, will be further addressed within the Possum 3D MSS EP. Based on the preliminary impact assessment conducted on crustaceans x it is possible that scampi within the Possum 3D MSS Active Source Area could suffer statocyst damage as a result of seismic noise exposure, but this is likely to be recoverable (Day et al 2019).		

ID	Company/Stakeholder	Comms Date (To)	Comms Date (From)	Comms Type	Comms Content (redacted)	Assessment of Claims	Status
		21/06/2021 16:55 cont.			Any effects to stocks in the 2.33% of the NWSTF fishery are unlikely to be permanent (Day et al 2019). The best available scientific evidence shows that seismic noise exposure did not change catch rates of prawns in much shallower waters (Andriguetto-Filho et al 2005). Furthermore, a review of all the available scientific evidence found exposure to seismic noise did not affect catch rates in invertebrates (Carroll et al 2017). As the proposed survey area overlaps an extremely small portion of the fishery, with over 97% of the fishery unaffected by the survey, it is reasonably predicted that the Possum 3D survey is unlikely to affect the overall catch rates of scampi in the North West Slope Trawl fishery. Further information on the preliminary impact assessment and available science is also summarized above. Searcher is requesting a 2-year validity of the EP; a narrower operational window for the activity is currently being defined considering environmental and social constraints and will be communicated to relevant stakeholders in the ongoing consultation Also Noted: Searcher is requesting an EP validity period of 20 months, between December 2021 and end July 2023, to provide several suitable timeslots for completion of the activity. The duration and access period of the activity will be a maximum of 70 days. The acquisition window is now expected to take place in one operational window, within the EP validity, between December and end April (6 month), but may extent to July (9months) with additional controls implemented. *(Table 1 and Table 2 are available in full at the end of this table in WAFIC response spreadsheet:)*		

***Table 1**: Spawning periods of key or target commercial fish species for fisheries historically active within the Possum 3D MSS acquisition area*

Fishery	Key Species	J	F	M	A	M	J	J	A	S	O	N	D	Distribution
Active within 10 km of the Possum 3D MSS acquisition area														
North-west Slope Trawl Fishery (Cwlth)	Scampi													Benthic, in tropical Australian waters from 420-500 m throughout the North-West Shelf (AFMA 2020)

ID	Company/Stakeholder	Comms Date (To)	Comms Date (From)	Comms Type	Comms Content (redacted)	Assessment of Claims	Status
			21/06/2021 16:56		READ RECEIPT received for Proposed Possum 3D MSS & NERA compensation model Sent: June 21, 2021 4:54:46 PM was read on June 21, 2021 4:55:50 PM		
		29/06/2021 15:06		Phone Call	Spoke with WAFIC executive officer : Confirmed email with timing of survey and ran through the outcomes of consultation to date, NERA compensation model and contact with Stakeholder ID130 to provide scampi data as requested by previous representative. WAFIC representative noted that weather has been bad with big rolling waves so many fishers with much smaller boats than seismic vessels and with less technology are not being able to fish to the same extent as normal. WAFIC representative has no further comments at this time. Offer to contact Searcher at any time if any queries arise.		
		23/09/2021 11:47			To Stakeholder ID130 and CC'd to WAFIC: Just a quick update to advise that as our current time frame for the 2022 shooting window is narrowing, we are most likely able to avoid shooting in the northern portion of the Survey till later in the acquisition window. As per your communication with executive officer at WAFIC confirming that Stakeholder ID130 are more focused on your fishing between August to April this means that the survey may avoid the location and timing of your main fishing effort, especially for the 2022 acquisition window. We would therefore appreciate the opportunity to discuss your movements in the area, otherwise we are happy to keep you updated on the survey progress and timeline. Further if you have any contact details you would like to provide us for on-water communications that would be appreciated. Please note that the EP, when submitted, will be available for public comment on NOPSEMA's website should you wish to respond independently		
			23/09/2021 12:20	Email	READ RECEIPT received for Proposed Possum 3D MSS & NERA compensation model Sent: June 21, 2021 4:54:46 PM was read on June 21, 2021 4:55:50 PM		
	Fishing - Commercial (Mackerel Managed Fishery: Area 2)						
23	BARDSLEY FISHERIES PTY LTD	24/12/2019 02:30		Post	Initial notification Fisheries Flyer (F002)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Post	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Post	Invitation for consultation Letter (D001) and updated extension to July 2023 Flyer (F004)		
24	BILYARA HOLDINGS PTY LTD	24/12/2019 02:30		Post	Initial notification Fisheries Flyer (F002)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Post	Invitation for consultation updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Post	Invitation for consultation Letter (D001) and updated extension to July 2023 Flyer (F004)		
45	Stakeholder ID 45	24/12/2019 02:30		Post	Initial notification Fisheries Flyer (F002)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Post	Invitation for consultation updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Post	Invitation for consultation Letter (D001) and updated extension to July 2023 Flyer (F004)		
53	Stakeholder ID 53	24/12/2019 02:30		Post	Initial notification Fisheries Flyer (F002)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Post	Invitation for consultation updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Post	Invitation for consultation Letter (D001) and updated extension to July 2023 Flyer (F004)		
56	KAI NOMINEES PTY LTD	24/12/2019 02:30		Post	Initial notification Fisheries Flyer (F002)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Post	Invitation for consultation updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Post	Invitation for consultation Letter (D001) and updated extension to July 2023 Flyer (F004)		
57	KFM LEASING PTY LTD	24/12/2019 02:30		Post	Initial notification Fisheries Flyer (F002)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Post	Invitation for consultation updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Post	Invitation for consultation Letter (D001) and updated extension to July 2023 Flyer (F004)		
64	Stakeholder ID 64	24/12/2019 02:30		Post	Initial notification Fisheries Flyer (F002)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Post	Invitation for consultation updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Post	Invitation for consultation Letter (D001) and updated extension to July 2023 Flyer (F004)		
66	MARETERRAM FISHERIES PTY LIMITED	25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
95	Stakeholder ID 95	24/12/2019 02:30		Post	Initial notification Fisheries Flyer (F002)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Post	Invitation for consultation updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Post	Invitation for consultation Letter (D001) and updated extension to July 2023 Flyer (F004)		
96	Stakeholder ID 96	24/12/2019 02:30		Post	Initial notification Fisheries Flyer (F002)	See Stakeholder ID95 - same contact	CLOSED
98	SEA HARVEST FISHING COMPANY PTY LTD	6/02/2020 13:52		Email	Initial notification Email (E001) and Fisheries Flyer (F002)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		6/02/2020 13:52		Email	Undeliverable notification		
		6/02/2020 14:00		Online	Contact Form filled out with Link to Searchers Feedback form and Possum 3D MSS information submitted to stakeholder		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		

ID	Company/Stakeholder	Comms Date (To)	Comms Date (From)	Comms Type	Comms Content (redacted)	Assessment of Claims	Status
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
101	Staleholder ID 101	24/12/2019 02:30		Post	Initial notification Fisheries Flyer (F002)	Stakeholder is no longer a fishing license holder, does not wish to be consulted and is not relevant to the Possum 3D MSS, accordingly no further consultation efforts are merited.	CLOSED
			9/01/2020 14:36	Phone	Would like someone to return call regarding the letter sent to fishing license holders. I wish to be removed from the list.		
		9/01/2020 15:05		Phone	Tried to call back no answer		
		9/01/2020 15:33		Phone	Tried to call back no answer		
		9/01/2020 15:49		SMS	Sent sms to advise receipt of message and removal from future correspondence for Possum 3D MSS		
		23/01/2020 15:33		Phone	Tried to call back no answer		
		23/01/2020 16:30		Phone	No longer Fishing License holders and wish to be removed from correspondence.		
112	Stakeholder ID 112	25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
	Fishing - Commercial (Other identified fishers or associations)						
4	ALLPLAINS CORPORATION PTY LTD AND PANORAMA MANAGEMENT PTY LTD	25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
9	Australian Conservation Foundation	25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
10	Australian Council of Prawn Fisheries	25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
22	Australian Southern Bluefin Tuna Industry Association	25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)	Stakeholder has elected to opt out of the consultation process. No concerns raised at time of EP submission accordingly no further consultation efforts are merited.	CLOSED
		25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)		
		25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)		
			25/12/2019 03:57	Email	Opt out form received		
34	Commonwealth Fisheries Association	25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
36	Stakeholder ID 36	25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
37	Stakeholder ID 37	25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
61	Kimberley Professional Fishermen's Association	25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)	Stakeholder has elected to opt out of the consultation process. No concerns raised at time of EP submission accordingly no further consultation efforts are merited.	CLOSED
		26/12/2019 09:00		Email	Opt Out Form received		
69	MG Kailis Group	25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
72	Northern Wildcatch Seafood Australia Pty Ltd	25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
73	Ocean Wild	25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
83	Pearl Producers Association	25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
125	WA Professional Shell Fisherman's Association	25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
127	Western Australian Fishing Industry Council	23/12/2019 14:30		Phone	Initial notification of survey in advance of sending emails to make sure WAFIC is notified of the survey by Searcher and not by a third party.	1. Searcher acknowledged but will continue to communicate with commercial fishing sector and all other identified relevant parties. 2. Acknowledged and thanked 3. Acknowledged and thanked 4. Bathymetry data shows no water depths in survey area as less than 100m however Managed Mackerel Fishers (MMF) Area 2 have been contacted to identify any potential active fishers. 5. Acknowledged and thanked 6. Confirmed PPA was contacted and will continue to keep informed 7. Confirmed EP validity, timing and 1 acquisition window of 70 days has been communicated to stakeholders for response. 8. Searcher confirmed survey designs identify the best "window of opportunity" considering Environmental, social constraints, relevant approvals, and stakeholder communication. Vessel availability is then sourced and booked, in advance where possible. 9. Searcher will address all relevant fisheries in the EP. 10. Acknowledged and thanked 11. Provided access to the acoustic modelling	CLOSED
		7/01/2020 15:06		Email	Initial notification and Fisheries Flyer (F002)		
		7/01/2020 15:06		Email	Initial notification and Fisheries Flyer (F002)		
			7/01/2020 15:07	Email	Confirmation of receipt and *[communications]* contact no longer working with WAFIC, alternative email and phone number supplied		
			7/01/2020 16:46	Email	Please note in relation NOPSEMA EPs, the commercial fishing sector is in almost all cases the ONLY "relevant AND potentially affected party" to the activities described in the EP. This is especially relevant to the Possum EP. Thank you for providing information specific to commercial fisheries in the above attachment. *[F002]* Thank you also for limiting consultation to Mackerel Managed Fishery (Area 2) and North-West Slope Trawl Fishery. WAFIC's agreed engagement with mackerel fishers is no consultation is required for any activity in water depths greater than 100 metres. By and large Mackerel fishers don't fish in water depths greater than 70 metres (as State of the Fisheries notes, around shoals and headlands, a surface trawl fishery) and fish as shallow as is possible. Note there must be a sneaky shoal in your operational area, appreciate caution re notifying Mackerel Area 2 fishers. Thank you for engaging with ASBTIA and *[specified individual fisher]*. Please also ensure you advise and update the Pearl Producers Association, the PPA expects to receive all EP		

ID	Company/Stakeholder	Comms Date (To)	Comms Date (From)	Comms Type	Comms Content (redacted)	Assessment of Claims	Status
					notifications, especially seismic survey information (*[PPA]* copied above). Key potentially affected fishery is the North West Slope Trawl Fishery, this fishery's targeted water depths is between 200 and 750 metres of water, right over the water depths for the Possum MSS (I have copied WAFIC's response to the CFA Association contact *[contact supplied]*). Noting limited scampi specific science but noting current research showing issues with other crustaceans with limited movement (eg Bass Strait lobster) essential that the potential impacts on fishing activities and the scampi resource are addressed in detail in the Possum EP. Please also note it is extremely difficult for active fishers to respond and provide feedback when the survey window is over nearly a two year period – between July 2020 and April 2022. I would also like to express our ongoing frustration with the seismic industry when in each and every consultation the key criteria regarding the survey timing is always "vessel availability", it seems that vessel availability is always the first point of consideration. Our expectation is that the best possible "window of opportunity" is deduced and vessels are booked in advance where possible. Please note that even though a fishery may not be active in the operational area of this proposed Possum 3D MSS, please ensure the EP accounts for the resource of each fishery which has a legal right to fish in the area in the EP. Exception being the South-west salmon fishery – they do not fish, migrate or spawn in this area. We look forward to Searcher Seismic sharing the sound modelling information. Can Searcher Seismic share the environmental impact assessments relevant to commercial fisheries please? Irrespective of the fact that Searcher Seismic is an active member of the NERA managed Consortium Seismic EP (CSEP) project and, as such, agrees to accept and adopt any protocols that are henceforth developed and mutually ratified by both the Consortium and the WA commercial fishing industry during the Possum 3D seismic survey. The proposed CSEP is a long way off, still at the very early stages of consultation. It is WAFIC's expectation that Searcher Seismic includes in all EPs the provision for compensation of potentially affected parties as a matter of course, with a full understanding that any compensation process will be data based. Why wait especially if a affected party can prove a (negative) impact.	12. Environmental impact assessments will be incorporated into the EP which will be available for public comment on NOPSEMA website for 30 days after submission. 13. A Make Good Agreement may be negotiated on a case by case basis, with any fishers that can demonstrate negative commercial or resource effects directly attributable to the activity, as per NERA compensation protocol when ratified. 14. A choice to "Opt-out" is made available to reduce stakeholder fatigue. 15. Searcher will continue to communicate directly with identified, relevant and interested stakeholders providing sufficient time for response. 16. Searcher will try to minimise stakeholder fatigue by sending consultation requests to communicate only with relevant and interested stakeholders. 17. Corrected name and confirmed CSEP is likely to be complete by time Possum 3D MSS EP is submitted and that Searcher has committed to adopt any ratified outcomes. 18. Initial consultation and feedback at the planning stage enables identification of the most appropriate acquisition window, minimising potential adverse effects on relevant stakeholders and apply further relevant controls to the survey. The activity window and access period is a maximum 70 days and has been designed with mitigating controls, to consider sustainability and cumulative impact issues to all relevant parties including avoiding active fishing areas to SE as identified by DPIRD. 19. Acknowledged, however Managed Mackerel Fishery has a catch history in the OA therefore consultation has included area specific current license holders. Searcher must include and respond to all potentially relevant identified activities including recreational divers who may be in or close to the OA. 20. Acknowledged. Fisheries Consultation has been limited to current license holders with a catch history in the OA (or limited to area specific Fisheries where license holders were unable to be identified) with a catch history in the OA. 21. Acknowledged FishCube data covers fishing activity only. Any block with fishing history data has been deemed relevant for contacting potentially impacted stakeholders. 22. initial round of consultation was to gain feedback for planning the Possum 3D MSS. Key indicator species were identified and communicated to stakeholders, including WAFIC, in a subsequent flyer F003 and are further addressed in the EP which will be available for public comment. Provided WAFIC with preliminary noise modelling results It is not possible to avoid overlap however there are no known spawning aggregations for key or indicator species within the OA. 23. Confirmed Possum 3D MSS OA overlaps 9,221 km (2.33%) of the NWSTF management area. Potential impacts and mitigation efforts will be addressed within the EP but provided preliminary assessment summary, with spawning periods, showing catch rates or effects to stocks are unlikely to be changed or permanent and are not expected to impact the broader populations in the region. 24. Cited relevant scientific peer reviewed papers confirming limited impacts are expected from the seismic activity relative to the natural variation in zooplankton concentrations and mortality rates. 25. At the time of the response , there are no simultaneous Seismic Surveys planned over the Possum 3D MSS OA. This information will be updated in the EP which will be made available for 30-day public comment. We are continuing to consider the interests of commercial fishers and narrow the window of opportunity, within the environmental constraints of our survey, to provide the best possible outcome for all parties. In this manner Searcher supports appropriate sharing of ocean access. 26. Searcher has provided preliminary noise modelling results and has included the information in the relevant sections of the EP. The Possum 3D MSS has a limited spatial and temporal footprint with a maximum of 70 days acquisition and has included relevant controls throughout the EP to mitigate potential impacts. 27. Seismic surveys were forwarded to WAFIC and have been communicated to stakeholders, including WAFIC, in a subsequent flyer F003 Planned surveys all have limited spatial overlap with the Possum 3D MSS OA, and have varying activity windows. Only 2 historical surveys in the past 5 years are in the vicinity of Possum and only one has a minor overlap with the OA. 29. Searcher acknowledged that EP consultation requests have increased due to regulatory requirements for both contracted, speculative and lapsed survey EP's. Searcher cannot speculate on the broader reasons for the alleged impact on the fisheries, but can observe that current and previous seismic acquisition in the area is restricted in areal extent and duration. 30. Effects from the survey will be temporary as the seismic vessel traverses each survey line, and fish are expected to move away as the seismic array approaches. The body of peer-reviewed literature does not indicate any long-term abandonment of fishing grounds by commercial species and the total number of fish within the fishery stock remains unchanged. 31. There has been no seismic survey activities over the Possum 3D MSS OA since 2012. Considering that there is limited overlap by the Possum 3D MSS of the fishery areas the impact from the Possum 3D MSS is considered likely to be negligible. 32. Previous and future planned seismic surveys in the vicinity of the Possum 3D MSS were identified, forwarded and are included in the EP. The body of peer-reviewed literature does not indicate any long-term abandonment of fishing grounds by commercial species due to seismic activity, with several studies indicating that catch levels returned to pre-survey levels after seismic activity had ceased however additional mitigation (proposed control measures) have been adopted and communicated to all stakeholders. Searcher is not aware of any other future surveys which will overlap the fisheries, and cannot plan for future work that is unknown. 33. The Possum 3D MSS does not overlap the Joint Authority Northern Shark Fishery. 34. Searcher can confirm that all vessel staff and contractors will be advised of the policy of "zero recreational fishing from support/ commercial vessels" via the induction process and will strictly enforce adherence to the policy during the survey. 35. Assessment of the environmental impacts and risks including the potential impacts of underwater noise from seismic operations on fish stocks, fish spawn, aspects of the food chain (including plankton and benthic ecosystems) will be conducted and incorporated into the EP and made available for public review. 36. Searcher does not intend to do any pre-survey stock assessments at this time. Searcher has used the best available science and further reputable resources including but not limited to the SPRAT database, WA Museum, CSIRO and AIMS research reports, and online government enquiry systems to describe and understand the existing marine environment within the Possum 3D MSS operational and acquisition areas and the environment that may be affected by the survey (EMBA). 37. Well-known and reputable fisheries scientists and fish biologists (e.g. Allen; Edgar; Newman; Mackie) have been	
		24/01/2020 17:10		Email	Due to newly established international guidelines and subsequent EP commitments, we are respectfully contacting you to possibly reconfirm or contact us, at your earliest convenience, if you believe any of your members may be actively diving inside or within 45km of the [redacted] Operations Area as per the attached map [redacted], shape file can be made available upon request. [redacted] Further information is available for any of your members in the EP documents that are posted on the NOPSEMA web site, where the final Environment Plan will be posted in due course if accepted by NOPSEMA. Should you require any additional information or wish to provide feedback please do not hesitate to contact us via return email or through any of the alternate methods detailed below.		
			24/01/2020 17:28	Email	You're asking if anyone is "diving" within 45km of the operational area? How would I know? That's your role to appropriately consult in a bespoke manner with commercial fishers to ascertain what they're doing as well as obtaining information from DPIRD (Fisheries). WAFIC does not do consultation on your behalf - that's your job. Is the [redacted] EP approved? Today is the 24th January, you are targeting a 22 February survey start for an EP which has not been approved! I do not consider this "Fishing" email to be adequate consultation / notification. You're clearly in panic mode and running out of time. In addition, you have set this out at 5:10pm on a Friday at the start of a long weekend - delays and inconveniences of your making. So if you think getting this email out after close of business on Friday before a long weekend gets you under the "4 weeks notice" requirement then you're dreaming. I'm accessing this from my phone (same as fishers), very hard to click through the myriad of attachments. I won't be able to cross check this until some time next week.		
		28/01/2020 10:28		Email	Apologies if you misunderstood my email, as a courtesy to you and your members, with the interest of our commitment to ongoing consultation, we wished to make sure you had the opportunity to let us know of any changes/updates to members possibly not reflected elsewhere. All relevant person's who's functions, interests or activities may be affected by our activity have been consulted and included those obtained from DPRID. The notices, as per our EP commitment, were circulated giving the required 4 weeks notification of commencement of the survey and clearly stated that the commencement was "contingent on EP acceptance prior". Many thanks for your time.		

ID	Company/Stakeholder	Comms Date (To)	Comms Date (From)	Comms Type	Comms Content (redacted)	Assessment of Claims	Status
			30/01/2020 14:00	Email	Further to information contained in the above fact sheet and your email below, note the following points: • Your front page has a register or opt out button. o For all EP consultations, please don't confuse a lack of replies from commercial fishers as a lack of interest / concern. o Commercial fishers are extremely busy fishing plus they receive a phenomenal volume of consultation requests. • NERA Collaborative Seismic EP. o Note the correct NERA EP name is the Collaborative Seismic EP, not the Consortium Seismic EP. o Reference to this EP has no value at this point in time, still very much at ground zero with a long way to go. • Proposed activity schedule is between July 2020 and April 2022 with approval being sought for a July 2020 to June 2022 window. o This is a 12 month access period and pays zero consideration to sustainability and cumulative impact issues commercial fishers / fisheries have with seismic operations. o You are applying for a 12 month window, this is unacceptable to the commercial fishing sector. o The MSS window should be the "best window of opportunity" clearly demonstrating that this time frame minimises all potential impacts. o You haven't even included mitigations to the commercial fishing resource in your consultation. o See next point. • Vessel availability o From my experience ultimately the seismic survey schedule is determined by vessel availability and whale season, very little consideration or minimal consideration to commercial fishing and the commercial fishing resource. • Water depths – no seismic activities in water depths less than 100 metres. o Therefore query Searcher Seismic inclusion of "where possible, plans will be made to avoid overlapping seismic and dive activities". o You queried dive activities last week with me re the [redacted] seismic survey – why? o What commercial fisheries have dive activities in water depths greater than 100 metres? – None. No one can dive that deep, it is a valueless / pointless inclusion in your "fact" sheet. o Please also note that Mackerel fishers do not fish in water depths greater than 100 metres, this is the agreed water depth WAFIC has with licence holders. • Note you have consulted with licence holders who have a catch history in the operational area 2014 – 2018. o To avoid stepover fatigue we appreciate consultation be limited to the stakeholders who are "relevant and potentially impacted" by the activity. o Please be alert, if there were any blocks sourced from FishCube which the Department would not provide data because of less than three vessels (confidentiality rule) then don't assume it is low or no fishing activity area (if DPIRD wasn't clear on that). o The above points only covers actual fishing activities. o You have made no reference at all in your fact sheet regarding the impacts on the key indicator species of each fishery overlapping the Possum 3D MSS operational area, this is a significant issue for commercial fishers. o This implies that Searcher Seismic does not believe that seismic surveys could potentially impact the resource and the food chain. o North West Slope Trawl targets scampi – scampi cannot swim away – how do you mitigate potential impacts to scampi? Have you identified scampi spawning etc patterns? o There is enough research to show there may be potential negative impacts to the resource and the food chain (note the quite recent impact to plankton paper) – not identifying and mitigating peak spawning activities and having this included upfront in your consultation is unacceptable o Have you identified the key indicator species overlapping the operation area? o Have you identified the peak spawning periods of these key indicator species and how Searcher Seismic plans to avoid these peak spawning periods, EP mitigations? • Simultaneous Operations o It is completely unacceptable to the commercial fishing industry for there to be simultaneous seismic surveys over the same fisheries. Completely restricts where they can / cannot fish. Absolutely ensures fish will move from their usual habitats (and therefore a fishers known fishing "mark"). If there are simultaneous surveys – where do our commercial fishers fish??? This is not appropriate sharing of ocean access. o I cannot comprehend the potential impacts to fish spawning activities with simultaneous seismic surveys over the same fisheries. o Note you have listed the simultaneous surveys which are potentially planned to take place in the vicinity of or similar timeframes as the Possum MSS. o You have included nothing about past seismic surveys over the fisheries which the Possum survey overlaps, this is unacceptable. o Seismic survey EP consultation requests and actual seismic survey activities are well up, it is completely unacceptable for a fishery to have seismic survey activities over the commercial fishing area year in and year out and multiple times within a calendar year with no breaks. The Northern Demersal Scalefish and Mackerel fisheries (amongst many others) are being hammered. o What mitigation /considerations have you included and mitigated in your EP regarding past surveys over the fisheries which are being overlapped by the Possum MSS – not just the operational area – over the actual fisheries? o As noted above, there is enough science demonstrating that seismic surveys potentially impact the resource – not accounting for past surveys is completely unacceptable. o You note potential concurrent surveys, have you investigated other surveys which are going through the approval process? What other surveys are planned in the future which will overlap the fisheries being overlapped by Possum (not just the potential concurrent surveys)? o Simply put, no identification of, consideration for or accountable mitigations in place for any form of cumulative impacts. • I cannot see the map clearly enough – does this survey overlap the Joint Authority Northern Shark Fishery?	cited to demonstrate a complete understanding of fish spawning practices, however there are no known spawning aggregations for key or indicator species for commercial fisheries historically active within 10 km of the Possum 3D MSS acquisition area. 38. The potential impacts will be assessed and presented in the EP however a summary outline was presented. The assessment will take into consideration underwater noise modelling, records of commercial fish catches and the best available science on fish behaviour. 39. Searcher Seismic provided information and proposed controls for other proposed seismic surveys, with limited spatial overlap, in the vicinity of the Possum 3D MSS OA, that may or may not be partly acquired within the same calendar year as the Possum 3D MSS. An assessment of the environmental impacts and risks associated with the Possum 3D MSS is being undertaken by Searcher for the development of the EP. 40. Searcher will put in place an appropriate induction process and communication protocols which will convey to all staff, vessel crew, contractors and sub-contractors regarding relevant communication protocols and controls in place regarding interaction with fishers and to mitigate, potential displacement 41. Searcher is continuing to consider the interests of commercial fishers and narrow the window of opportunity, within the environmental constraints of our survey, to provide the best possible outcome for all parties. Controls in place regarding minimising disturbance from the seismic and support vessels have been communicated to stakeholders and are included as part of the second round of consultation and as per the attached Flyer (F003) and will be further detailed in the Environment Plan as submitted to NOPSEMA. In this manner Searcher supports appropriate sharing of ocean access. 42. The main port used by support vessels is most likely to be Broome however this is still to be confirmed. <u>May 2020</u> WAFIC confirmed Searcher have clearly addressed the issues and concerns raised by WAFIC. Further Mackerel Fishery, Pilbara Area 2 (actively fished area), has been defined in the EP (Figure 4.20). Relevant North West Slope Trawl license holders have been forwarded comprehensive information on potential impacts to scampi resource. Evidence based adjustment protocol has been adopted for the Possum 3D MSS. <u>June 2021</u> WAFIC cc'd in response to Stakeholder ID 130. Important consultation outcomes from previous communications forwarded to new representative for review. No further comments raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	
			31/01/2020 09:06	Email	CC'd 30/01/2020 14:00:00 email copied from WAFIC to DPIRD		

ID	Company/Stakeholder	Comms Date (To)	Comms Date (From)	Comms Type	Comms Content (redacted)	Assessment of Claims	Status
			31/01/2020 09:55	Email	I forgot to include the following additional EP queries:In no set order:• What is Searcher's policy in relation to "No fishing from support/commercial vessels"?o Commercial fishers are not permitted to recreationally fish whilst engaged in commercial fishing activityo It is the commercial fishing industry's expectation that there is zero recreational fishing from any support or O&G commercial vesselo Based on potential impact on the (fish) resourceo Based on safetyo Can Searcher please confirm that the "No fishing from support/commercial vessels" policy is abided by all at proponent level and also strictly enforced and communicated with contractors and subcontractors?• What processes does the Searcher have in place to quantitively assess any damage to fish stocks, fish spawn, the food chain such as plankton etc due to seismic survey activity?o Does Searcher plan to do any pre-survey stock assessments?o If Searcher is not planning on doing any pre-survey stock assessments what science is Searcher using to have a complete understanding of the marine environment prior to the commencement of the seismic survey?o What science is Searcher using to demonstrate that you have a full understanding of fish spawning practices and will avoid all seismic activities during spawning periods?o What science is Searcher using to demonstrate that you have a full understanding of fish behavioural activities and will avoid all seismic activities during key fish schooling, migrating etc patterns?• What processes does Searcher have using bespoke or available science to assess short / medium and long term cumulative impacts on key indicator species?o This is especially relevant noting the possibility that there may be concurrent seismic surveys over the same fisherieso Potential concurrent seismic surveys resulting in multiple seismic surveys over the same fisheries within the same fishing season / calendar year• What is the proponent's communication policy with all staff and vessel crew, contractors and sub-contractors regarding interacting and protecting the rights of active commercial fishers on the water?o All support vessels must divert around active fishing activity (even if not convenient to do so)o All support vessels are to avoid any close engagement with any commercial fishing activity o All support vessels in the vicinity of a commercial fishing vessel to do their utmost not to create an ocean disturbance risking the split of schooling fisho What will be the main port used by support vessels?Look forward to your reply.		
		31/01/2020 10:51		Email	Confirming receipt of your emails, thankyou for your feedback. We will be in touch as soon as possible to answer your queries.		
			4/03/2020 15:49	Email	Have you had the chance to respond to the queries raised by WAFIC below in our emails of 30th and 31st January 2020?		
		4/03/2020 16:03		Email	We are just finalising the Sound Modelling and are in the process of putting together the responses to your queries from: • Tuesday, 7 January 2020 16:46 • Thursday, 30 January 2020 14:00 • Friday, 31 January 2020 09:55 We should have these for you shortly, many thanks for your patience.		
			4/03/2020 16:13	Email	Apologies for the pressure, I was worried I had missed something.		
			4/03/2020 16:36	Email	As per the email trail below, do you have a rough timeframe when we can expect to get the next round of information? Appreciate it's difficult times for all. I am working from home from COB today, will still have full access to all information and contact via my mobile. Look forward to your update in due course. Stay safe, stay well.		
		7/04/2020 12:41		Email	Well its definitely different times, I hope you and your members are safe and well. We are now in receipt of the Possum 3D MSS Acoustic Modelling Report which is available for your perusal from the updated link at the top of Feedback form (searcherseismic.com/stakeholderfeedback) or click here. Please find attached an excel spreadsheet (note the additional sheets with the tables provided) with the responses to your queries from: • Tuesday, 7 January 2020 16:46 • Thursday, 30 January 2020 14:00 • Friday, 31 January 2020 09:55 Please also find attached the updated Flyer and consultation email (below) sent with updated information for consultation regarding the Possum 3D MSS. We confirm that Searcher are committed to the best possible outcome for all parties and sincerely thank you for your feedback which is welcome at any time. Invitation for consultation (E002) and updated acoustic modelling Flyer (F003) with WAFIC reply (see ATTACHMENT 1 at the end of this Table).		
			7/04/2020 13:46	Email	Thank you for your email. I have done a mega quick scan. Initially note the following: your email below received 12:41pm today requesting our additional comments and feedback by 15th April 2020 for consideration (with Easter in the middle)! We are INUNDATED with COVID-19 state and federal initiatives etc etc etc – manic here. My responses were in January! I have also had a very quick look at the spreadsheet (I appreciate this format, thank you) – a stack to go through. Can you push back the reply date please?		
		7/04/2020 14:30		Email	We understand that it has taken time to get back to you on your queries, this was due to waiting for our Environmental Consultants to digest the results and outcomes of the Acoustic Modelling to provide valid replies to your queries. I did try to keep the responses very clean and clear in the spreadsheet and will keep to this format if it works well for WAFIC. More than happy to push back the deadline, as such if you have anything that you deem appropriate to include at the planning stages if you could possibly forward by 20 April 2020 however please note that we deem consultation with WAFIC to be valuable and as such your feedback is welcome at any time and will be considered through the EP process and throughout the Possum 3D MSS activity.		
			7/04/2020 15:16	Email	Love the spreadsheet approach, means neither you or I miss anything! Drowning not waving, once the state and federal assistance packages / initiatives are in place should come up for air. Don't hesitate to send me reminders!!!!!		

ID	Company/Stakeholder	Comms Date (To)	Comms Date (From)	Comms Type	Comms Content (redacted)	Assessment of Claims	Status
		28/04/2020 16:22		Email	Hope you and all your members are being able to keep everything going in this awful times. Just checking in to see if you had any further comments to add to the Possum 3D MSS spreadsheet responses.		
			28/04/2020 16:29	Email	Huge thanks for the reminder, been mega-manic here. Promise I will have final comments back by tomorrow (we will need to agree to disagree on some points).		
			29/04/2020 07:27	Email	I get to my desk at 7:00am this morning to clear the oil and gas backlog – you're first on my list.I have "lost" the spreadsheet attachment from your email of 7th April. I have clearly saved the ongoing email trail emails but in replying, have lost your detailed attachment. AAAAAAGH!Can you please re-send?Many thanks and ciao for now		
		29/04/2020 11:09		Email	Just saw your email, please find re-attached the spreadsheet responses for your perusal. Please don't rush or feel pressured to get this back to us today. If you are able to get it back to us this week that would be great. Invitation for consultation (E002) and updated acoustic modelling Flyer (F003) with WAFIC reply in Excel spreadsheet attached. Any problems please do not hesitate to call me.		
			6/05/2020 16:44	Email	Many thanks for the detailed reply, clearly addressing the issues and concerns raise by WAFIC. I also greatly appreciate your response and table information, very clear and bespoke for our commercial fishing queries. Note both the commercial fishing industry and the offshore exploration industries are severely impacted by COVID-19 – here's hoping we all emerge intact in the not too distance future. Note the following: · Understand this is a survey duration of approximately 70 days, timed to meet the best possible (not perfect) environmental and stakeholder impact window. · Thank you for confirming no survey activity in waters less than 100 metres. · Thank you for confirming no recreational fishing from any vessels / support vessels etc associated with this activity and that this requirement is well communicated. · Thank you for confirming ongoing liaison with vessels on the water and support vessels from home port (possibly Broome but to be confirmed). · Thank you for confirming that the commercial fisheries potentially impacted by the Possum survey are Mackerel and North West Slope Trawl. · Please make sure for all EPs that you define which area(s) of the Mackerel fishery – in effect three separate fisheries under the one fishery. For Possum it is Pilbara Area 2 (up to 121°E). · Acknowledge from previous WAFIC contact that our agreed engagement with Mackerel fishers is for all activities up to 100 metre water depth, noting very little mackerel fishing activity in waters above 70 metres water depth. · Note comprehensive information on potential impacts on the North West Slope Trawl scampi resource – please ensure North West Slope licence holders receive this information. · Note we will not agree on potential commutative impacts – what we do agree is that there is lack of science. What WAFIC is seeking is commitment from the offshore and seismic sector for research support to assess potential cumulative impacts. There is phenomenal data available from DPIRD (Fisheries) as a research baseline starting point – for ongoing across industry discussion. · Note WAFIC continues to liaise with the Collaborative Seismic EP process with NERA etc and the associated adjustment protocol. · It is WAFIC's expectations that ALL seismic surveys include the provision of an evidence based adjustment protocol. This has been highlighted by the significant negative impacts recorded against commercial fishing activities (Austral and the NT Bethany seismic EP and more recently, the CGG survey in Bass Strait). · Evidence based does not mean there will be claims from commercial fishers for each and every seismic survey – stress it is evidence based. · WAFIC believes, even for the Possum survey with far less than the average potential seismic survey impacts on commercial fishing and the commercial fishing resource, the Possum EP should absolutely include an evidence based adjustment protocol – based on the formation you have provided you would be very certain that, based on evidence, expectations for an adjustment request would be extremely low (in short, stand by your science, your information and your convictions!!!). I really hope Searcher does this for the Possum survey, in my experience from seismic proponents, Searcher has always been very progressive and a positive leader – please don't disappoint me!		
			19/05/2020 15:54	Email	WAFIC is currently working with Stakeholder ID130 (one of the major fishers in the North West Slope Trawl fishery). We have additional feedback from Stakeholder ID130 regarding the proposed Searcher Seismic Possum survey, I hope to have the full response to you tomorrow.		
		19/05/2020 18:12		Email	Thanking WAFIC for assistance, that's really great news, I've been trying to contact Stakeholder ID130 representative but have been unable to get through to date, unusual and difficult times for all to be sure. We would be happy to consult with either yourself or a Stakeholder ID130 representative in order for Searcher to work toward identifying a suitable window of opportunity, considering Stakeholder ID130's possible fishing activities and within the environmental, temporal and spatial constraints of our proposed survey. I will respond to your previous email separately however I have attached a newly updated Flyer (F004). Due to NOPTA and associated bodies regarding the COVID-19 pandemic as a force majeure event they have made a decision to allow a 12 month suspension and extension of permit title conditions and as such Searcher Seismic Pty Ltd (Searcher) is considering extending its Possum 3D MSS Environment Plan validity to July 2023. Please note there is no change to the: • maximum expected survey duration being one 70 day acquisition. • window of opportunity of the survey which will take place in one operational window, between Dec and end April, (2020/21 or 2021/22 or 2022/23) detailed in attached "F004-Invitation for Consultation" Flyer. Our sincere thanks in advance for your time and anticipated communications. We look forward to being able to consult and work with you to the best possible outcome for all parties. Attached updated extension to July 2023 Flyer (F004)		

ID	Company/Stakeholder	Comms Date (To)	Comms Date (From)	Comms Type	Comms Content (redacted)	Assessment of Claims	Status
			20/05/2020 09:30	Phone	Phone call from WAFIC regarding North West Slope Trawl and Stakeholder ID130, WAFIC is hoping to help assist towards a better EP. The EP is in an area that may impact the North West Slope Trawl fisheries and possibly Mackerel. WAFIC representative has been corresponding with representative at Stakeholder ID130 to assist with their response. I confirmed that I had been trying to contact them. WAFIC representative noted that their reception is not good. Stakeholder ID130 hold licenses in North West Slope Trawl, Pilbara Trap, Pilbara Trawl, Shark bay and a number of other fisheries licenses. Stakeholder ID130 have processing facilities at Fremantle and have recently bought out other concerns and warehouses. WAFIC representative noted that although it was not our fault, WAFIC representative was "pissed off" and wondered when fisheries were going to be notified of the NOPTA 12 month delay for titleholders obligations. I noted that we were not a titleholder and were therefore not notified directly and have gone out to stakeholders as soon as we knew there may be an update to our survey schedule.		
			20/05/2020 10:07	Email	CC'd in email BCC'd to all North West Slope Trawl license holders:Hello North West Slope Trawl licence holders and potentially some lesseesPlease see the above updated fact sheet and map below re the proposed Searcher Seismic Possum 3D Marine Seismic Survey.The consultation for this EP is being done by Searcher Seismic, however, I'm concerned that Searcher have received minimal fisher feedback. This seismic survey is slap-bang over your North West Slope Trawl fishery. If you have concerns that your fishing activities and your scampi resource are going to potentially be impacted by this seismic survey it is important you please either liaise directly with Searcher Seismic or via WAFIC regarding this survey.If you are leasing your licence it would be greatly appreciated if you could also on send this information to your lessee.		
			26/05/2020 09:38	Email	Further to WAFIC's ongoing contact with you and the proposed Searcher Seismic Possum 3D marine seismic survey. WAFIC has been contacted by representative of Stakeholder ID130 (ID99 & ID48). Stakeholder ID130's are one of the major operators in the North West Slope Trawl Fishery and are genuinely concerned regarding the potential impact of the Possum survey on their fishery resource (primarily scampi) and potential impacts to their commercial catch. Stakeholder ID130's representative has provided confidential commercial information showing their vessel plots, please see the map below left. When compared with the Possum fact sheet map on the right there is a clear overlay between considerable commercial fishing activity in the North West Slope Trawl fishery and the Possum MSS operational area. The broader Mermaid Reef area is a key fishing location for Stakeholder ID130's. There are no distinct seasonal patterns as the North West Slope Trawl fishery is a 12 month calendar fishery, vessels are active off and on throughout the full 12 month calendar year. The water depth parameters are from 200 metres up to 750 metres with the majority of trawl activity in 250 to 550 metre range. By and large representative has indicated very broadly speaking, they have a history of most activity in Mermaid Reef / Possum MSS operational area but on occasion can be more focussed on their fishing between August to April. We are not at all confident that the proposed mitigations provided by Searcher Seismic are enough. We are greatly concerned that scampi, an animal which does not move and lives just under the mud line in burrows will be potentially significantly impacted (very little formal science on this specie) and on top of this, potential impacts on Stakeholder ID130's catchability etc. WAFIC reiterates from our most recent email of 6th May 2019 that Searcher Seismic, as a member of the Collaborative Seismic EP project with the associated Commercial Fisheries Adjustment Protocol formally include in this Possum 3D MSS and future marine seismic surveys an evidence based adjustment protocol for potentially affected commercial fishers. Noting the information below, Stakeholder ID130 are very keen to receive your feedback and how you are going to protect their environmental and business interests.		
			16/05/2020 10:36	Email	Follow up email from WAFIC, have I missed / forgotten something? Keen to receive Searcher's reply to the query on behalf of Stakeholder ID130 in the email below.		
		16/07/2020 12:05		Email	I can confirm receipt of your emails dated Tuesday, 26 May 2020 9:38 AM and today Thursday, 16 July 2020 10:36 and apologise for not replying earlier. We are currently working through some items that are integral for the response to your earlier email. As such we wished to provide you with the best and most accurate data and thought it prudent not to offer information that may change or was not ratified. We understand that this is difficult times for all industries and wish to remain supportive of our broader communities. We will come back to you shortly with a response and look forward to working with you to the best possible outcome for all parties.		
			17/08/2020 09:41	Email	Further to the email trail below and appreciate from our last telephone contact (similar time as the last email in mid-July) was that you were still working on this EP. Noting the concerns expressed by Stakeholder ID130 and the potential impacts on their commercial operations, are you in position to provide an update please as to the status of this survey and EP? We are currently working through some items that are integral for the response to your earlier email. As such we wished to provide you with the best and most accurate data and thought it prudent not to offer information that may change or was not ratified. We understand that this is difficult times for all industries and wish to remain supportive of our broader communities. We will come back to you shortly with a response and look forward to working with you to the best possible outcome for all parties.		
		21/08/2020 09:41		Phone Call	Phone call from WAFIC to check current status of EP and to advise that the draft protocol for Fisheries compensation has been released.		
			12/11/2020 09:44	Email	With EP push backs, rescheduling, cancellations, new ones the forward schedule (and for us, potential cumulative impacts) is getting messy / messier. How's Possum looking?		
		12/11/2020 11:05		Email	Acknowledgement of your email. Hoping to provide further information however survey is unlikely to go ahead before the Dec 2021 window of opportunity		
			12/11/2020 14:47	Email	I Googled "images of dead possums" this morning to spice up my email, but thought it might have been viewed in poor tase (my sense of humour!!!) Look forward to the next update.		
			11/01/2021 09:42	Email	Hope you had a lovely Christmas and New Year. What is the latest update on the Possum 3D MSS please?		

ID	Company/Stakeholder	Comms Date (To)	Comms Date (From)	Comms Type	Comms Content (redacted)	Assessment of Claims	Status
		11/01/2021 13:04		Phone Call	General chat and noted no updates on the Possum survey yet.		
			15/02/2021 10:01	Email	Any update on Possum please?		
		15/02/2021 11:19		Email	I'm afraid that in this climate there are a lot of dynamics at play and we would much prefer to come back to you with concrete information which is unfortunately not yet ratified. As soon as we have something tangible to present a notification will go out to all stakeholders and please be assured that we will be working with you to provide the best outcome for all parties.		
			15/02/2021 11:37	Email	Thanks heaps. All the very best for a great 2021 . . . as weird as it looks to be. I sooooo miss jumping on a plane and keep reminding myself of first world problems – many industries doing well, many other industries struggling. Look forward to a Possum update when you are in position to do so. Here's your Possum at work at Searcher Seismic!!!		
		21/06/2021 16:55		Email	CC'd in email to Stakeholder ID130, Proposed extension to July 2023, response to concerns around the impacts to scampi and confirmation of compensation model as produced in consultation with NERA		
		25/06/2021 11:35		Email	Congratulating new representative of WAFIC and confirming important communications and responses to date. Also confirming cc'd reply to Stakeholder ID130. Will keep in formed of any updates to the survey.		
			25/06/2021 15:04	Email	Thank you for your email and for providing a summary on the Possum 3-dimensional Marine Seismic Survey. If you have some time available of Tuesday, can I give you a call to say hello and touch base on the information you have provided?		
		28/06/2021 08:51		Email	Yes I'm available on Tuesday, please give me a call at your convenience. More than happy to have a chance to chat		
		29/06/2021 15:06		Phone Call	Confirmed email with timing of survey and ran through the outcomes of consultation to date, NERA compensation model and contact with Stakeholder ID130 to provide scampi data as requested by previous representative. WAFIC representative noted that weather has been bad with big rolling waves so many fishers with much smaller boats than seismic vessels and with less technology are not being able to fish to the same extent as normal. WAFIC representative has no further comments at this time. Offer to contact Searcher at any time if any queries arise.		
		23/09/2021 11:47		Email	To Stakeholder ID130 and CC'd to WAFIC: Just a quick update to advise that as our current time frame for the 2022 shooting window is narrowing, we are most likely able to avoid shooting in the northern portion of the Survey till later in the acquisition window.As per your communication with executive officer at WAFIC confirming that Stakeholder ID130 are more focused on your fishing between August to April this means that the survey may avoid the location and timing of your main fishing effort, especially for the 2022 acquisition window. We would therefore appreciate the opportunity to discuss your movements in the area, otherwise we are happy to keep you updated on the survey progress and timeline. Further if you have any contact details you would like to provide us for on-water communications that would be appreciated.Please note that the EP, when submitted, will be available for public comment on NOPSEMA's website should you wish to respond independently		
	Fishing - Recreational						
21	Australian Recreational Fishing Foundation	21/01/2020 15:53		Email	Initial notification Email (E001) and Fisheries Flyer (F002)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
26	Broome Billfish Charters	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
28	Broome Fishing Club	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
47	Exmouth Game Fishing Club	4/02/2020 10:55		Email	Initial notification Email (E001) and Fisheries Flyer (F002)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
74	Oceanus Sports Fishing Charters	21/01/2020 17:40		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
75	Oceanwise Research Expeditions	21/01/2020 17:40		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
78	On Strike Charters	21/01/2020 17:58		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
82	Peak Sportfishing Adventures	4/02/2020 10:49		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
93	RecFishWest	25/12/2019 03:01		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)		
			25/12/2019 03:02	Email	Thank you for your email, our office is closed until the 2nd of January. Your email will be attended to then.		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
124	WA Game Fishing Association	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
	Government - Commonwealth						
8	Australian Border Force (Maritime Border Command, Operations Group)	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
11	Australian Customs and Border Protection Service (Coast Watch)	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)		
		25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)		

ID	Company/Stakeholder	Comms Date (To)	Comms Date (From)	Comms Type	Comms Content (redacted)	Assessment of Claims	Status
		25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
12	Australian Fisheries Management Authority	25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)	Searcher phoned to confirm they have consulted relevant associations, fisheries and individual concession holders as identified. To reduce stakeholder fatigue only individuals or companies of fisheries that have been Historically active in the OA are considered relevant for the purposes of this EP. Key commercial fisheries species within the OA and extended EMBA have however been considered throughout the EP. No further response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications and request annnual updates as required.	CLOSED
		25/12/2019 03:24		Email	Initial notification Email (E001) and Fisheries Flyer (F002)		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
			6/04/2020 10:18	Email	Important to consult with all fishers who have entitlements to fish in the proposed area, contacts and links provided for fisheries lists and contact details.		
		6/04/2020 10:50		Phone Call	Call to confirm receipt and thank for fisheries lists and contact details received. Will confirm relevant fisheries with associations and contact individual concession holders as identified with due regard to stakeholder fatigue.		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
14	Australian Hydrographic Office	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise, provide appropriate survey notifications and keep AHO informed once survey proposal is confirmed.	CLOSED
		25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)		
			6/01/2020 09:13	Email	Please accept this email as acknowledgement that your email has been received by the AHO. The data you supplied will now be registered, assessed, prioritised and validated in preparation for updating our Navigational Charting products. These adhere to International and Australian Charting Specifications and standards. These standards may result in some data generalisation or filtering due to the scale of existing charts, proximity to other features, and the level of risk a reported feature presents to mariners.		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
			3/04/2020 08:02	Email	Please accept this email as acknowledgement that your email has been received by the AHO. The data you supplied will now be registered, assessed, prioritised and validated in preparation for updating our Navigational Charting products. These adhere to International and Australian Charting Specifications and standards. These standards may result in some data generalisation or filtering due to the scale of existing charts, proximity to other features, and the level of risk a reported feature presents to mariners.		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
			19/05/2020 08:40	Email	Please accept this email as acknowledgement that your email has been received by the AHO. The data you supplied will now be registered, assessed, prioritised and validated in preparation for updating our Navigational Charting products. These adhere to International and Australian Charting Specifications and standards. These standards may result in some data generalisation or filtering due to the scale of existing charts, proximity to other features, and the level of risk a reported feature presents to mariners.		
			19/05/2020 09:06	Email	Thanks for the update, please keep us informed once survey proposal is confirmed		
17	Australian Marine Oil Spill Centre	30/01/2020 13:17		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
18	Australian Marine Oil Spill Centre - General Manager	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
			25/12/2019 03:25	Email	Confirmation of receipt, Out of office notification returning 8th Jan 2020. Alternative contacts provided for urgent and administrative enquiries. Not the duty phone is: 0438 379 328		
		30/01/2020 13:17		Email	Initial notification Email (E001) and Fisheries Flyer (F002)		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
19	Australian Maritime Safety Authority	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	Searcher has included the requests and information provided in the relevant sections of the EP, committments register and notifications table . Searcher will continue to provide survey notifications.	CLOSED
		25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)		
			3/01/2020 07:10	Email	The Master should notify AMSA's Joint Rescue Coordination Centre (JRCC) by e-mail to rccaus@amsa.gov.au (Phone: 1800 641 792 or +61 2 6230 6811) for promulgation of radio-navigation warnings at least 24-48 hours before operations commence. AMSA's JRCC will require the vessel details (including name, callsign and Maritime Mobile Service Identity (MMSI)), satellite communications details (including INMARSAT-C and satellite telephone numbers), area of operation, requested clearance from other vessels and any other information that may contribute to safety at sea. JRCC will also need to be advised when operations start and end. Contact the Australian Hydrographic Office at datacentre@hydro.gov.au no less than four working weeks before operations, with details relevant to the operations. The AHO will promulgate the appropriate Notice to Mariners (NTM), which will ensure other vessels are informed of your activities. To obtain a vessel traffic plot showing Automatic Identification System (AIS) traffic data for your area of interest, please visit AMSA's spatial data gateway and Spatial@AMSA portal to download digital data sets and maps. A form for requesting customised information and data is also available via the portal (fees and charges may apply).		
			3/01/2020 07:39	Email	Enquiry received, case number is: CAS-39778-Q7X3B8		

ID	Company/Stakeholder	Comms Date (To)	Comms Date (From)	Comms Type	Comms Content (redacted)	Assessment of Claims	Status
			28/01/2020 13:32	Email	The Master should notify AMSA's Joint Rescue Coordination Centre (JRCC) by e-mail to rccaus@amsa.gov.au (Phone: 1800 641 792 or +61 2 6230 6811) for promulgation of radio-navigation warnings at least 24-48 hours before operations commence. AMSA's JRCC will require the vessel details (including name, callsign and Maritime Mobile Service Identity (MMSI)), satellite communications details (including INMARSAT-C and satellite telephone numbers), area of operation, requested clearance from other vessels and any other information that may contribute to safety at sea. JRCC will also need to be advised when operations start and end. Contact the Australian Hydrographic Office at datacentre@hydro.gov.au no less than four working weeks before operations, with details relevant to the operations. The AHO will promulgate the appropriate Notice to Mariners (NTM), which will ensure other vessels are informed of your activities. To obtain a vessel traffic plot showing Automatic Identification System (AIS) traffic data for your area of interest, please visit AMSA's spatial data gateway and Spatial@AMSA portal to download digital data sets and maps. A form for requesting customised information and data is also available via the portal (fees and charges may apply).		
		30/01/2020 11:26		Email	Confirming receipt of response. Searcher will incorporate the advised notifications into the Environment Plan and subsequent survey commitments register.		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
			7/04/2020 08:44	Email	The Master should notify AMSA's Joint Rescue Coordination Centre (JRCC) by e-mail to rccaus@amsa.gov.au (Phone: 1800 641 792 or +61 2 6230 6811) for promulgation of radio-navigation warnings at least 24-48 hours before operations commence. AMSA's JRCC will require the vessel details (including name, callsign and Maritime Mobile Service Identity (MMSI)), satellite communications details (including INMARSAT-C and satellite telephone numbers), area of operation, requested clearance from other vessels and any other information that may contribute to safety at sea. JRCC will also need to be advised when operations start and end. Contact the Australian Hydrographic Office at datacentre@hydro.gov.au no less than four working weeks before operations, with details relevant to the operations. The AHO will promulgate the appropriate Notice to Mariners (NTM), which will ensure other vessels are informed of your activities. To obtain a vessel traffic plot showing Automatic Identification System (AIS) traffic data for your area of interest, please visit AMSA's spatial data gateway and Spatial@AMSA portal to download digital data sets and maps. A form for requesting customised information and data is also available via the portal (fees and charges may apply).		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
32	Commonwealth Department of Industry, Science, Energy and Resources (DISER)	25/12/2019 03:45		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
			25/12/2019 03:46	Email	Confirmation of receipt and out of office notification returning 2 Jan 2020		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
33	Commonwealth Department of the Environment and Energy - Assessments & Sea Dumping Branch	25/12/2019 03:45		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		25/12/2019 03:45		Email	Initial notification Email (E001) and General Flyer (F001)		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
133	Commonwealth Marine Reserves Branch	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	See Director of National parks	CLOSED
39	Department of Agriculture, Water and the Environment – Biosecurity	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	Searcher confirm that this is not an Offshore Installation operation and therefore the received bio-security assessment questionnaire is not relevant. The contracted vessel will be responsible for meeting regulated requirements for import to Australian water if relevant. Searcher has included the applicable requests in the relevant sections of the EP and committments register and will continue to provide survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
			20/04/2020 11:54	Email	Information sent regarding requirements for biosecurity risk and project consideration regarding COVID-19 for department to assess the project. Offshore Installation Operation Bio-security Assessment questionaire received.		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
		2/06/2020 11:42		Phone	• Confirming, as per the information in the email, the Vessel will be used for a Marine Seismic Survey titled "Possum 3D MSS". • The seismic survey area is located entirely in offshore Commonwealth waters within the North West Marine Region therefore the vessel will be operating inside Australian EEZ Waters. • Confirmed Seismic Vessels must comply with MARS reporting requirements. The contracted vessel will be responsible for meeting regulated requirements for import to Australian water if relevant. • Confirmed project is not related to interactions with offshore installations and vessel will not travel between an Australian port and an installation in the course of the activity.		
		2/06/2020 11:51		Email	Thanking for time on the phone. The project is not an installation or vessel that intends to travel between and Australian port and an installation. The survey is located entirely in offshore Commonwealth waters and will be subjec to any relevant Australian government biosecurity reuqirements. Thank you for confirming that the Seismic vessel will be reuqired to report under the Maritime Arrivals Reporting System (MARS).The Seismic Survey Vessel and any support vessels that may be imported into Australia to conduct this seismic survey activity, will do so under the strict requirements of the biosecurity legislation administered by the Australian Department of Agriculture and Water Resources. We understand that the vessel may be required to undertake inspections by a department biosecurity officer prior to mobilisation to the OA. Thank you for forwarding the email contact details for biosecurity assessment, being seaports@agriculture.gov.au. We will further review the biofouling requirements and confirm that any contracted vessel will be required to adhere to any Australian pre-arrival reporting using MARS, ballast water and biofouling requirements.		
40	Department of Agriculture, Water and the Environment – Fisheries	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No concerns raised at time of EP submission, stakeholder has requested to be kept informed of future developments. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
			6/04/2020 09:46	Email	Confirmation of receipt and will respond by 15 April 2020.		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
			29/05/2020 14:02	Email	Confirmation of receipt, department remains interested to be informed of future developments		
41	Department of Communications and the Arts	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)		CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		

ID	Company/Stakeholder	Comms Date (To)	Comms Date (From)	Comms Type	Comms Content (redacted)	Assessment of Claims	Status
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	
42	Department of Defence	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
43	Director of National Parks	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	Searcher has included the requests and information provided in the relevant sections of the EP, committments register and notifications table . We will further adhere to the required Emergency Response notifications should there be any oil/gas pollution incidences associated with the activity and occurring within or are likely to impact on a marine park. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
			25/12/2019 03:25	Email	receipt and notification that office closed till 1 Jan 2020		
			30/01/2020 05:11	Email	Noting location of the survey and approvals requiring an accepted Environment Plan under OPGGS (E) reg 2009. Guidance note link provided to ensure EP identifies and manages all risks and is consistent with the relevant management plans. Further Emergency Response guidance for DNP provided.		
		1/04/2020 21:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
			28/04/2020 10:48	Email	Noting location of the survey and approvals requiring an accepted Environment Plan under OPGGS (E) reg 2009. Notes specific values for Mermaid Reef and Argo-Rowley Terrace Marine Parks. Guidance note link provided to ensure EP identifies and manages all risks and is consistent with the relevant management plans. Further Emergency Response guidance for DNP provided.		
		28/04/2020 12:44		Email	Confirming the EP as submitted to NOPSEMA will: - identify and manage all impacts and risks on Australian marine park values (including ecosystem values) to an acceptable level considering the options to avoid or reduce them to as low as reasonably practicable. - clearly demonstrate that the activity will not be inconsistent with the management plan. We further confirm that we will provide DNP with at least 10 days notification prior to any activities occurring within the marine park (excluding transiting) and notification at the conclusion of the activity. We will further adhere to the required Emergency Response notifications as listed below should there be any oil/gas pollution incidences associated with the activity and occurring within or are likely to impact on a marine park.		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
		28/05/2020 13:40		Email	Thanking for update, comments remain consistent with those provided on 30 Jan20 and 28 Apr 20. Please continue to send updated information to marineparks@awe.gov.au for comment by the DNP.		
			28/07/2021 13:38	Email	Director of National Park's (DNP) attention that consultation has commenced on the proposed Possum 3D MMS. The DNP is a relevant person and is seeking to provide comment. To assist, can you please provide the information sheet on this project and any other requisite information. Can you also confirm whether the proposed operational area crosses into any Australian Marine Parks. Apologies if you have already provided this information.		
			28/07/2021 14:49	Phone	Missed Phone call from Assistant Director		
		28/07/2021 15:46		Email	Noted and attached previous correspndance with alternative contact. Sent updated information (flyer F005 attached) and offer to contact us directly for any further queries		
			30/07/2021 14:10	Email	Given the identification and mitigation of risks to the environment and correspondence with respresentative in 2020, we have no further feedback beyond that already provided.		
		30/07/2021 15:01		Email	Will keep DNP informed. As always Searcher welcomes feedback at any time should anything change or you wish any further detail on the survey please do not hesitate to contact me directly.		
49	Federal Member for Durack - Broome Office	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
			25/12/2019 03:25	Email	Confirmation of receipt and out of office notification alternative urgent contacts supplied		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
68	Maritime Border Control	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
70	National Native Title Tribunal	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	Stakeholder has elected to opt out of the consultation process. No concerns raised at time of EP submission accordingly no further consultation efforts are merited.	CLOSED
			7/01/2020 16:48	Email	Opt Out Form received		
			7/01/2020 16:51	Email	Thank you for your email and the opportunity to provide feedback on the proposed survey. It would not be appropriate for the NNTT to comment on the proposal. We have therefore elected to opt out of the consultation process.		
		23/01/2020 15:44		Email	Many thanks for getting back to us. As you have elected to opt out of the consultation process, I will remove your details from further consultation on the Possum 3D MSS. Should you require any further information or wish to make a comment in the future please do not hesitate to contact us.		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
			2/04/2020 07:20	Email	Opt Out Form received		
106	Strategic Border Command	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
	Government - State WA						
60	Kimberley Ports Authority - Port of Broome	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
77	Office of the Environmental Protection Authority	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
84	Pilbara Ports Authority	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
87	Port Hedland Pilots	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)		CLOSED

ID	Company/Stakeholder	Comms Date (To)	Comms Date (From)	Comms Type	Comms Content (redacted)	Assessment of Claims	Status
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
88	Port Hedland Port Authority	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)		
			25/12/2019 03:25	Email	Confirmation of receipt, out of office notification returning 1 Jan 2020		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
115	WA Department of Biodiversity, Conservation and Attractions	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No concerns or comments regarding the Possum 3D MSS survey. Searcher will provide 4 weeks notification of future operations and mobilisations to contacts provided and survey notifications to EMBAdmin@dbca.wa.gov.au.	CLOSED
			25/12/2019 03:25	Email	Confirmation of receipt and noting mailbox is checke intermittently, phone number supplied		
			25/12/2019 03:25	Email	Contact no longer works at the department. Please forward to Licensing@dbca.wa.gov.au		
			25/12/2019 03:25	Email	Confirmation of receipt and out of office notification returning 23 Jan 2020, alternative phone number for urgent enquiries supplied		
		30/01/2020 13:17		Email	Initial notification Email (E001) and General Flyer (F001)		
			20/02/2020 11:57	Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
		1/04/2020 16:00		Email	Based on the information provided DBCA has no comments in relation to its responsibilities under the Biodiversity Conservation Act 2016 and the Conservation and Land Management Act 1984. Please continue to provide all future notifications to EMBAdmin@dbca.wa.gov.au.		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
		13/07/2020 14:38		Phone	Phone call to West Kimberley (Broome) district office on 9195 5500 to request information on relevant stakeholders in the Possum Operation area. Email contact address given for co-ordinator of moorings and bookings in the Rowley Shoals and advised I contact her for further information.		
		18/07/2020 15:07		Email	As co-ordinator for possible moorings, bookings and main focal point for commercial and recreational visitors to the Rowley Shoals could you possibly advise if 4 weeks notification by email, to DBCA, of mobilisation would be sufficient to advise any possible stakeholder of our seismic survey. Alternatively, if appropriate, would you be able to provide contact details for us to notify the relevant parties directly closer to the commencement of the survey to give 7-10 days forecast of operations.		
		23/06/2021 16:45		Email	As co-ordinator for possible moorings, bookings and main focal point for commercial and recreational visitors to the Rowley Shoals we have scheduled to provide DBCA with 4 weeks notification of mobilisation of the Possum 3D MSS via email. Should you require earlier notification or have details of any relevant individuals who you believe should be contacted due to being in the vicinity of the Operational Area during the Possum 3D survey please do not hesitate to let me know.		
			7/07/2021 10:27	Email	Can you please keep representative from the DBCA Environmental Protection Branch and myself informed of any future operations and mobilisations. At this stage four weeks notification is fine. We can forward the information to recreational and commercial visitors to the Rowley Shoals, if needed. Also, could you please re-send a copy of the flyer, I didn't receive your original email.		
		7/07/2021 10:59		Email	Thank you so much for getting back to us. As requested please find attached a copy of the flyer as sent in the original email and the update to the schedule as below. Proposed Possum 3D Marine Seismic Survey Due to regarding the COVID-19 pandemic as a force majeure event, NOPTA and associated bodies have made a decision to allow a 12 month suspension and extension of permit title conditions. As such Searcher Seismic Pty Ltd (Searcher) is planning to extend its Possum 3D MSS Environment Plan validity to July 2023. • Please note that there is no change to the maximum expected survey duration being one 70 day acquisition. • The survey will take place in one operational window, between 1 Dec 2021 and end April 2023, within the EP validity, other survey details remain the same as the attached "F004-Invitation for Consultation" Flyer. Searcher sincerely appreciate your offer to forward the information to the wider recreational and commercial visitors to the Rowley Shoals as required and will keep Charlotte Patrick and yourself informed of our future operations and mobilisations.		
			7/07/2021 11:30	Email	Many thanks, much appreciated.		
116	WA Department of Fisheries	25/12/2019 03:01		Email	Initial notification Email (E001) and Fisheries Flyer (F002)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
117	WA Department of Mines and Petroleum	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
118	WA Department of Mines, Industry Regulation and Safety	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
119	WA Department of Parks and Wildlife	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)		
		25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)		
		25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		

ID	Company/Stakeholder	Comms Date (To)	Comms Date (From)	Comms Type	Comms Content (redacted)	Assessment of Claims	Status
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
120	WA Department of Planning Lands and Heritage	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	Possum 3D MSS does not intersect with a Registered Aboriginal site or heritage place therefore no approvals are required under the AHA. No further concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
			25/12/2019 03:25	Email	Confiramtion of receipt and out of office notification returning 6 Jan 2020, alternative phone number supplied		
		23/01/2020 11:26		Email	Initial notification Email (E001) and General Flyer (F001)		
		23/01/2020 11:31		Email	Initial notification Email (E001) and General Flyer (F001)		
			23/01/2020 11:48	Email	Can you please provide a GIS shapefile of the proposed area		
		23/01/2020 13:55		Email	Shape files sent for the proposed Possum 3D MSS Operational Area and the Active Source Area		
			24/01/2020 10:56	Email	Possum 3D MSS does not intersect with a Registered Aboriginal site or heritage place therefore no approvals are required under the AHA		
		24/01/2020 11:08		Email	Thanking for getting back to us so quicly and confirming no approvals required under the Aboriginal Heritage Act 1972 (AHA)		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
121	WA Department of Primary Industries & Regional Development	28/10/2019 09:30		Meeting	Millodon as Searcher representative meeting with Research dept to present form for fisheries activity data request. Data and relevant license lists generated in Excel format while at the meeting.	Searcher confirmed relevant fisheries and aquired FishCube catch and effort data annually. No concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise, provide appropriate survey notifications and will continue to request annnual updates as required.	CLOSED
		20/12/2019 12:11		Email	Request for contact list of WA Fisheries license holders for: Mackeral Managed Fishery/Northern Demersal Scalefish Managed Fishery (NDSMF)/Pilbara Fish Trawl (Interim) Managed Fishery (Area 5)/Pilbara Trap Managed Fishery		
		20/12/2019 15:34		Email	Completed application forms for WA Fisheries License holders		
		25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)		
		16/01/2020 01:18		Email	Request for information regarding one listing for block 165200 in 2018 for mackerel managed fishery showing up in the operational area for the proposed possum survey. Is it possible to check if it's a correct entry, as it's a along way offshore for any mackerel fishing to occur and its unusual to only show up in one year.		
			16/01/2020 01:37	Email	I've had a look at this for you . The value record on the logbook is in fact 16.52/120.02 lat/lng which would make it that block of 165200 However, looking at the sessions prior to this I would suggest the value should be 18.52/120.02 I will need to confirm through VMS data. Leave it with me and I'll get back to you once I confirm.		
			16/01/2020 01:38	Phone	phone call from {redacted] to say she has checked the database and the entry is correct.		
		16/01/2020 17:21		Email	Follow up to request data as not received to date		
			17/01/2020 08:05	Email	CC'd in DPIRD inter-department email to follow up on data request		
		17/01/2020 08:05		Phone	Called and left message to request call back for licensing Officer at DPIRD regarding fisheries licenseholders and specifically Zone 2 MMF.		
			20/01/2020 10:18	Email	Licensing Officer sent receipt and requested fisheries lists from the public register.		
		20/01/2020 13:15		Phone	Called and left message to request regeneration of MMF specifically Zone and allocation details missing from Mackerel and Pilbara Trawl fisheries.		
			20/01/2020 14:41	Email	Licensing Officer sent receipt and updated fisheries lists with zone and allocation details from the public register.		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
		21/06/2021 11:18		Email	Request for update to stakeholder information for relevant Fisheries for 2021		
			21/06/2021 13:59	Email	CC'd in DPIRD inter-department email (licensing@fish.wa.gov.au) to follow up on data request		
			2/07/2021 09:20	Email	Licensing Officer sent receipt and updated fisheries lists with zone and allocation details from the public register.		
		2/07/2021 13:05		Email	Many thanks, ill check the files open ok later today. No problem with the delay in the receipts. Keep safe and thanks for your assistance.		
		5/07/2021 17:14		Email	Requesting an update to our Per Fishery Year 10x10Block Fish Cube catch data, search parameters included.		
		7/07/2021 14:06		Email	Requesting an update to our Per Fishery Year 10x10Block Fish Cube catch data, search parameters included.		
			8/07/2021 13:30	Email	We should be able to provide this except 2021 data isn't available yet.		
		8/07/2021 15:41		Email	Data to 2020 is fine – I have updated the request for should it be required.		
			9/07/2021 13:37	Email	Updated form received to fill out for data license agreement with termination date		
		13/07/2021 12:15		Email	Updated form sent for data request		
			19/07/2021 14:50	Email	Data has been processed and provided as Excel spreadsheet with signed data license form		
		19/07/2021 18:26		Email	Confirmation of receipt and thanking for assistance.		
		10/08/2021 14:56		Email	Requesting Receipts for payment.		
122	WA Department of Transport	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	Searcher has reviewed the guidance note and provided DoT the OPEP with key modelling outcomes showing no requirement for shoreline cleanup on 22/04/2020. Searcher has included the requests and necessary information in the relevant sections of the EP, OPEP, committments register and/or notifications table. DoT has requested a copy of the final approved EP and OPEP which will be forwarded upon acceptance. No further concerns raised at time of EP submission. Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
			16/01/2020 08:43	Email	If there is a risk of a spill impacting State waters from the activity, please ensure that the Department of Transport is consulted as outlined in the Department of Transport Offshore Petroleum Industry Guidance Note – Marine Oil Pollution: Response and Consultation Arrangements (September 2018) which can be accessed here - https://www.transport.wa.gov.au/mediaFiles/marine/MAC_P_Westplan_MOP_OffshorePetroleumIndGuidance.pdf		
		23/01/2020 15:04		Email	Many thanks for your feedback and link to the Department of Transport Offshore Petroleum Industry Guidance Note – Marine Oil Pollution: Response and Consultation Arrangements (September 2018). We will review the document and make sure that the Department of Transport is consulted and any relevant controls are added to the Survey Activity and detailed in the Environment Plan.		
			23/01/2020 15:04	Email	Auto reply confirmation of receipt		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		7/04/2020 08:44		Phone	Phone call clarifying OPEP content		
		7/04/2020 17:20		Email	Noting currently preparing the OPEP, key modelling outcomes so no need for shoreline clean-up. Off to send copy of the draft OPEP.		
			7/04/2020 17:21	Email	Auto reply confirmation of receipt		
		7/04/2020 17:29		Email	Signature with contact details missing from previous email, resent.		

ID	Company/Stakeholder	Comms Date (To)	Comms Date (From)	Comms Type	Comms Content (redacted)	Assessment of Claims	Status
			7/04/2020 17:29	Email	Auto reply confirmation of receipt		
			22/04/2020 11:14	Email	Thanking for the details provided. Request to provide a copy of the OPEP.		
		22/04/2020 16:30		Email	Copy of the OPEP provided and will check receipt of email.		
		22/04/2020 16:34		Email	Copy of the OPEP provided and will check receipt of email.		
			22/04/2020 16:34	Email	Auto reply confirmation of receipt		
		22/04/2020 17:02		Email	Attachment B- NEBA had title cell information chopped when it converted to pdf. This has been rectified on the copy as attached.		
			22/04/2020 17:03	Email	Auto reply confirmation of receipt		
			23/04/2020 15:36	Email	Confirmation of receipt of OPEP and given the details in the OPEP and information you have provided, detailing the low risk to State waters, a full review has not been deemed necessary at this time. Request to send final OPEP for their records when finalised.		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
			18/05/2020 14:50	Email	Confirmation of receipt of eMail		
			27/05/2020 11:04	Email	Thank you for the update		
123	WA Department of Transport - Marine Operations	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
126	Western Australian Department of Aboriginal Affairs	23/01/2020 11:26		Email	Initial notification Email (E001) and General Flyer (F001) see WA Department of Plannkng Lands and Heritage	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
129	Western Australian Museum	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	Searcher has included notifying WA Museum of any discovery of shipwreck, aircraft or other underwater cultural heritage feature, under the Commonwealth Underwater Cultural Heritage Act 2018 in the commitments register. No further concerns raised at time of EP submission. Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
			8/04/2020 13:51	Email	We have checked our database and have no record of any known UCH sites located in the proposed survey area. If during the course of your survey there is any discovery made of as yet unlocated/ unreported shipwreck, aircraft or other underwater cultural heritage feature, it is a legal requirement to report it to the WA Museum under the Commonwealth Underwater Cultural Heritage Act 2018.		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
	Local Shire or Council						
27	Broome Chamber of Commerce and Industry	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
54	Independent Community Board - Broome Growth Plan	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
102	Shire of Broome	4/02/2020 12:25		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
			4/02/2020 12:26	Email	Confirmation of receipt and notification of email allocated to relevant officer for action		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
			1/04/2020 18:01	Email	Confirmation of receipt and notification of email allocated to relevant officer for action		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
			18/05/2020 14:51	Email	Confirmation of receipt and notification of email allocated to relevant officer for action		
104	Shire of East Pilbara	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
105	State Member for Kimberley	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
135	State Member for Pilbara	21/01/2020 17:01		Email	Initial notification Email (E001) and General Flyer (F001)	Searcher will keep State Member for Pilbara informed of survey progress and continue to provide survey notifications.	CLOSED
			22/01/2020 10:55	Email	Your correspondence has been received, formal response will be sent if required.		
			15/04/2020 09:07	Email	Missed call from Member for Pilbara, just wondering how the 3D survey is going and if please call back contact numbers supplied		
		15/04/2020 11:30		Email	Phone call to Member for Pilbara, confirmed receipt of flyers and was wondering what stage the project was at. Had no issues with the project and would like to be kept in formed as survey progresses. Thanked us for our good work to date.		
		15/04/2020 13:22		Email	Email follow up thanking for confirming receipt of the flyers and noted acoustic modelling available on our website. We will continue to keep you informed as the survey progresses. Thank you for your kind words on our "good work" to date, Searcher are committed to the best possible outcome for all parties and sincerely thank you for your feedback which is welcome at any time.		
109	Town of Port Hedland (Shire)	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
			25/12/2019 03:25	Email	Confirmation of receipt and out of office notification alternative phone number for urgent enquiries supplied.		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
			1/04/2020 18:02	Email	Confirmation of receipt and will forward to relevant department for action.		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
	Petroleum Exploration & Production						
1	3D Oil	25/02/2020 11:33		Email	Initial notification Email, General Flyer (F001) and Ingress letter	Request for Ingress, shape files and requested information sent. Searcher will confirm Ingress has been granted prior to entry into 3D Oil's Permit. Searcher will plan to avoid overlapping seismic activity or develop a simultaneous operations (SIMOPS) plan where this is not possible. Searcher has included the information provided in the relevant sections of the EP, committments register and notifications table . Searcher will continue to consult with 3D Oil and provide survey notifications.	CLOSED
			15/05/2020 11:58	Email	Questions from Eploration Manager regarding timing and use of boundary for cumulative analysis for Sauropod EP		
		19/05/2020 15:18		Email	Timing and window clarified, Ingress letter resent, General Flyer (F004) and Shape files of the Operational and Acquisition area sent.		
			20/05/2020 07:42	Email	Thanking for comprehensive reply, will review and respond if any questions.		

ID	Company/Stakeholder	Comms Date (To)	Comms Date (From)	Comms Type	Comms Content (redacted)	Assessment of Claims	Status
		15/06/2021 14:12		Email	Updated extension to July 2023 and request for Ingress with Letter		
20	Australian Petroleum Production and Exploration Association	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
			25/12/2019 03:25	Email	Thanking for email and advising no longer works for APPEA, alternative email and phone number supplied		
		30/01/2020 13:17		Email	Initial notification Email (E001) and General Flyer (F001)		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
137	INPEX		13/06/2021 13:00	Form	Feedback Form was completed by stakeholder on 25/03/2021 however due to internal issues it wasn not received 13/06/2021 INPEX is interested to know timing of the survey to co-ordinate surveying at different points in time.	Information regarding Operational Area and Aquisition Area shape files were sent. The INPEX survey is due to start on 20 December 2021 with a duration of 90 days, as the INPEX survey is likely to be completed by April it is unlikely that the surveys will be conducted at the same time. However, Searcher will plan to avoid overlapping seismic activity or develop a simultaneous operations (SIMOPS) plan where this is not possible. Searcher has included the information provided in the relevant sections of the EP, committments register, notifications table. Searcher will continue to consult with INPEX and provide survey notifications.	CLOSED
		18/06/2021 12:48		Email	Notification of survey timing with shapefiles for the OA and AA for discussing survey acquisition dates to avaoid cumulative impacts		
			23/06/2021 14:50	Email	Please find attached GIS files as requested and a copy of our map from the EP. Please note we plan to commence work November 1st this year and all going well we will be finished by April 2022. Should be about 90 days give or take a few days.		
		23/06/2021 15:47		Email	Thanking for quick reply with GIS coordinates and requesting schedule of acquisition for South Western portion of their survey.		
			24/06/2021 06:30	Email	We are not sure yet. Once I know i can fill you in.		
		24/06/2021 09:52		Email	We look forward to hearing from you regarding survey schedule in due course. Could you possibly add Searcher to your notification of commencement/mobilisation and completion please.		
			24/06/2021 10:44	Email	Yep No problem		
			7/09/2021 09:33	Email	We have now let our contract and are making plans to commence the survey late November (around the 30th Nov). Most likely survey activity would commence in the Northern portion and move towards the southern portion. Are you still planning to go ahead in Jan 2022?		
		21/09/2021 12:56		Email	We are still planning to go ahead in 2022 however at this stage, realistically, we are more likely to be closer to a March/April 2022 start, NOPSEMA approval dependent. We are planning to submit the EP fairly soon with additional controls to allow acquisition to end July. (As per flyer (F004) which was attached in the email, dated 18 June 2021 12:48 PM, in the history below.) I have attached an updated flyer (F005) for your perusal, noting if a 2022 start is not viable then we will look to the 2023 acquisition window.If you are planning to commence late November with 90 days acquisition does this mean you are likely to have completed the survey by early March 2022?		
			21/09/2021 13:30	Email	Thanks. Yes if all goes well and we don't have many issues with stoppages we should be done after 90 days or so. At present we plan to start 30 November. Our approval permits us to survey until May31st but we are unlikely to need it.		
		21/09/2021 13:30		Email	Excellent, many thanks for the information, please don't hesitate to contact me if anything changes. Good luck with the survey hope all goes to plan.		
			26/10/2021 11:53	Email	Hope all is well. It looks like our mobilisation timeframe will slip a few weeks. Current target is for 20 Dec in Broome. Are you still on track?		
		26/10/2021 11:53		Email	Still working towards and expecting to start shooting Possum 3D MSS at end of April 2022 subject to EP submission and approval, otherwise we will be looking at next acquisition window 2023.		
81	Pathfinder Energy	25/02/2020 10:59		Email	Initial notification Email, General Flyer (F001) and Ingress letter	Request for Ingress sent and has been forwarded to legal team to confirm content, Searcher will confirm Ingress has been granted prior to entry into Pathfinder's Permits. No comments or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		16/06/2021 14:12		Email	Updated extension to July 2023 and request for Ingress with Letter		
		28/10/2021 17:11		Email	Requested action of Ingress documents please		
			2/11/2021 08:27	Email	Hi guys, attached is Searchers request for the Multiclient Survey over our permits. They need us to sign off. It looks pretty standard to me but you guys need to review the Ingress Agreement before I sign it.		
97	Santos	25/02/2020 11:04		Email	Initial notification Email, General Flyer (F001) and Ingress letter	Request for Ingress sent, Searcher will confirm Ingress has been granted prior to entry into Santos's Permits. SANTOS is planning the Keraudren 3D Extension Seismic Survey with the same vessel as the Possum 3D MSS therefore no simultaneous operations are likely to occur. Searcher will plan to avoid overlapping seismic activity or develop a simultaneous operations (SIMOPS) plan where this is not possible. No concerns raised at time of EP submission, Searcher will continue to conslut with SANTOS and provide survey notifications.	CLOSED
			12/05/2020 11:04	Email	This one has been sitting in my inbox for a while as I've understood the Possum 3D is likely to be delayed until 2021 or even 2022 and that EP submission is likely to be delayed. That being the case, I'm not progressing this for the time being, but will be happy to do so when you advise it is required.		
		12/05/2020 12:39		Email	We are currently reviewing the timeline for the survey and will get back to you with the outcome of the review and timeline for the Ingress document.		
		16/06/2021 14:12		Email	Updated extension to July 2023 and request for Ingress with Letter		
		28/10/2021 11:59		Email	We are now getting close to submitting the EP for the Possum 3D MSS and wondered if you would be able to follow up on the Ingress agreement for the NOPTA approvals, as sent to [redacted] with history below.		
			29/10/2021 13:58	Email	Proposed amendments on T&Cs of the subject Ingress Agreements		
		2/11/2021 16:12		Email	To advise that Searcher legal team confirming ammendments		
		4/11/2021 11:00		Meeting	The Keraudren 3D Extension is being planned using the same vesel as the Possum 3D MSS therefore no simultaneous operations will occur.		
138	TGS		21/06/2021 11:13	Form	Request for further information to be sure of any concerns regarding the survey	Provided detailed information regarding timing and shape files exchanged for survey operational boundaries to determine cumulative analysis for possible concurrent surveys. A separation of >82km exists between our Operational Areas. This is outside the 60km distance we recognise as requiring to develop a simultaneous operations plan (SIMOPS) for any concurrent surveys. Searcher will continue to consult with TGS to provide on-water details for communications and survey notifications.	CLOSED
		9/08/2021 16:09		Email	Notificaiton email ad General Flyer (F005). Sent shape files and requested same, requesting to confirm location, have communications in place to discuss the schedule of the survey acquisition to make sure we are able to avoid any cumulative impacts.		
			10/08/2021 15:53	Email	Operational Area shape files and map received for Capreolus Phase 2. TGS still finalising the acquisition area and welcome the opportunity to discuss further.		
		10/08/2021 17:09		Email	A separation of >82km exists between our Operational Areas. This is outside the 60km distance we recognise as requiring to develop a simultaneous operations plan (SIMOPS) for any concurrent surveys. We do however believe it prudent to make sure we have on-water details for communications should the surveys be running at the same time. We will be in touch to check whether there are changes that may require SIMOPS, with contact details as required.		

ID	Company/Stakeholder	Comms Date (To)	Comms Date (From)	Comms Type	Comms Content (redacted)	Assessment of Claims	Status
139	PGS	9/08/2021 16:09		Email	Notificaiton email ad General Flyer (F005). Sent shape files and requested same, requesting to confirm location, have communications in place to discuss the schedule of the survey acquisition to make sure we are able to avoid any cumulative impacts.	Provided detailed information regarding timing and shape files exchanged for survey operational boundaries to determine cumulative analysis for possible concurrent surveys. No requiement for simultaneous operations (SIMOPS) as PGS have no planned acquisition. Searcher will continue to consult with PGS and provide survey notifications.	CLOSED
			9/08/2021 17:05	Email	We do not currently have acquisition plans, but I would like to be kept in the loop as we do expect to have a vessel in the region. I would also welcome discussion around utilising a PGS vessel for the acquisition.		
		11/08/2021 13:10		Email	Thanking for confirming no acquisition in the vacininty. Will keep notified of the survey and will contact regarding utilising PGS vessel for Possum acquisition.		
		17/08/2021 10:56		Email	Lovely to get the chance to talk to you in person at the WA Seafood awards. Requested a vessel profile sheet to keep options open for use of PGS vessel.		
			17/08/2021 11:37	Email	Received copies of vessel specifications		
		17/08/2021 12:37		Email	Thanked for the vessel specifications		
	Scientific Research						
15	Australian Institute of Marine Science	25/12/2019 03:01		Email	Initial notification Email (E001) and General Flyer (F001)	Searcher provided a current indicative survOPT model with acquisition run-in/run-outs/turns shown in consideration of the IMOS buoy and application of a 1000m buffer will be added to the committments register. Searcher will make sure the buoy location is noted and considered in our final survey design and will keep AIMS informed of any updates, transit paths, times near NWSROW and continue to proivde survey notifications.	CLOSED
		25/12/2019 22:55		Email	Initial notification email custom and Generic Flyer (F001)		
		11/02/2020 22:55		Email	Initial notification email custom and Generic Flyer (F001)		
		12/02/2020 10:14		Phone	Confirmation of receipt of email, Office wishes to respond however is unable to access the online form due to being offsite. Can we please call representative on [redacted] to organise to send a pdf of the form for them please.		
		12/02/2020 10:42		Phone	Called representative on [redacted] (had to call the generic line 93694000 as number not working) to organise the correct email address to send a pdf of the form as their Officer wishes to respond however is unable to access the online form due to being offsite. Noted wishing to make sure if AIMS have any diving activities that we wish to make sure we have relevant contact details available for the Vessel.		
		12/02/2020 11:36		Email	Copy of Form sent in pdf format. Flyer F001 also attached.		
			27/02/2020 16:01	Email	AIMS have a long term oceanographic mooring deployed within the described survey area at S 17deg 45.481', E 119deg 54.366' (designated NWSROW). Also as noted this response is to highlight our equipment located in survey area, and our wish to notified of transit paths and times near NWSROW during active survey campaigns. And one question would be what is the planned clearances of vessel/streamers etc to the ODAS mark?		
		28/02/2020 10:32		Email	Many thanks for getting back to us with information on the AIMS oceanographic mooring in the Possum 3D MS Survey Area. We will review the data in your attachment and get back to you when we have checked relevant details including planned clearances and locked in the final survey times and transit paths. Also as noted this response is to highlight our equipment located in survey area, and our wish to notified of transit paths and times near NWSROW during active survey campaigns. And one question would be what is the planned clearances of vessel/streamers etc to the ODAS mark?		
		8/07/2020 15:28		Email	Updated information on the survey provided (Flyer F004). Indicative survOPT model provided in consideration of IMOS buoy and 1000m buffer. The buoy location to the curved vessel sail line which is 3300m with the outside of the spread around 3300-(1112/2) = ~2750m from the buoy. With application of a 1000m safety buffer the outside of the spread should still be around 1750m from the buffer. We will make sure the buoy location is noted and considered in our final survey design. Notify AIMS of any updates, transit paths and times near NWSROW during the survey. The support vessel is likely to scout over the top of the buoy using the echosounder to verify location, Noting the buoy is anchored on the 200m contour. Requested update if the location of the buoy changes.		
110	University of Western Australia	2/06/2020 15:45		Email	Notified of posssible Ocean Glider program in vacinity of OA. Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)	No concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		15/06/2020 12:29		Phone	Stakeholder has no objections to the seismic survey. The UWA Ocean Glider has been picked up and they have no plans for anything more at this time. Stakeholder is deemed relevant and should be notified of the commencement date of the survey due to the extended temporal nature of the EP for any unplanned Ocean Glider activities.		
128	Western Australian Marine Science Institution	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
	Shipping, Charter or Tourism						
3	Absolute Ocean Charters	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
			1/04/2020 18:05	Email	Confirmation of receipt and giving information regarding charter bookings		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
			18/05/2020 14:51	Email	Confirmation of receipt and giving information regarding charter bookings		
5	Arrow Pearl Co	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
25	Blue Sun2	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
29	Broome Whale Watching Sentosa Charters	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
			18/05/2020 14:50	Email	I am out of the office until this week end and will reply to all emails at this point. If the matter is urgent, alternative number supplied		
44	Diversity Charter Company	21/01/2020 16:26		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		

ID	Company/Stakeholder	Comms Date (To)	Comms Date (From)	Comms Type	Comms Content (redacted)	Assessment of Claims	Status
51	Go Beyond Broome	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
			25/12/2019 03:25	Email	Confirmation of receipt, out of office reply returning 6 Jan 2020		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
			1/04/2020 16:00	Email	Confirmation of receipt. Our office is currently experiencing a very high influx of emails and phone calls. If you are enquiring about our tours or cancellation policy you can access this via our website www.gohorizontalfallstours.com.au. We appreciate your patience at this time and will be in contact as soon as possible.		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
			18/05/2020 14:50	Email	Confirmation of receipt. Our office is currently experiencing a very high influx of emails and phone calls. If you are enquiring about our tours or cancellation policy you can access this via our website www.gohorizontalfallstours.com.au. We appreciate your patience at this time and will be in contact as soon as possible.		
52	GT Diving	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
58	Kimberley Boat Cruises	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
59	Kimberley Expeditions	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
62	Kimberley Quest	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	Searcher will notify stakeholder if survey is schedule changes to include October/November. No further concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
			25/12/2019 03:25	Email	Confirmation of receipt, out of office notification returning 16 Jan 2020, office phone number and alternative email address supplied		
		30/01/2020 12:37		Phone	Confirmed receipt of Flyer and queried if have diving activities in the Mermaid reef and Rowley Shoals area No diving currently in the Possum 3D MSS Area only potentially run diving operations in October/November Confirmed that survey is not likely to be in the months of October/November, however should the schedule change we would get in touch otherwise no further requirement to advise stakeholder.		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
			18/05/2020 14:50	Phone	Confirmation of receipt. Due to the current COVID-19 global health situation, we are experiencing higher than normal enquiries. We ask you to please be patient at this time and to rest assured that we will attend to your request as soon as possible.		
63	Lady M Luxury Cruises	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
65	Lindblad Expeditions	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
67	Marine Tourism WA	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
71	North Star Cruises Australia	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	See Stakeholder ID134 - same company	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
76	Odyssey Expeditions	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
79	One Tide Charters	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
94	Reel Teaser Fishing Adventures	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
100	Sealife Charters	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
108	The Great Escape Charter Company	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)		
			25/12/2019 03:25	Email	Receipt of email and out of office notification, back on deck Monday 6th Jan 2020.		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
			1/04/2020 18:05	Email	Automatic reply confirming receipt and notification of up to 48 hours to respond.		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
134	True North Adventure Cruises	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
			25/12/2019 03:25	Email	Confirmation of receipt and out of office notification returning 2 Jan 2020. Provision of generic cruise details.		
111	Unreel Adventure Safaris	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)		CLOSED
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		

ID	Company/Stakeholder	Comms Date (To)	Comms Date (From)	Comms Type	Comms Content (redacted)	Assessment of Claims	Status
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	
	Other Interested Parties						
107	Telstra	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
			25/12/2019 03:25	Email	Confirmation of receipt, out of office notification returning 6 Jan 2020. Mobile number and alternative contact provided for urgent requests		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
		30/01/2020 13:17		Email	Initial notification Email (E001) and General Flyer (F001)		
113	Vocus Communications (Nextgen Network)	25/12/2019 03:24		Email	Initial notification Email (E001) and General Flyer (F001)	No response or concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
			25/12/2019 03:25	Email	Confirmation of receipt, out of office notification returning 6/1/2020		
		1/04/2020 16:00		Email	Invitation for consultation (E002) and updated acoustic modelling Flyer (F003)		
		18/05/2020 14:50		Email	Invitation for consultation eMail (E003) and updated extension to July 2023 Flyer (F004)		
140	Australian Communications and Media Authority	16/09/2020 10:43		Phone Call	Phone call to request correct contact email for notifications	Searcher has contacted Vocus as the operator of the North West Cable System submarine cable and Telstra. No further concerns raised at time of EP submission. Searcher consider consultation efforts to be adequate however Searcher will continue to address any future comments should they arise and provide appropriate survey notifications.	CLOSED
		16/09/2020 10:56		Email	Initial notification email and Flyer (F005)		
			16/09/2020 14:24	Email	ACMA Enquiries Officer returned the call, advised we were looking for the correct email or contact to advise of the Possum 3D MSS. She confirmed that she is in receipt of the email (correct address) and that she will forward to the relevant department and contact.		
			16/09/2020 14:23	Email	ACMA Enquiries Officer thanked for contacting the Australian Communications and Media Authority (ACMA).Your enquiry has now been escalated to the relevant line area for an expert response. Should the line area require additional information they will contact you directly. Please note, as this enquiry requires an expert response it may be some time before you receive a reply.		
			17/09/2020 12:33	Email	ACMA Policy Analyst thanked us for the opportunity to comment on the Possum 3D Marine seismic survey commencing 1 January 2022, in the waters off the WA coast. Schedule 3A to the Telecommunications Act 1997 provides for submarine cable protection zones to be declared around telecommunications submarine cables that are considered to be of national significance. Certain activities that may affect submarine cables are prohibited or restricted in protection zones. There are currently three protection zones: the North Sydney Protection Zone, the South Sydney Protection Zone and the Perth Protection Zone. Information about the protection zones is available here. As the seismic survey is not in the vicinity of any existing protection zones I have no comments to offer. Nevertheless, I would encourage you to contact directly the operator of any submarine cables in the identified waters to discuss the seismic survey, if you have not done so.		
		17/09/2020 13:25		Email	Thanked ACMA for reply and provision of protection zones. Confirmed that we have contacted Vocus as the operator of the North West Cable System submarine cable and Telstra.		

ATTACHMENT 1 (Appendix E) : WAFIC Response

The response to WAFIC for communication on 7/04/2020 12:41 is provided in the following pages to provide clarity without being limited by the STAKEHOLDER CONSULTATION REGISTER table format.

ID	Correspondance Date	WAFIC Feedback Received	Response
1	31/01/2020 9:55	What is Searcher's policy in relation to *"No fishing from support/commercial vessels"*?	Searcher's policy in relataion to *"No fishing from support/commercial vessels"* is:
2		Commercial fishers are not permitted to recreationally fish whilst engaged in commercial fishing activity	Searcher understands that commercial fishers are not permitted to recreationally fish whilst engaged in commercial fishing activity and can confirm that the Possum 3D MSS will strictly enforce and adhere to all legal requirements during the survey.
3		It is the commercial fishing industry's expectation that there is zero recreational fishing from any support or O&G commercial vessel Based on potential impact on the (fish) resource	Searcher can confirm that will there will be no potential impact on the (fish) resource from recreational fishing due to the policy of no (zero) recreational fishing from the survey or support vessels conducting the Possum 3D MSS seismic survey .
4		Based on safety	Searcher can confirm that all vessel staff and contractors will take part in an induction process to cover general Environmental awareness, safety and requirements from the EP.
5		Can Searcher please confirm that the *"No fishing from support/commercial vessels"* policy is abided by all at proponent level and also strictly enforced and communicated with contractors and subcontractors?	Searcher can confirm that all vessel staff and contractors will be advised of the policy of *"no recreational fishing from support/ commercial vessels"* via the induction process and will strictly enforce adherence to the policy during the survey.
6	31/01/2020 9:55	What processes does the Searcher have in place to quantitively assess any damage to fish stocks, fish spawn, the food chain such as plankton etc due to seismic survey activity?	Assessment of the environmental impacts and risks associated with the Possum 3D MSS is being undertaken by Searcher for the development of the EP as required by OPGGS(E) Regulations 10A and 13. The risk assessment process aligns with ISO 31000:2008 and Searcher's HSE management systems. The risk assessment process includes a detailed assessment of the potential impacts of underwater noise from seismic operations on fish stocks, fish spawn, aspects of the food chain (including plankton and benthic ecosystems). The assessment will use the best available science and bespoke underwater sound modelling conducted by JASCO Applied Services (Australia) Pty. Ltd. (JASCO) on behalf of Searcher, to assess potential damage to fish stocks.
7		Does Searcher plan to do any pre-survey stock assessments?	Searcher does not intend to do any pre-survey stock assessments at this time.
8		If Searcher is not planning on doing any pre-survey stock assessments what science is Searcher using to have a complete understanding of the marine environment prior to the commencement of the seismic survey?	Searcher has used the best available science to describe and understand the existing marine environment within the Possum 3D MSS operational and acquisition areas and the environment that may be affected by the survey (EMBA). This includes developing an understanding of fish behavioural activities during seismic acquisition activity. The body of peer-reviewed literature does not indicate any long-term abandonment of fishing grounds by commercial species due to seismic activity, with several studies indicating that catch levels returned to pre-survey levels after seismic activity had ceased (Carroll et al. 2017). As noted by Przeslawski et al. (2016), it is possible that fish may be displaced from a survey footprint to adjacent areas, however the total number of fish within the fishery stock remains unchanged. Effects from the survey will be temporary as the seismic vessel traverses each survey line, and fish are expected to move away as the airgun array approaches. Searcher has considered all publicly available scientific literature to develop an understanding of the marine environment, including reviewing literature published from surveys conducted on the Rowley Shoals, west of the Possum 3D MSS operational area (the operational area), noting that the literature does not record any spawning aggregations, feeding or nursery grounds at the shoals (Edgar et al. 2017). It is known that the atolls of the Rowley Shoals support a diverse marine fauna typical of oceanic coral reef communities of the Indo-west Pacific and are important stepping-stones in the maintenance of gene flow among the northwest Australian coral reefs. For example, the most common macroinvertebrate recorded in recent biological surveys at the Rowley Shoals (the Trinidad clam Tridacna crocea) was at least six times more abundant in this shoal system than any other in the North-west Marine Region (NWMR) and cryptic fish occurrence was twice as likely to be present on Mermaid and Clerke Reef than at Imperieuse Reef (Edgar et al. 2017). Surveys have also identified 389 species of finfish at the Rowley Shoals (DEWHA 2008a). Mermaid and Clerke Reefs, along with Scott Reef, had the highest biomass of large (>20 cm) reef fishes in comparison to other recently surveyed reefs of the NWMR network (Edgar et al. 2017). The Rowley Shoals also exhibit a greater proportion of living corals and crustose coralline algae than others within the NWMR network (70% total live cover, 70% live hard coral cover, 5% turf algae cover, 20% crustose coralline algae cover and <1% macroalgae cover) (Edgar et al. 2017). This research is considered to be the best available to describe and understand the shoal ecology within the EMBA. Fisheries stock assessments conducted on behalf of DPIRD (e.g. Mackie et al 2003; Mackie & Lewis 2001; de Lestang et. al. 2003), fisheries information sheets (e.g. Rome & Newman 2001) and other well-known and reputable fisheries scientists and fish biologists (Allen; Edgar) have been cited in the description of the existing environment of the EP to demonstrate a complete understanding of the marine environment prior to the commencement of the seismic survey. Conservation values and sensitivities that may occur within the operational area and EMBA were identified through online database search tools: the Protected Matters Search Tool (PSMT) and the Aboriginal Heritage Enquiry System (AHIS). Target species of commercial fisheries with a jurisdictional area that overlaps the EMBA were identified from reputable sources that are used by AFMA and DPRID to guide their fisheries management and planning (e.g. Newman et al 2018). This is required as some fisheries, such as the Northern Demersal Scalefish Managed Fishery, cover a large spatial range and do not target a single species, so indicator species are used to assess the risk to sustainability of all 'like' species susceptible to capture within a fishery resource. Red emperor, rankin cod and bluespotted emperor are considered to be 'indicator species' for the Pilbara region, and Red Emperor and Goldband Snapper for the Kimberley Region (Newman et al. 2018). They were determined to be suitable indicator species based on information on their inherent vulnerability (e.g. biological attributes); risk to sustainability (e.g. stock status); and management importance (e.g. commercial prominence, social and/or cultural amenity value of the resource) (Newman et al. 2018). This research is considered to be the best available to describe and understand the existing marine environment within the EMBA. Further reputable resources (e.g. the SPRAT database, WA Museum, CSIRO and AIMS research reports, and online government enquiry systems) have been used to identify and describe the marine environment, including the sedimentology, climate, oceanic processes, and stakeholder environment (e.g. tourism and recreation, defence). These research and information sources, among others, are considered to be the best available to describe and understand the existing marine environment within the EMBA.
9		What science is Searcher using to demonstrate that you have a full understanding of fish spawning practices and will avoid all seismic activities during spawning periods?	Well-known and reputable fisheries scientists and fish biologists (e.g. Allen; Edgar; Newman; Mackie) have been cited to demonstrate a complete understanding of fish spawning practices. Table 1 (provided below) lists the fish spawning periods for all key or target commercial fish species for fisheries with a jurisdiction over the Possum 3D MSS operational area. Fish spawning periods are spread throughout the year, indicating there is no specific period of higher sensitivity (see Table 1); therefore it is not possible to avoid overlap with the spawning periods for all key or target commercial fish species. Preliminary noise modelling results indicate that fish behaviour may be impacted up to 10 km distance from the acquisition area (JASCO 2020). However there are no known spawning aggregations for key or indicator species for commercial fisheries historically active within 10 km of the Possum 3D MSS acquisition area.
10		What science is Searcher using to demonstrate that you have a full understanding of fish behavioural activities and will avoid all seismic activities during key fish schooling, migrating etc patterns?	It is understood that increased sound levels associated with seismic acquisition may modify the behaviour, local abundance and distribution of fish species, and therefore may temporarily affect commercial fisheries catch rates within the Possum 3D MSS operational area and in adjacent waters. This potential impact will be assessed and presented in the EP. The assessment will take into consideration underwater noise modelling, records of commercial fish catches and the best available science on fish behaviour, however there is little research undertaken on what effect seismic surveys have on fish catch rates. Salgado Kent et al. (2016) acknowledge that there has been some effort to relate fisheries catch data to seismic survey effort, but to date none of the Australian efforts to relate finfish catch rates with seismic surveys have yielded results of any meaning. Effects on fish behaviour are expected to be temporary as the seismic vessel traverses each survey line, and fish are expected to move away as the airgun array approaches. This research is considered to be the best available to describe and understand the existing marine environment within the EMBA. There is no evidence to indicate that there are key fish migrating occurrences of target or indicator species for the fisheries that are able to fish within the operational area. Southern bluefin tuna, which migrate seasonally north to their single spawning ground in the Timor Sea do not follow any distinct depth or feature, instead preferring the temperature range of 19-21°C and adjusting their depth to suit (DAWE 2020) and will move in and out of the AFZ (ABSTIA 2020). It is possible that south-migrating juveniles may occur within the operational area as they follow the Leeuwin Current to the feeding grounds in the Great Australian Bight (ABSTIA 2020). This research is considered to be the best available to describe and understand the existing marine environment within the Possum 3D EMBA.

ID	Correspondance Date	WAFIC Feedback Received	Response
11	31/01/2020 9:55	What processes does Searcher have using bespoke or available science to assess short / medium and long term cumulative impacts on key indicator species?	Searcher Seismic is aware that there are other proposed seismic surveys in the vicinity of the Possum 3D MSS operational area that may or may not be partly acquired within the same calendar year as the Possum 3D MSS. These are listed in Table 3 : An assessment of the environmental impacts and risks associated with the Possum 3D MSS is being undertaken by Searcher for the development of the EP as required by OPGGS(E) Regulations 10A and 13. The risk assessment process aligns with ISO 31000:2008 and Searcher's QHSE management systems. The risk assessment process involves a detailed impact assessment of the impacts of underwater noise from seismic operations including the cumulative impact on key and indicator species using the best available science and bespoke underwater sound modelling conducted by JASCO on behalf of Searcher. Proposed controls to mitigate the impact of concurrent seismic surveys include: •Searcher will engage with proponents for potentially concurrent seismic activities prior to commencing the Possum 3D MSS and will develop a concurrent operations plan for any concurrent surveys identified within 60 km of the acquisition area •A minimum separation distance of 40 km will be maintained between the Possum 3D MSS survey vessel and other operating seismic sources •Searcher will use the smallest practicable seismic array size to meet the geophysical objectives of the survey
12		This is especially relevant noting the possibility that there may be concurrent seismic surveys over the same fisheries	Future planned seismic surveys in the vicinity of the Possum 3D MSS are identified in Table 3. These surveys all have limited spatial overlap with the Possum 3D MSS operational area, and have varying activity windows. Note that at the time of this response, none of the projects immediately adjacent to or with minor overlap to the Possum 3D MSS have approved EP's from the regulator.
13		Potential concurrent seismic surveys resulting in multiple seismic surveys over the same fisheries within the same fishing season / calendar year	See (Index No.48-57) "Simultaneous operations", response to email dated 30/01/2020 14:00:00
14	31/01/2020 9:55	What is the proponent's communication policy with all staff and vessel crew, contractors and sub-contractors regarding interacting and protecting the rights of active commercial fishers on the water?	Searcher will put in place an appropriate induction process and communication protocols which will convey to all staff, vessel crew, contractors and sub-contractors regarding relevant communication protocols and controls in place regarding interaction with fishers and to mitigate, potential displacement
15		All support vessels must divert around active fishing activity (even if not convenient to do so) All support vessels are to avoid any close engagement with any commercial fishing activity	Searcher has contacted commercial fishers and other relevant persons whose interests, functions, and activities may be affected by the proposed Possum 3D MSS. Searcher is continuing to consider the interests of commercial fishers and narrow the window of opportunity, within the environmental constraints of our survey, to provide the best possible outcome for all parties. In this manner Searcher supports appropriate sharing of ocean access.
16		All support vessels in the vicinity of a commercial fishing vessel to do their utmost not to create an ocean disturbance risking the split of schooling fish	Controls in place regarding minimising disturbance from the seismic and support vessels have been communicated to stakeholders and are included as part of the second round of consultation and as per the attached Flyer (F003) and will be further detailed in the Environment Plan as submitted to NOPSEMA.
17		What will be the main port used by support vessels?	The main port used by support vessels is most likely to be Broome however this is still to be confirmed.
18		Further to information contained in the above fact sheet and your email below, note the following points:	
19	30/01/2020 14:00	Your front page has a register or opt out button.	Noted. Searcher seeks to limit ongoing consultation in order to reduce stakeholder fatigue, contacting only the relevant active stakeholders identified. The choice to "Opt-out" is made available to all stakeholders contacted during the consultation period.
20		For all EP consultations, please don't confuse a lack of replies from commercial fishers as a lack of interest / concern.	Searcher is aware that lack of reply may not be due to lack of interest or concern therefore Searcher will continue to communicate directly with identified, relevant and interested stakeholders providing sufficient time for response noting that NOPSEMA publishes the EP for a further extended public comment period for 30 days after submission.
21		Commercial fishers are extremely busy fishing plus they receive a phenomenal volume of consultation requests.	Searcher is aware of the volume of consultation requests, that are exhausting to fishers, often from activities which do not eventuate. Searcher will try to minimise stakeholder fatigue by sending consultation requests to communicate only with relevant and interested stakeholders.
22	30/01/2020 14:00	NERA Collaborative Seismic EP.	NERA Collaborative Seismic EP response:
23		Note the correct NERA EP name is the Collaborative Seismic EP, not the Consortium Seismic EP.	Noted and corrected
24		Reference to this EP has no value at this point in time, still very much at ground zero with a long way to go.	Reference to the NERA EP was to demonstrate awareness of the project, and confirm that Searcher has committed to adopt any ratified outcomes. It is considered likely that the NERA EP will have progressed by the time the Possum 3D MSS activity commences.
25	30/01/2020 14:00	Proposed activity schedule is between July 2020 and April 2022 with approval being sought for a July 2020 to June 2022 window.	Proposed Activity Schedule response :The purpose of the initial round of consultation was to notify potentially relevant stakeholders and gain feedback to add to the planning stages of the Possum 3D MSS. We are currently progressing with acoustic modelling review of environmental and other constraints, including commercial fishing. This process will enable us to consider all factors to allow us to identify the most appropriate acquisition window, minimising potential adverse effects on relevant stakeholders and apply further relevant controls to the survey.
26		This is a 12 month access period and pays zero consideration to sustainability and cumulative impact issues commercial fishers / fisheries have with seismic operations.	Searcher is requesting an EP validity period of 20 months, between December 2021 and end July 2022, to provide several suitable timeslots for completion of the activity. The duration and access period of the activity will be a maximum of 70 days and has been designed with mitigating controls, to consider sustainability and cumulative impact issues to commercial fishers/fisheries which has been communicated to stakeholders as part of the second round of consultation and as per the attached Flyer (F003).
27		You are applying for a 12 month window, this is unacceptable to the commercial fishing sector.	Searcher is applying for a maximum of 70 days within an acquisition window which is now expected to be between December and end April (6 month), but may extent to July (9months) with additional controls implemented.
28		The MSS window should be the "best window of opportunity" clearly demonstrating that this time frame minimises all potential impacts.	The best window of opportunity for acquisition has been reduced, after considering environmental and social factors, so as to minimize all potential impacts from the activity.
29		You haven't even included mitigations to the commercial fishing resource in your consultation.	Mitigation (proposed control measures) have been planned following relevant feedback for the proposed survey and have been communicated to stakeholders as part of the second round of consultation and as per the attached Flyer (F003). This includes control measures relevant to the impact to commercial fishing resources.
30		See next point.	see (Index No.31-32) "Vessel Availability", response to email dated 30/01/2020 14:00:00
31	30/01/2020 14:00	Vessel availability	Vessel availability response:
32		From my experience ultimately the seismic survey schedule is determined by vessel availability and whale season, very little consideration or minimal consideration to commercial fishing and the commercial fishing resource.	The initial determination of seismic survey schedule is based on the key creiteria such as the environmental, social and relevant approvals including stakeholder feedback constraints identified during the EP process, followed by vessel availability within that window of opportunity. The EP defines the window of acquisition, not the vessel availability. Searcher has minimised the survey to exclude the active fishing areas to the south east as identified by DPIRD, further considering and working with any active fishers in the area to the best outcome for all parties.
33	30/01/2020 14:00	Water depths – no seismic activities in water depths less than 100 metres.	Water Depths response : Searcher has designed the survey to be in water depths greater than 100m.
34		Therefore query Searcher Seismic inclusion of "*where possible, plans will be made to avoid overlapping seismic and dive activities*".	We note that the potential for acoustic noise impact on recreational divers adjacent to the operational survey is still a valid consideration; there is no commercial diving activity in the vicinity Possum 3D MSS operational area.
35		You queried dive activities last week with me re the [redacted] seismic survey – why?	[redacted]3D MSS consultation is not relevant to the Possum 3D MSS survey.
36		What commercial fisheries have dive activities in water depths greater than 100 metres? – None. No one can dive that deep, it is a valueless / pointless inclusion in your "fact" sheet.	Seismic activities can impact on recreational diving activities in the vicinity of the survey. Further DPIRD cube data has identified a Managed Mackerel Fishery license holder may have previously been active in the operational area. Searcher must therefore include and respond to all potentially relevant identified activities.
37		Please also note that Mackerel fishers do not fish in water depths greater than 100 metres, this is the agreed water depth WAFIC has with licence holders.	Thank you for advising that the agreed water depth WAFIC has with commercial fishing by Managed Mackerel Fisheries licence holders is <100m. Therefore there will be no overlap given the survey has been designed to be in greater than 100m water depths.
38	30/01/2020 14:00	Note you have consulted with licence holders who have a catch history in the operational area 2014 – 2018.	License Holder consultation response :
39		To avoid stepover fatigue we appreciate consultation be limited to the stakeholders who are "relevant and potentially impacted" by the activity.	Fisheries Consultation has been limited to current license holders (or limited to area specific Fisheries where license holders were unable to be identiifed) with a catch history in the operational area.
40		Please be alert, if there were any blocks sourced from FishCube which the Department would not provide data because of less than three vessels (confidentiality rule) then don't assume it is low or no fishing activity area (if DPIRD wasn't clear on that).	Consultation with DPIRD was clear and any block with fishing data has been deemed relevant for contacting potentially impacted stakeholders. Searcher is aware of the confidentiality rule around fish cube data and has taken this into consideration with the initial Stakeholder Consultation flyer being sent to all current license holders in blocks sourced with listed activity so as to inform any potentially impacted fishers.

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41		The above points only covers actual fishing activities.	Searcher acknowledges the above 2 points cover only fishing activities.
42		You have made no reference at all in your fact sheet regarding the impacts on the key indicator species of each fishery overlapping the Possum 3D MSS operational area, this is a significant issue for commercial fishers.	Key indicator species have been identified for each fishery overlapping the Possum 3D MSS Operational Area and are listed in Table 1. These are addressed in the EP, along with a description of the potential impacts and mitigations. This information has been communicated to stakeholders as part of the second round of consultation and as per the attached Flyer (F003).
43		This implies that Searcher Seismic does not believe that seismic surveys could potentially impact the resource and the food chain.	This comment is out of context and is not justified, Searcher will detail and address potential impacts in the EP.
44		North West Slope Trawl targets scampi – scampi cannot swim away – how do you mitigate potential impacts to scampi? Have you identified scampi spawning etc patterns?	Acoustic modelling has been undertaken by JASCO Applied Services (Australia) Pty. Ltd. (JASCO) on behalf of Searcher for the Possum 3D MSS Searcher. A full discussion of the results is provided in the EP; a preliminary summary is provided here. Details of Environmental Impact on Crustaceans: Physical injury: Physical injury in the form of statocyst damage, which could influence reflexes in crustaceans on the seabed, could occur at the distances from the source outlined in Table 2. The evidence suggests from lobster exposed to seismic noise, that these effects could last for at least a year after exposure (Day et al 2019). However, statocysts are shed when crustaceans moult and although the damage received to individual statocysts in this experiment did not repair, it is expected that the development of new setae may correct the damage (Day et al 2019). Sub-lethal effects: At the lowest level of exposure detailed in Table 2 (202 dB re 1 µPa; pk-pk), American lobster did not show any sub-lethal effects (Payne et al 2008). Based on this evidence it is reasonable to infer that crustaceans, including scampi, are unlikely to suffer sublethal effects beyond the physical injury effect zone detailed in Table 2. Behaviour: Thresholds for seismic noise effects on behaviour of crustaceans have not been developed in the scientific literature. However, Christian et al (2003) showed that crabs monitored by video camera and telemetry tags did not show any changes in movement or behaviour when exposed to received noise level of 197 to 237 dB re 1 µPa – a noise level that is predicted to occur only about 100m from the source for the Possum 3D MSS seismic survey (JASCO, 2020). Similarly, Andriguetto-Filho et al (2005) showed that fishing yields of a shrimp species were unchanged after exposure to seismic noise in shallow waters and Celi et al (2013) showed shrimp did not respond behaviourally to low frequency noise. For the Possum 3D MSS survey, noise levels are predicted to attenuate below 197 dB re 1 µPa within 100m. This is a very conservative and reasonable inference that aligns with the evidence of behaviour effects outlined above and the noise modelling results presented in Table 2. Reproduction/Spawning: A detailed scientific study with an excellent experimental design that exposed berried female rock lobster to seismic noise showed that embryos and larvae were not affected (Day et al 2016). Embryos in early stage development were exposed to noise levels between 209 – 212 dB dB re 1 µPa SPL while still attached to the berried females. The study tracked both the success of hatching, and the survival and fitness of the larvae once hatched and found that seismic noise had no effects (Day et al 2016). Based on this evidence and the similarity in reproductive mode in scampi (a key fishery within the operational area), effects from seismic noise on reproduction in scampi is highly unlikely. Furthermore, since seismic noise is unlikely to influence behaviour (discussed above) seismic activity is also unlikely to influence spawning behaviour. Evaluation of Environmental Impact on Crustaceans: The seismic survey has the potential to cause statocyst damage in crustaceans as detailed above, however these impacts are likely to be partially recoverable after successive moulting (Day et al 2019). The modelling from JASCO (2020) for the Possum 3D MSS survey shows that noise at the seabed that could cause statocyst damage to crustaceans is predicted to 141m either side of each sail line in shallower waters. However, as the vessel moves into deeper water, this propagation distance at the seabed will become smaller, as shown by the difference in propagation distance between sites 5 and 6 (Table 2). The sail lines for the survey are planned to be separated by 112.5 m therefore, dependent on depth, most or all the seabed within the survey could be affected by noise levels that could induce statocyst injury in crustaceans. However, there is no evidence to suggest that lethal levels of noise will be emitted from the seismic source. The predicted minor impacts to crustaceans are not expected to have an impact on the broader crustacean populations in the region for the following reasons: • The minor statocyst impacts are not expected to be lethal and are predicted to repair through time • No other sub-lethal effects are known to occur • Effects on behaviour are very unlikely • The area of seabed exposed is extremely small in the context of the very large and the likely inter-connected crustacean populations of the north west Australian waters (Wilson 2013) that are likely to be inherently resilient to such a small perturbation. Scampi spawning patterns are summarised in Table 1; the key spawning period is identified to be September - October. Proposed control measures to mitigate the impact to scampi from underwater noise include: • Reduction of the operational and acquisition areas to reduce overlap with commercial fishing areas • Use of the smallest array size that will achieve the survey objectives • Most efficient survey design possible to reduce survey time • Avoidance of identified spawning period for scampi (Sept-Oct)
45		There is enough research to show there may be potential negative impacts to the resource and the food chain (note the quite recent impact to plankton paper) – not identifying and mitigating peak spawning activities and having this included upfront in your consultation is unacceptable	As mentioned above, the purpose of the initial round of consultation in December 2019 was to notify potential relevant stakeholders and gain feedback to add to the planning stages of the Possum 3D MSS. The spawning periods for all key and target commercial fish species within the operational area have been determined and are included in Table 1 and have been communicated to stakeholders as part of the second round of consultation and as per the attached Flyer (F003). This consultation include information on the updated proposed survey acquisition periods. The recent paper by CSIRO (Richardson, Matear & Lenton 2017), found that while there was a local impact on zooplankton biomass within the vicinity of a seismic survey, there was no discernable effect at a regional scale when ocean circulation is considered. Impacts to zooplankton are only expected to be significant within a short range (e.g. 8 km) of seismic survey areas, based on the maximum worst case mortality exposure suggested by McCauley et al. (2017) and modelling completed by CSIRO (Richardson, Matear & Lenton 2017). After 22 days of ongoing acquisition, CSIRO (Richardson, Matear & Lenton 2017) found that no further relative increase in zooplankton mortality occurs, due to recruitment of zooplankton via currents from adjacent areas, and conditions return to normal within a few days of a survey ceasing. Further, natural mortality rates can be as high as ~60%, and not entirely as a result of predation, therefore, limited impacts are expected from the seismic activity relative to the natural variation in zooplankton concentrations and mortality rates.
46		Have you identified the key indicator species overlapping the operation area?	Key indicator species overlapping the operation area have been identified and are listed in Table 1. Red Emperor and Goldband Snapper are considered to be 'indicator species' for the Kimberley Region with Red Emperor, Rankin Cod and Bluespotted Emperor for the Pilbara region (Newman et al. 2018). They were determined to be suitable indicator species based on information on their inherent vulnerability (e.g. biological attributes); risk to sustainability (e.g. stock status); and management importance (e.g. commercial prominence, social and/or cultural amenity value of the resource) (Newman et al. 2018).

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47		Have you identified the peak spawning periods of these key indicator species and how Searcher Seismic plans to avoid these peak spawning periods, EP mitigations?	Preliminary noise modelling results (JASCO, 2020) indicate that fish behaviour may be impacted up to 10 km distance of the acquisition area. The spawning periods for all key and target commercial fish species from all the commercial fishery that overlap the Possum 3D MSS Operational area, including those that are historically active within 10 km of the acquisition area, are included in Table 1. It is not possible to avoid overlap with the spawning periods for all key or target commercial fish species, as fish spawning periods are spread throughout the year, indicating there is no specific period of higher sensitivity. There are no known spawning aggregations for key or indicator species within the Operational Area. (See Index No.44 - response to email dated 30/01/2020 14:00:00, for mitigation control measures applied).
48	30/01/2020 14:00	Simultaneous Operations	Simultaneous Operations response :
49		It is completely unacceptable to the commercial fishing industry for there to be simultaneous seismic surveys over the same fisheries. Completely restricts where they can / cannot fish. Absolutely ensures fish will move from their usual habitats (and therefore a fishers known fishing "mark"). If there are simultaneous surveys – where do our commercial fishers fish??? This is not appropriate sharing of ocean access.	There are currently no simultaneous Seismic Surveys planned over the Possum 3D MSS Operational area. At the time of this response, none of the projects adjacent to or with minor overlap to the Possum 3D MSS have approved EP's from the regulator. Searcher has contacted commercial fishers and other relevant persons whose interests, functions, and activities may be affected by our proposed Possum 3D MSS. We are continuing to consider the interests of commercial fishers and narrow the window of opportunity, within the environmental constraints of our survey, to provide the best possible outcome for all parties. In this manner Searcher supports appropriate sharing of ocean access.
50		I cannot comprehend the potential impacts to fish spawning activities with simultaneous seismic surveys over the same fisheries.	Preliminary noise modelling results for the Possum 3D MSS area (JASCO, 2020) indicate that fish behaviour may be impacted up to 10 km distance to the acquisition area. Fish spawning periods for fisheries with a jurisdiction over the Possum 3D MSS area are spread throughout the year, indicating there is no specific period of higher sensitivity (see Table 1), and that it is not possible to avoid overlap with the spawning periods for all key or target commercial fish species. However as discussed above, there are no known spawning aggregations for key or indicator species within this zone. As noted by Przeslawski et al. (2016), it is possible that fish may be displaced from a survey footprint to adjacent areas, however the total number of fish within the fishery stock remains unchanged. Effects on fish behaviour are expected to be temporary as the seismic vessel traverses each survey line, and fish are expected to move away temporarily as the airgun array approaches. The Possum 3D MSS has a limited spatial and temporal footprint with a maximum of 70 days acquisition. Searchers consultation is used to identify relevant Fishers who may be in the area and work with them to attain reasonable access and sharing of commercial ocean resources. The proposed Possum 3D MSS operational area overlaps approximately 13,440 km2 of the MMF Area 2, which is ~2.7% of the total size of Area 2. By and large mackerel fishers do not operate in water depths more than 70 m (via consultation with WAFIC 7/01/2020). Therefore Mackerel fishers are not expected to be encountered or excluded from fishing grounds due to the Possum 3D MSS, even though catch and effort data provided by DPIRD included one historical record of effort (2018) within the operational area from 2014-2019. The Possum 3D MSS operational area overlaps 9,221 km (2.33%) of the NWSTF management area, and it is possible that fishing operations may occur within the vicinity of the proposed survey activities. However, considering the large size of the fishery management area, the long distance to known fished areas, the low effort level within the fishery, current and anticipated ongoing communications with fisheries stakeholders, interactions between the NWSTF and the proposed survey activities are expected to be minimal and manageable. The proposed Possum 3D MSS operational area overlaps ~4,326 km2 or 1.08% of the whole of Area 2 of the Northern Demersal Scalefish Managed Fishery (NDSMF). Area 2 is historically where fishing effort is concentrated (DPIRD 2000) and is further divided into three zones, A - C. The Possum 3D MSS operational area overlaps ~42 km2 of zone B (0.06% of the whole zone) and ~4,290 km2 of zone C (2.58% of the whole zone). There is no overlap with zone A. The majority of fishing effort is recorded with zone B – in 2016 the catch was 965 t of the total 1,173 t recorded for the fishery (DoFWA 2016). The fishing range of operators within the NDSMF extends throughout the area of Zone B (Principal Fisheries Scientist DPIRD pers. comm. 6 May 2019) with the majority of effort occurring north of Broome (FishCube data obtained from DPIRD 20/06/19), and limited effort occurring within Zone C. Proposed controls to mitigate the impact of simultaneous seismic surveys on fish spawning include: • Searcher will engage with proponents for potentially concurrent seismic activities prior to commencing the Possum 3D MSS and will develop a concurrent operations plan for any concurrent surveys identified within 60 km of the acquisition area • Maintain a minimum separation distance of 40 km between the Possum 3D MSS survey vessel and other operating seismic sources • Use the smallest practicable seismic array size to meet the geophysical objectives of the survey
51		Note you have listed the simultaneous surveys which are potentially planned to take place in the vicinity of or similar timeframes as the Possum MSS.	Future planned seismic surveys in the vicinity of the Possum 3D MSS are identified in Table 3 and have been communicated to stakeholders as part of the second round of consultation and as per the attached Flyer (F003). These surveys all have limited spatial overlap with the Possum 3D MSS operational area, and have varying activity windows. Note that at the time of this response, none of the projects immediately adjacent to or with minor overlap to the Possum 3D MSS have approved EP's from the regulator.
52		You have included nothing about past seismic surveys over the fisheries which the Possum survey overlaps, this is unacceptable.	Previous seismic surveys in the vicinity of the Possum 3D MSS are identified in Table 4. There was no overlap between Keraudren 3D and the proposed Possum 3D MSS survey, and only minor overlap with Zeester. There is no other known seismic activity within the Possum 3D MSS operational area) in the last 5 years.
53		Seismic survey EP consultation requests and actual seismic survey activities are well up, it is completely unacceptable for a fishery to have seismic survey activities over the commercial fishing area year in and year out and multiple times within a calendar year with no breaks. The Northern Demersal Scalefish and Mackerel fisheries (amongst many others) are being hammered.	Previous and future planned seismic surveys in the vicinity of the Possum 3D MSS are identified in the Tables 3 & 4. Seismic survey EP consultation requests have increased due to regulatory requirements for both contracted and speculative surveys. However there has been no actual seismic survey acquisition over the Possum 3D MSS operational area in the last 5 years, and there are currently no other approved EP's. For example, there are two lapsed Environmental Plans (Nightcap 3D and Greater Pina Colada MC MSS) over the area, for which seismic acquisition did not and will not occur. Searcher cannot speculate on the broader reasons for the alleged impact on the fisheries, but can observe that previous seismic acquisition in the area is restricted in areal extent and duration.
54		What mitigation /considerations have you included and mitigated in your EP regarding past surveys over the fisheries which are being overlapped by the Possum MSS – not just the operational area – over the actual fisheries?	The body of peer-reviewed literature does not indicate any long-term abandonment of fishing grounds by commercial species due to seismic activity, with several studies indicating that catch levels returned to pre-survey levels after seismic activity had ceased (Carroll et al. 2017). As noted by Przeslawski et al. (2016), it is possible that fish may be displaced from a survey footprint to adjacent areas, however the total number of fish within the fishery stock remains unchanged. Effects from the survey will be temporary as the seismic vessel traverses each survey line, and fish are expected to move away as the seismic array approaches.
55		As noted above, there is enough science demonstrating that seismic surveys potentially impact the resource – not accounting for past surveys is completely unacceptable.	As outlined in the responses above, there has been no seismic survey activities over the Possum 3D MSS operational area since 2012. As discussed above, the Possum 3D MSS operational area overlaps the active fisheries: • ~13,440 km2 or ~2.7% of the total size of MMF Area 2. By and large mackerel fishers do not operate in water depths more than 70 m (via consultation with WAFIC 7/01/2020). Therefore Mackerel fishers are not expected to be encountered or excluded from fishing grounds due to the Possum 3D MSS. • ~4,326 km2 or 1.08% of the whole of Area 2 of the Northern Demersal Scalefish Managed Fishery (NDSMF) (0% of zone A, 0.06% of zone B and 2.58% of zone C). • 9,221 km (2.33%) of the NWSTF management area. It is possible that fishing operations may occur within the vicinity of the proposed survey activities, and Searcher will continue to consult with the relevant fishers to attain reasonable access and sharing of commercial ocean resources. Considering that there is limited overlap by the Possum 3D MSS of the fishery areas as outlined above, the impact from the Possum 3D MSS is considered likely to be negligible on the entire fisheries. However proposed controls to further mitigate the presence of the survey vessel include: • Reduction of the operational and acquisition areas to reduce overlap with commercial fishing areas • Use of the smallest array size that will achieve the survey objectives • Maintain a minimum separation distance of 40 km between the Possum 3D MSS survey vessel and other operating seismic sources. This will ensure no significant discernible cumulative impacts to zooplankton Additional mitigation (proposed control measures) for the impact of the proposed survey on commercial fishing resources have been detailed in response to other queries throughout this response.

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56		You note potential concurrent surveys, have you investigated other surveys which are going through the approval process? What other surveys are planned in the future which will overlap the fisheries being overlapped by Possum (not just the potential concurrent surveys)?	Previous and future planned seismic surveys in the vicinity of the Possum 3D MSS are identified in Tables 3 & 4. However there has been no actual seismic survey acquisition over the Possum 3D MSS operational area in the last 5 years, and there are currently no other approved EP's. The body of peer-reviewed literature does not indicate any long-term abandonment of fishing grounds by commercial species due to seismic activity, with several studies indicating that catch levels returned to pre-survey levels after seismic activity had ceased (Carroll et al. 2017). As noted by Przeslawski et al. (2016), it is possible that fish may be displaced from a survey footprint to adjacent areas, however the total number of fish within the fishery stock remains unchanged. Effects from the survey will be temporary as the seismic vessel traverses each survey line, and fish are expected to move away as the airgun array approaches. Tables 3 & 4 include the known seismic surveys that are currently in the process of Environmental Plan approval. Searcher is not aware of any other future surveys which will overlap the fisheries, and we cannot plan for future work that is unknown.
57		Simply put, no identification of, consideration for or accountable mitigations in place for any form of cumulative impacts.	Mitigations (proposed control measures) for the impact of cumulative impacts of the proposed survey on commercial fishing resources have been communicated to stakeholders as part of the second round of consultation and as per the attached Flyer (F003). Given the reported short timeframes for recovery from behavioural and TTS effects (Popper 2018; Popper et al 2005; 2014), temporal separation of repeated data acquisition can be expected to avoid or reduce the potential cumulative effects of infill or reacquisition lines therefore significant intra-project cumulative impacts from seismic sound are not predicted. Proposed controls to mitigate the impact of simultaneous seismic surveys on fish spawning include: • Searcher will engage with proponents for potentially concurrent seismic activities prior to commencing the Possum 3D MSS and will develop a concurrent operations plan for any concurrent surveys identified within 60 km of the acquisition area • Maintain a minimum separation distance of 40 km between the Possum 3D MSS survey vessel and other operating seismic sources • Use the smallest practicable seismic array size to meet the geophysical objectives of the survey
58	30/01/2020 14:00	I cannot see the map clearly enough – does this survey overlap the Joint Authority Northern Shark Fishery?	The western boundary of the Joint Authority Northern Shark Fishery is to the east of Cape Leveque with the proposed Possum 3D MSS being ~210 km west of Broome. The Possum 3D MSS therefore does not overlap the Joint Authority Northern Shark Fishery.
59			
60	7/01/2020 16:46	Please note in relation NOPSEMA EPs, the commercial fishing sector is in almost all cases the ONLY "relevant AND potentially affected party" to the activities described in the EP. This is especially relevant to the Possum EP.	Searcher acknowledge that the commercial fishing sector is a relevant and potentially affected party, but also have identified other relevant and potentially affected parties. Searcher is continuing to communicate with all relevant parties.
61	7/01/2020 16:46	Thank you for providing information specific to commercial fisheries in the above attachment.	Noted thank you.
62	7/01/2020 16:46	Thank you also for limiting consultation to Mackerel Managed Fishery (Area 2) and North-West Slope Trawl Fishery.	Noted thank you.
63	7/01/2020 16:46	WAFIC's agreed engagement with mackerel fishers is no consultation is required for any activity in water depths greater than 100 metres. By and large Mackerel fishers don't fish in water depths greater than 70 metres (as *State of the Fisheries* notes, around shoals and headlands, a surface trawl fishery) and fish as shallow as is possible. Note there must be a sneaky shoal in your operational area, appreciate caution re notifying Mackerel Area 2 fishers.	Managed Mackerel Fishers (MMF) Area 2 have been contacted as unable to isolate which individual is the potentially affected party in the Operational Area. The bathymetry data available to Searcher does not show any water depths in the Possum 3D MSS area being less than 100 meters. However we will continue to correspond with the MMF Area 2 fishers to identify any potential interatctions.
64	7/01/2020 16:46	Thank you for engaging with ASBTIA and [name redacted].	Noted thank you.
65	7/01/2020 16:46	Please also ensure you advise and update the Pearl Producers Association, the PPA expects to receive all EP notifications, especially seismic survey information (*PPA Executive Officer* copied above).	PPA was contacted during the initial stage of consultation by Searcher; we will continue to keep them informed
66	7/01/2020 16:46	Key potentially affected fishery is the North West Slope Trawl Fishery, this fishery's targeted water depths is between 200 and 750 metres of water, right over the water depths for the Possum MSS (I have copied WAFIC's response to the CFA Association contact [name redacted]). Noting limited scampi specific science but noting current research showing issues with other crustaceans with limited movement (eg Bass Strait lobster) essential that the potential impacts on fishing activities and the scampi resource are addressed in detail in the Possum EP. Please also note it is extremely difficult for active fishers to respond and provide feedback when the survey window is over nearly a two year period – between July 2020 and April 2022. ?	The Possum 3D MSS operational area overlaps 9,221 km (2.33%) of the North West Slope Trawl (Scampi) Fishery (NWSTF) management area, and it is possible that fishing operations may occur within the vicinity of the proposed survey activities. The potential impacts of the seismic survey on crustaceans, including scampi, will be further addressed within the Possum 3D MSS EP. Based on the preliminary impact assessment conducted on crustaceans x it is possible that scampi within the Possum 3D MSS Active Source Area could suffer statocyst damage as a result of seismic noise exposure, but this is likely to be recoverable (Day et al 2019). Any effects to stocks in the 2.33% of the NWSTF fishery are unlikely to be permanent (Day et al 2019). The best available scientific evidence shows that seismic noise exposure did not change catch rates of prawns in much shallower waters (Andriguetto-Filho et al 2005). Furthermore, a review of all the available scientific evidence found exposure to seismic noise did not affect catch rates in invertebrates (Carroll et al 2017). As the proposed survey area overlaps an extremely small portion of the fishery, with over 97% of the fishery unaffected by the survey, it is reasonably predicted that the Possum 3D survey is unlikely to affect the overall catch rates of scampi in the North West Slope Trawl fishery. Further information on the preliminary impact assessment and available science is also summarized, see (Index No.44) response to email dated 30/01/2020 14:00:00. Searcher is requesting a 2-year validity of the EP; a narrower operational window for the activity is currently being defined considering environmental and social constraints and will be communicated to relevant stakeholders in the ongoing consultation Also Noted: Searcher is requesting an EP validity period of 20 months, between December 2021 and end July 2022, to provide several suitable timeslots for completion of the activity. The duration and access period of the activity will be a maximum of 70 days. The acquisition window which is now expected to be between December and end April (6 month), but may extent to July (9months) with additional controls implemented and communicated to stakeholders as part of the second round of consultation and as per the attached Flyer (F003).
67	7/01/2020 16:46	I would also like to express our ongoing frustration with the seismic industry when in each and every consultation the key criteria regarding the survey timing is always "vessel availability", it seems that vessel availability is always the first point of consideration. Our expectation is that the best possible "window of opportunity" is deduced and vessels are booked in advance where possible.	Searcher can confirm that at all times our survey designs identify the best "window of opportunity" considering key criteria such as Environmental, social constraints and relevant approvals, including the results of relevant stakeholder communication. Information regarding vessel availability within the determined best "window of opportunity" is then sourced. Searcher make a concerted effort to book vessels in advance however due to the unknown timeframe for regulatory approvals, and the limited access to specialised vessels this is not alwaays possible.
68	7/01/2020 16:46	Please note that even though a fishery may not be active in the operational area of this proposed Possum 3D MSS, please ensure the EP accounts for the resource of each fishery which has a legal right to fish in the area in the EP.	Searcher has reviewed and will address all the relevant fisheries for the region in the EP, including those which are not active in the area. The EP will be available for public comment on the NOPSEMA website in due course.
69	7/01/2020 16:46	Exception being the South-west salmon fishery – they do not fish, migrate or spawn in this area.	Thank you for confirming that the South-West Salmon fishery do not fish, migrate or spawn in area of the Possum 3D MSS.
70	7/01/2020 16:46	We look forward to Searcher Seismic sharing the sound modelling information.	The acoustic modelling undertaken by JASCO Applied Services (Australia) Pty. Ltd. (JASCO) on behalf of Searcher for the Possum 3D MSS. Due to the size of the document it has not been directly attached however the report is now available on Searchers website (http://searcherseismic.com/stakeholderfeedback). Please click on the link for "Acoustic Modelling Report" to view.
71	7/01/2020 16:46	Can Searcher Seismic share the environmental impact assessments relevant to commercial fisheries please?	Assessment of the environmental impacts and risks associated with the Possum 3D MSS is being undertaken by Searcher for the development of the EP as required by OPGGS(E) Regulations 10A and 13. The risk assessment process aligns with ISO 31000:2008 and Searcher's HSE management systems. The risk assessment process includes a detailed assessment of the potential impacts of underwater noise from seismic operations on fish stocks, fish spawn, aspects of the food chain (including plankton and benthic ecosystems). The assessment will use the best available science and bespoke underwater sound modelling conducted by JASCO (2020), to assess potential damage to fish stocks. Environmental impact assessments from the acoustic modelling results and scientific information will be included in the EP provided to NOPSEMA. NOPSEMA publishes the EP for public comment for 30 days after submission.

ID	Correspondance Date	WAFIC Feedback Received	Response
72	7/01/2020 16:46	Irrespective of the fact that Searcher Seismic is an active member of the NERA managed Consortium Seismic EP (CSEP) project and, as such, agrees to accept and adopt any protocols that are henceforth developed and mutually ratified by both the Consortium and the WA commercial fishing industry during the Possum 3D seismic survey. The proposed CSEP is a long way off, still at the very early stages of consultation. It is WAFIC's expectation that Searcher Seismic includes in all EPs the provision for compensation of potentially affected parties as a matter of course, with a full understanding that any compensation process will be data based. Why wait especially if a affected party can prove a (negative) impact.	Reference to the NERA EP was to demonstrate awareness of the project, and confirm that Searcher has committed to adopt any ratified outcomes. It is considered likely that the NERA EP will have progressed by the time the Possum 3D MSS activity commences. A Make Good Agreement may be negotiated, on a case by case basis, with any fishers that can demonstrate negative commercial or resource effects directly attributable to the activity.

Table 1 **: Spawning periods of key or target commercial fish species for fisheries historically active within the Possum 3D MSS acquisition area**

Fishery	Key Species	J	F	M	A	M	J	J	A	S	O	N	D	Distribution
Active within 10 km of the Possum 3D MSS acquisition area (2014-2019)														
Mackerel Managed fishery (WA)	Spanish mackerel													Single genetic stock along the WA coast. Adults in waters up to 50 m, spawning probably occurs at large number of sites over protracted season (Mackie and Lewis, 2001; Mackie *et al.* 2003; Mackie *et al.* 2010)
North-west Slope Trawl Fishery (Cwlth)	Scampi													Benthic, in tropical Australian waters from 420-500 m throughout the North-West Shelf (AFMA 2020)
Not Active within 10 km of the Possum 3D MSS acquisition area (2014-2019) (West Australian)														
Northern Demersal Scalefish Managed Fishery (WA)	Red Emperor													Adults in waters 10-180 m near reefs, lagoons, limestone sand flats and gravel patches from the Abrolhos, WA, along the northern coast to the Qld/ NSW border. (DPRID Principal Scientist, pers. Comm. 2019)
	Rankin cod													Adults in waters 10-150 m near drop-offs, deep rocky reefs. Juveniles near inshore coral reef from the Abrolhos to Cape Leveque (DoF 2004).
	Blue spotted emperor													Single genetic stock (Johnson at el. 1993) and dispersed spawning along the entire continental shelf from Geraldton to Darwin, occurring near coral reefs and on sandy or weedy bottoms, to 180 m (Gaughan *et al.* 2018; Rome & Newman 2010).
	Goldband Snapper													Adults in waters 50-200 m near shoals, flat bottom and offshore reef (DPRID Principal Scientist, pers. Comm. 2019) found throughout northern Australia and the tropical Indo-West Pacific
Kimberley and Pilbara Crab Managed Fisheries	Mud Crab													Estuaries throughout northern WA south to Shark Bay (AFMA 2020)
	Blue Swimmer Crab													Estuaries and offshore waters to 50 m depths throughout Australian coastal waters (de Lestang et. al. 2003)
Marine Aquarium Fish Managed Fishery	*N/A - Fishery targets no specific species*													
Broome Prawn Managed Fishery	Western King Prawn													Juveniles in shallow estuaries or seagrasses, adults in deep waters to 30 m on mud or sand throughout the West-Pacific region (Penn 1980)
Nikol Bay Prawn Managed Fishery	Banana Prawns													Juveniles in shallow estuaries or seagrasses, adults in deep waters to 45 m on mud or sand throughout northern Australian waters (Penn 1980)
Pilbara Fish Trawl (Interim) Managed Fishery and Pilbara Trap Managed Fishery	Red Emperor													Adults in waters 10-180 m near reefs, lagoons, limestone sand flats and gravel patches from the Abrolhos, WA, along the northern coast to the Qld/ NSW border. (DPRID Principal Scientist, pers. Comm. 2019)
	Rankin Cod													Adults in waters 10-150 m near drop-offs, deep rocky reefs. Juveniles near inshore coral reef from the Abrolhos to Cape Leveque (DoF 2004).
Pilbara Line Fishery	Ruby Snapper													Adults found in depths 80-300 m, associated with reef in the tropical waters of the Indo-Pacific (Allen 2009)
	Goldband Snapper													Adults in waters 50-200 m near shoals, flat bottom and offshore reef (DPRID Principal Scientist, pers. Comm. 2019) found throughout northern Australia and the tropical Indo-West Pacific
Pearl Oyster Managed Fishery	Pearl Oyster													Flat bottom with high water movement, to 60 m but most common 5-30 m (DPIRD 2020) found in northern Australian coastal waters from Shark Bay.
West Coast Deep Sea Crustacean Managed Fishery	Crystal (Snow) Crabs													13 – 2,200 m, commonly fished at 500-800 m in WA (PIRSA 2015) and limited to WA waters.
	Giant (king) Crabs													180-720 m (PIRSA 2015), endemic to southern Australian waters.
	Champagne (spiny) Crabs													500-800 m, commonly fished at 200 m in WA (PIRSA 2015) found in coastal waters off southern Australia and New Zealand.
Specimen Shell Managed Fishery	*N/A - Fishery targets no specific species*													
Not Active within 10 km the Possum 3D MSS acquisition area (2014-2019) (Commonwealth)														
Western Skipjack Tuna Fishery	Skipjack Tuna													Pelagic, to 260 m (AFMA 2020) throughout tropical waters of the Pacific, Atlantic and Indian Oceans.
Western Tuna and Billfish Fishery	Yellowfin Tuna													Pelagic to 250 m (AFMA 2020) throughout tropical waters of the Pacific, Atlantic and Indian Oceans.

Table 2: ***Maximum predicted distances (Rmax) to effect thresholds for invertebrates (lobster and scallops) at the sea floor, for all single pulse sites (From JASCO, 2020)***

Sound exposure threshold (PK-PK)	R_{max} (m)	
	Site 5 (220m depth)	Site 6 (121m depth)
Physical injury observed in lobster and not observed in scallops 213 dB re 1 µPa [a,b,c]	87	141
Physiological effects in scallops and not observed in lobster 209 dB re 1 µPa [a,b]	217	344
No impact detected in lobster 202 dB re 1 µPa [d]	666	560
Corals 226 dB re 1 µPa [d]	Threshold not reached	Threshold not reached

a Day et al. (2019), lobster
b Day et al. (2016a), lobster and scallops
Day et al. (2017), scallops
d Payne et al. (2008), lobster

Table 3: ***Future Planned Seismic Surveys***

Titleholder	Project Name	Activity Window
Potential surveys adjacent or with minor overlap to Possum 3D MSS Operational Area		
INPEX Browse E&P Pty Ltd (EP under assessment)	2D Seismic Survey WA-532-P, WA-533-P and WA-50-L	Nov 2020 – May 2021 (Max 140 days) (timing of the activity within proximity to Possum 3D MSS is unknown).
3D Oil Limited (EP under assessment)	Sauropod 3D Marine Seismic Survey (WA-527-P)	Jan – April 2020 or 2021 (Max 60 days)
Santos WA Northwest Pty Ltd (EP under assessment)	Keraudren 3D Extension	1st Feb – 31st July 2020-2022 (Est 132 days total)
Potential surveys in region - no overlap with Possum 3D MSS Operational Area		
TGS NOPEC Geophysical Company Pty Ltd (EP open for comment)	Capreolus-Phase II 3D MSS (West of Possum OA)	Not yet determined activity period 2020 - 2023
PGS Australia Pty Ltd (Approved)	Rollo MC (West of Possum OA) -	Feb – May Activity window (for 5 years 2019 – 2024)
TGS-NOPEC Geophysical Company Pty Ltd (Approved)	North West Shelf Renaissance North	Not yet determined activity period of 2 years from 2018

Table 4: ***Past Seismic Surveys***

Titleholder	Project Name	Activity Window
Past surveys in vicinity of Possum 3D MSS		
Fugro Multiclient	Zeester 3D	Acquired 2012
Santos	Keraudren 3D	Acquired May – July 2019

APPENDIX F SCHEDULE OF ONGOING NOTIFICATIONS

Searcher will provide activity specific notifications to relevant stakeholders prior to, during and following completion of the Possum 3D MSS EP, as summarised below.

Relevant Person or Organisation	Responsible	Notification	Method	Timing
Prior to Survey Commencement				
WAFIC & Stakeholder ID 130	Searcher	Advise when EP is available for review, provid elink to NOPSEMA website	Written	When available on NOPSEMA website for public comment
Australian Hydrographic Office (AHO)	Searcher	Notice of EP Acceptance	Written	On EP Acceptance by NOPSEMA
State: WA Department of Transport (DOT)	Searcher	Copy of final OPEP forwarded on acceptance	Written	On EP Acceptance by NOPSEMA
Commonwealth : Department of Defence/Australian Hydrographic Office (AHO)	Searcher	Notice of the estimated mobilisatlon (survey location, timing) to enable the promulgation of Notice to Mariners. Email: datacentre@hydro gov.au	Written	No less than four working weeks before operations commence
State: WA Department of Biodiversity, Conservation and Attractions	Searcher	4 weeks notification of commencement to DBCA Environmental Protection Branch (charlotte.patrick@dbca.wa.gov.au) and Marine DBCA Operations Officer - West Kimberley (jutta.wildforster@dbca.wa.gov.au) Survey Notifications to EMBAdmin@dbca.wa.gov.au	Written	4 weeks prior to commencement
Relevant persons or organisations listed in Appendix E	Searcher	Notification of commencement with timing, location and duration of the survey	Written	4 weeks prior to commencement unless otherwise agreed
Australian Institute of Marine Science	Searcher	Notification of commencement with transit paths and times near NWSROW during the survey	Written	14 days prior to commencement
Other seismic Operators Within 60km of the ASA with concurrent surveys	Searcher	Notification of commencement with agreed details of CONOPS plan	Written	14 days prior to the start of the survey unless otherwise agreed
Ingress/Titleholders	Searcher	Notification of commencement with date and time of expected entry to and exit from the Title(s)	Written	at least 14 days prior to the start of the survey unless otherwise agreed
Commonwealth : Director of National Parks	Searcher	Change of survey details. Email: marineparks@environment.gov.au; and marineparks@awe.gov.au	Written	10 days prior to survey commencement
Commonwealth : NOPSEMA	Searcher	Notice of commencement of Possum 3D MSS. Email: submissions@nopsema.gov.au	Written	At least 10 days prior to mobilisation
Relevant commercial fishers & WAFIC	Searcher	Notification of commencement with timing, location, duration of the survey and cautionary zones around the survey vessel	Written	7-14 days prior to the start of the survey
Western Australian Department of Mines, Industry Regulation and Safety	Searcher	Notice prior to commencement confirming the start date of the proposed activity. Email: petroleumenvironment@dmirs.wa.gov.au	Written	Prior to mobilisation

Relevant Person or Organisation	Responsible	Notification	Method	Timing
Commonwealth : Australian Maritime Safety Authority (AMSA)	Searcher	Notice to the Joint Rescue Coordination Centre (JRCC} of estimated mobilisation date and details to enable AusCoast warning broadcasts to be issued. Email: rccaus@amsa.gov.au Phone: 1800 641 792 or +61 2 6230 6811. Information required includes vessel details (name, callsign and Maritime Mobile Service Identity (MMSI)), satellite communications details (INMARSAT-C and satellite telephone), area of operation, requested clearance from other vessels.	Written/verbal	24-48 hours prior to mobilisation and on Survey Commencement
During the survey				
Commercial fishers actively operating in or near the survey area	Searcher/Vessel	24-hour look-ahead communication	Radio, AIS email and /or SMS	Daily
Commonwealth: NOPSEMA	Searcher	Notice of a change of contact person, titleholder or Joint venture arrangement. Email: submissions@notpsema.gov.au	Written	As required
Western Australian Museum	Searcher	Notify WA Museum of any discovery of shipwreck, aircraft or other underwater cultural heritage feature	Written	As required
Other seismic operators within 60km of the ASA with concurrent surveys	Searcher	Notification as detailed within the agreed CONOPS plan	Written	As required
Commonwealth : Director of National Parks	Searcher	Notification of oil/gas pollution incidences to 24 hour Marine Compliance Duty Officer on 0419 293 465. (Including titleholder details/time and location of the incident/name of marine park likely to be effected/proposed response arrangements as per the Oil Pollution Emergency Plan	Written	If required
After the survey				
Western Australian Department of Mines, Industry Regulation and Safety	Searcher	Notice of completion of Possum 3D MSS. Email: petroleumenvironment@dmirs.wa.gov.au	Written	After demobilisation
Commonwealth : Department of Defence/Australian Hydrographic Office (AHO)	Searcher	Notice of completion (survey location, timing) of Possum 3D MSS to enable the cease of issue of Notice to Mariners. Email: datacentre@hydro gov.au	Written	After demobilisation
Commonwealth : Australian Maritime Safety Authority (AMSA)	Searcher	Notice to the Joint Rescue Coordination Centre (JRCC} on survey completion Email: rccaus@amsa.gov.au Phone: 1800 641 792 or +61 2 6230 6811.	Written/verbal	After demobilisation

Relevant Person or Organisation	Responsible	Notification	Method	Timing
Commonwealth : Director of National Parks	Searcher	Change of survey details. Email: marineparks@environment.gov.au; and marineparks@awe.gov.au	Written	After demobilisation
State: WA Department of Biodiversity, Conservation and Attractions	Searcher	Survey Notifications to EMBAdmin@dbca.wa.gov.au	Written	After demobilisation
Commonwealth: NOPSEMA	Searcher	Notice of completion of Possum 3D MSS. Email: submissions@nopsema.gov.au	Written	Within 10 days of demobilising
Relevant persons or organisations listed in Appendix E	Searcher	Notice of completion of Possum 3D MSS.	Written	Within 14 days of demobilisation unless otherwise agreed
Relevant commercial fishers	Searcher	Notification of commencement with timing, location, duration of the survey and cautionary zones around the survey vessel	Written	Within 14 days of demobilisation unless otherwise agreed
Other seismic operators within 60km of the ASA with concurrent surveys	Searcher	Notice of completion of Possum 3D MSS.	Written	Within 14 days of demobilisation unless otherwise agreed
Commonwealth: NOPSEMA	Searcher	Notice of end date of operation of the EP. Email: submissions@nopsema.gov.au	Written	When all activities and obligations under the EP have been completed

APPENDIX G FULL TEXT RECORDS OF STAKEHOLDER CONSULTATION

NOTE: This report is considered sensitive information as described by NOPSEMA Policy note N-04750-PL1347 Revision 7 2019 and is not to be published in the public domain.

Generic invitation for consultation flyers have been included as detailed in section 8 :
F001 - General Flyer (23 December 2019)
F002 - Fisheries Flyer (23 December 2019)
F003 - Update Flyer (30 March 2020)
F004 - Update Flyer (13 May 2020)
F005 - Update Flyer (1 June 2021)
F006 - Update Flyer (28 October 2021)

Invitation for Consultation

Possum 3D Marine Seismic Survey

23 December 2019

Introduction

Searcher Seismic Pty Ltd (Searcher) is proposing to acquire a multiclient three-dimensional (3D) marine seismic survey (MSS) in the North-west Marine Region (NWMR) offshore from Western Australia.

This flyer is to inform you of the details of the survey with location and to invite you, as a potentially relevant person, to "register" and be involved in the consultation process for the regulatory environmental approvals procedure, as well as relevant communications related to the survey activity.

Throughout the project development, Searcher will provide each relevant person sufficient information to allow them to make an informed assessment of the possible consequences of the proposed survey on their functions, interests or activities.

Searcher will provide all stakeholder feedback to NOPSEMA, within the proposed activity's Environment Plan. Under recent changes to Environment Regulations, all environment plans for offshore oil and gas activities will be published, and draft environment plans for offshore seismic surveys and exploration drilling activities will be open for an additional 30-day public comment period prior to NOPSEMA assessment.

Please formally register using your preferred method from the contact details below. Alternatively, you may "opt-out" if you do not wish to receive further project updates or believe that this activity will not affect your functions, interests or activities.

Key Activity Information

- The proposed Possum 3D Multiclient Marine Seismic Survey ('Possum 3D MSS') Operational Area lies entirely within the NWMR and incorporates Exploration Permits WA-436-P, WA-479-P, WA-487-P, WA-527-P and WA-540-P (as shown on the following page)
- The proposed Possum 3D MSS is planned to be conducted over a maximum operational survey area of approximately 13,447 sq km.
- The proposed activity is scheduled to commence sometime between July 2020 and April 2022.
- Maximum expected survey duration with contingency time is 70 days; 24 hour operations.
- Final survey timing will be dependent on environmental considerations, regulatory approvals, vessel availability and weather conditions. Based on these unknown influences, the option to conduct the activity at any time between July 2020 and June 2022 whilst adhering to any identified environmental constraints, will be sought for approval from the relevant government regulators.
- Every effort will be made to time the activity to minimise any potential adverse effects on relevant stakeholders.

About Searcher

Searcher has a history of effectively conducting marine seismic surveys in the waters offshore of Western Australia with successful environmental outcomes attained from rigorous operating rules, environmental risk assessment, planning and management.

Searcher are committed to open and honest communications about the planned activity and to listening to relevant stakeholder concerns. Your valuable feedback will assist us in identifying all relevant stakeholders for the planned survey and assessing how it may affect your functions, interests or activities.

If you have any feedback, comments or questions on this activity you may contact us or opt-out via:-

Register

Contact

Possum 3D Consultation Team

PHONE:
+61 (0)8 9327 0301

WEBSITE:
searcherseismic.com/stakeholderFeedback

EMAIL:
feedback@searcherseismic.com

Opt Out

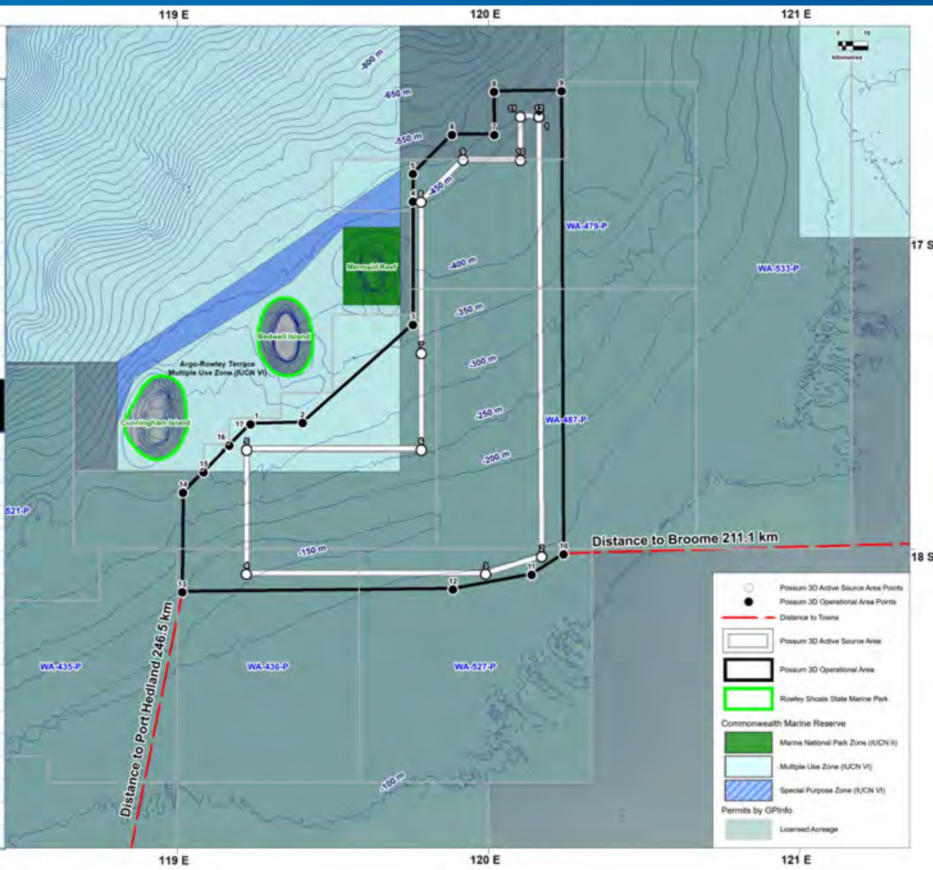
Stakeholders are to advise if any feedback is to remain confidential and not to be made available for public release within the draft or final Environment Plan. This is a one click option in the online feedback form, or can be requested via the alternative contact methods provided.

Possum 3D Survey Area WGS84

Idx	Longitude	Latitude
1	120° 09' 48.3452" E	16° 36' 29.8442" S
2	120° 10' 19.9223" E	18° 01' 15.5369" S
3	119° 59' 31.5658" E	18° 04' 37.3728" S
4	119° 13' 22.0184" E	18° 04' 36.5951" S
5	119° 13' 24.0593" E	17° 40' 44.8715" S
6	119° 47' 04.8498" E	17° 40' 42.5592" S
7	119° 47' 05.4248" E	17° 22' 09.5827" S
8	119° 47' 00.8030" E	16° 52' 59.3371" S
9	119° 55' 08.0532" E	16° 44' 51.3906" S
10	120° 06' 14.4232" E	16° 44' 54.3980" S
11	120° 06' 14.4233" E	16° 36' 32.2451" S
12	120° 09' 48.3452" E	16° 36' 29.8442" S

Possum 3D Operational Area WGS84

Idx	Longitude	Latitude
1	119° 14' 09.5135" E	17° 35' 48.6890" S
2	119° 24' 12.3661" E	17° 35' 35.4192" S
3	119° 45' 31.0716" E	17° 16' 38.5284" S
4	119° 45' 29.2682" E	16° 52' 53.6267" S
5	119° 45' 28.8612" E	16° 47' 33.0647" S
6	119° 53' 00.2830" E	16° 39' 58.8815" S
7	120° 01' 10.3513" E	16° 40' 01.7724" S
8	120° 01' 07.7448" E	16° 31' 42.8341" S
9	120° 14' 08.1238" E	16° 31' 34.4639" S
10	120° 14' 32.7660" E	18° 00' 46.2925" S
11	120° 08' 21.7465" E	18° 04' 45.2458" S
12	119° 53' 12.5126" E	18° 07' 36.1525" S
13	119° 00' 59.1120" E	18° 08' 06.6299" S
14	119° 01' 08.5223" E	17° 48' 54.9755" S
15	119° 05' 05.7300" E	17° 44' 56.1624" S
16	119° 10' 04.6884" E	17° 39' 55.1734" S
17	119° 14' 09.5135" E	17° 35' 48.6890" S



The Possum 3D MSS seismic survey area is located entirely in offshore Commonwealth waters within the NWMR incorporating Exploration Permits WA-436-P, WA-479-P, WA-487-P, WA-527-P and WA-540-P. Boundary co-ordinates are provided above.

At the closest point, the operational area is located ~211 km west of Broome ~246 km north-east of Port Hedland and >180 km north of Eighty Mile Beach. The survey area is in close proximity to, but has been designed to avoid, the Mermaid Reef Commonwealth Marine Reserve (MRCMR) boundary (4.4 km to Operational Area; 7.2km to Active Source area) and the Rowley Shoals Marine Park boundary at Imperieuse Reef (11.9km to Operational Area; 21.65km to Active Source area). The operational area also avoids the ancient coastline. Water depths across the survey area range from ~118–566m, with the deepest water depths situated in the northern half of the survey area. Seismic activities will not occur in water shallower than 100m.

Proposed Activity

A marine seismic survey is a method of determining geological features below the sea floor, by sending sound waves into the rock layers beneath the sea floor and then recording the time is takes for each wave to bounce back as well as measuring the strength of each returning wave along a towed cable ("streamer") of acoustic recorders.

The Possum 3D MSS will be acquired from a vessel towing approximately 10 streamers extending ~8.5km behind the survey vessel and nominally ~20m below the sea surface. The sound wave is generated by the use of a seismic source, consisting of an airgun array towed at a water depth of ~5–7m. The source generates acoustic pulses by periodically discharging compressed air into the water column at regular intervals, as the vessel transits along acquisition lines within the Active Source Area (ASA).

Seismic data will be acquired along pre-defined parallel lines, for a period of up to 70 days operating 24 hours a day. This time also includes shut downs for routine and reactive maintenance, repairs, transit and line turns, fauna and stakeholder avoidance. The process will continue until all survey lines, plus any re-acquisitions or 'infill' lines have been acquired.

Survey and Operational areas

• The full-fold 'Acquisition Area' (AA) covering ~5,400 sqkm is the focus area where the 3D seismic data will be acquired.

• The 'Active Source Area' (ASA) of ~8,584 sqkm includes a buffer around the Acquisition Area and is the area within which the seismic energy source may be operational, including soft start procedures and line run-outs (required to obtain full fold coverage). The full seismic source will not be operational outside of this area, although small, individual source elements may be tested during maintenance outside the ASA but still within the Operations Area.

• The entire 'Operations Area' (OA) covering ~13,447 sqkm provides an additional buffer area around the survey area. This buffer is required for routine vessel manoeuvring and other activities including potential streamer deployment and retrieval and maintenance. Vessel survey operations, other than transit to and from the activity areas, will not take place outside the OA.

Environment Impact Assessment

Searcher have engaged an experienced environmental consultancy company to coordinate and compile the environmental baseline study and impact assessments required by the Commonwealth regulator, NOPSEMA.

Particular considerations in the proposal survey area include, but are not limited to, the following:

- Proximity to the Mermaid Reef Commonwealth Marine Reserve (Sanctuary Zone IUCN-II) and the Rowley Shoals State Marine Park; environmental considerations and potential impact on recreational diving activities
- Survey Operational Area extending into Argo-Rowley Terrace Commonwealth Marine Park (Multiple Use Zone IUCN-VI)
- Acquisition and Operational Areas overlap well-used commercial shipping lanes
- Overlapping Commercial Commonwealth and State Fisheries
- Potential Impact on Marine Fauna, Plankton, Fish from this activity, as well as cumulative impact from other planned activities in the region
- Ensuring adherence to the strict requirements of the biosecurity legislation administered by the Australian Department of Agriculture and Water Resources for any vessel that will be temporarily imported into Australia
- Searcher will incorporate relevant findings from the North West Shoals to Shore Research Program being run by AIMS, including the impacts of marine noise from seismic surveys.

Due to the seismic streamers extending ~8.5 km behind the seismic vessel and the data acquisition process, the survey vessel will be restricted in its ability to manoeuvre. There will also be support vessel/s assisting with survey activities including redirecting any marine traffic away from the survey vessel and towed streamers. Because of the physical presence of these vessels, other marine users may be temporarily displaced from their intended area of operation or transit route.

Underwater sound emissions from the seismic array

As studies show that underwater noise can affect marine fauna in a variety of ways, acoustic sound modelling has been commissioned as part of this process. The objective of this acoustic modelling study is to evaluate the effects of sound on marine fauna including marine mammals, marine reptiles, fishes, elasmobranchs, benthic invertebrates and zooplankton, and on socio-economic receptors such as commercial fisheries and Australian Marine Parks. The modelling methodology considers source directivity and range-dependent environmental properties in each of the areas assessed. The results of the sound modelling is compared against sound exposure thresholds for marine fauna and other receptors.

This will have a specific focus on the impact due to the proximity of the nearby Rowley Shoals State Marine Park and Mermaid Reef Commonwealth Marine Reserve.

The modelling process and comparison against threshold limits will be used to complete an impact assessment based on the setting of ‘standard control measures’. Controls will be put in place to address Compliance with legislative requirements, as well as Compliance with Company and industry standards. The results of these studies and intended implemented controls will be shared on request with identified relevant stakeholders.

Simultaneous Operations

There are three other marine seismic surveys potentially planned in the vicinity during the period anticipated for acquisition of the Possum 3D MSS:

- Keraudren Extension 3D MSS located to the south and southwest (acquisition windows 1 Feb to 31 July in 2020, 2021 and possibly 2022) - *EP under assessment*
- Sauropod 3D MSS located immediately to the south of Possum 3D (acquisition windows January to April 2020, or January to April 2021) - *EP under assessment with titleholder*
- Inpex 2D Seismic MSS located immediately to the east (Acquisition grid of 3—6km; acquisition planned between 1 Nov to 31 May in either 2020/2021 or 2021/2022) - *EP under assessment with titleholder*

The potential for simultaneous operations and cumulative impact effects will be addressed in the Environmental Plan. Searcher will also remain in contact with the operators of these surveys and will review all opportunities to minimise impact on the marine fauna, fisheries and operations of relevant Stakeholders. Where possible, plans will be made to avoid overlapping seismic and diving activities. Where this is not possible, the activities should be prioritised and a simultaneous operations (SIMOPS) plan developed. Controls will be adopted to ensure that the impacts associated with underwater sound emissions from the seismic array are As Low As Reasonably Practicable (ALARP) and acceptable; and will be discussed with any concerned and relevant Stakeholders during further consultation.

Potential Impact on Commonwealth Commercial Fishers

The jurisdiction of four Commonwealth fishers overlap the Operations Area, as shown below. The Australian Fisheries Management Authority (AFMA) manage all the Commonwealth fisheries under the Fisheries Management Act 1991. Potential activity for these fisheries in the Operational Area is discussed in the table below, and all active fishers will be contacted directly.

Searcher Seismic is an active member of the NERA managed Consortium Seismic EP (CSEP) project and, as such, agrees to accept and adopt any protocols that are henceforth developed and mutually ratified by both the Consortium and the WA commercial fishing industry during the Possum 3D seismic survey.

Commonwealth Commercial fisheries with management boundaries overlapping the Possum 3D MSS Operational Area

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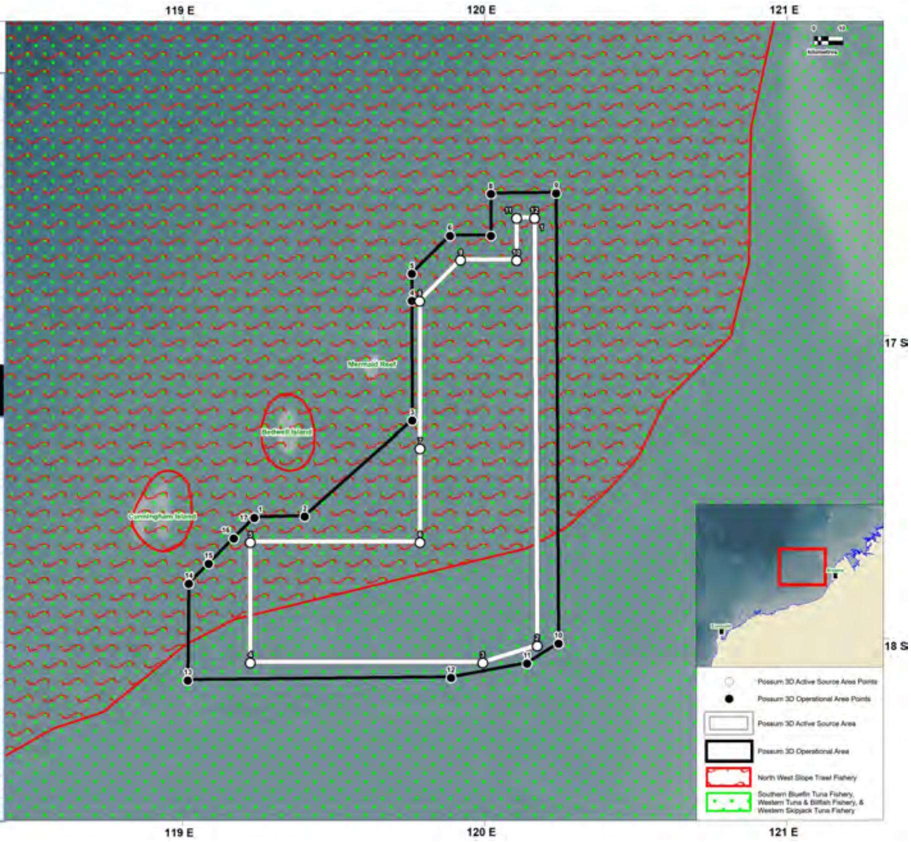


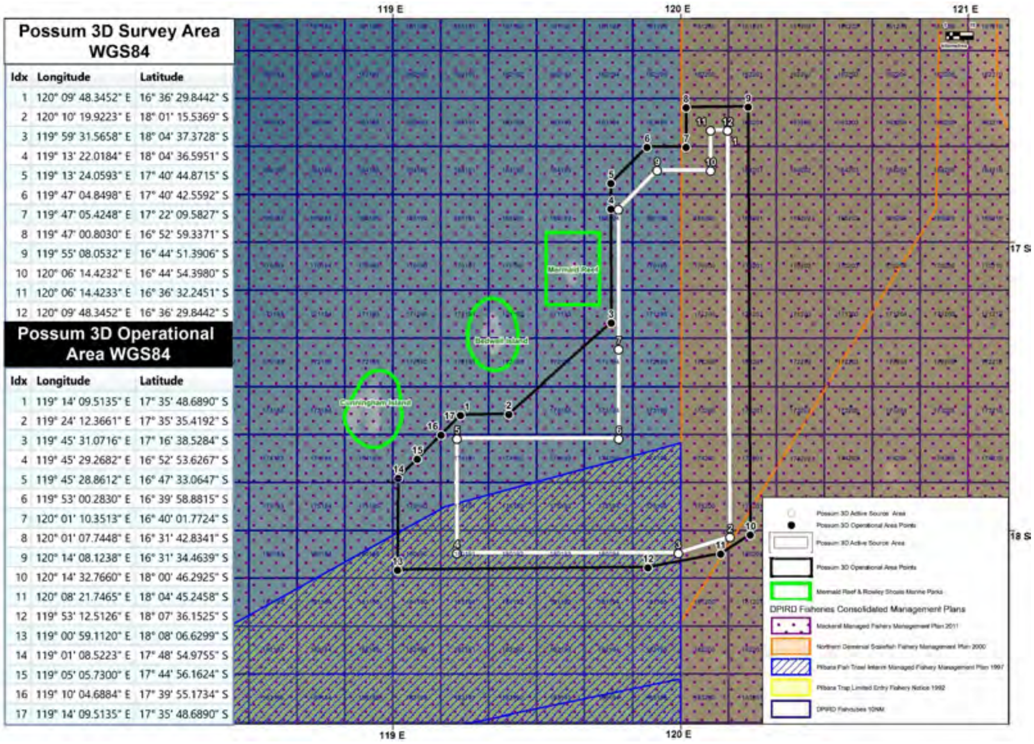
Commonwealth Fishery	Geographic Extent	Season	Activity within Possum 3D MSS Operations Area
North-West Slope Trawl Fishery (NWSTF)	Coast of Prince Regent National Park to Exmouth (WA) between the 200m depth contour to the outer limit of the AFZ	Year-round	Likely - *Fishery status reports 2019* shows total area of water fished in 2017-2018 included overlap with the MSS operational area. Fishers will be contacted directly
Southern Bluefin Tuna Fishery (SBTF)	All AFZ waters (3 – 200nm). Most of Australian catch is taken in the Great Australian Bight, with small amounts taken off SE Australia.	Fishing 1 Dec to 30 March. After feeding in the grow-out cages, fish are generally harvested in August	Unlikely – *Fishery status reports 2019 shows* fishing effort is focussed in the GAB and off SE Australia. Fishers will be contacted through Australian Southern Bluefin Tuna Industry Association (ASBTIA)
Western Tuna and Billfish Fishery (WTBF)	All AFZ waters (3 – 200nm) west from Cape York (Qld) around to the Vict-SA border. In recent years, effort has con-centrated off SW WA and SA	Year-round	Unlikely – *Fishery status reports 2019* shows total area of waters fished in 2018 were all south of Carnarvon. The active commercial fisher in WA will be contacted directly
Western Skipjack Tuna Fishery (WSTF)	All external Commonwealth and state waters out to 200nm	Year-round	No – license holders have not participated in the fish-ery since 2008-2009

Potential Impact on State Commercial Fishers

The Department of Primary Industries and Regional Development (DPIRD) manage fisheries predominantly within 3nm offshore from the Western Australia coastline. All the WA state fisheries that have jurisdictions overlapping the Operational Area (OA) have been reviewed. Those that may be potentially active in the OA are listed in the table below. Catch and effort records for the period 2014 – 2018 obtained from DPIRD's FishCube database show that only one of these WA fisheries, the Mackerel Managed Fishery has been active in the area of the Activity since 2014.

Searcher Seismic is an active member of the NERA managed Consortium Seismic EP (CSEP) project and, as such, agrees to accept and adopt any protocols that are henceforth developed and mutually ratified by both the Consortium and the WA commercial fishing industry during the Possum 3D seismic survey.

State Commercial fisheries with management boundaries overlapping the Possum 3D MSS Operational Area



State Fishery	Geographic Extent	Activity within Possum 3D MSS Operations Area (From DPIRD FishCube 2014-18)
Mackerel Managed Fishery (Area 2)	Extends from Cape Leeuwin to the WA/NT border.	Possible—Fishcube shows activity within 1 block in the OA in 2018 (<3 vessels). License holders are being contacted directly to confirm
Northern Demersal Scalefish Managed Fishery (NDSMF)	Operates in WA waters E of 120°E and N of 19°59'S. Area 2 (Zone B) of the NDSMF overlaps the OA.	Unlikely—Fishcube shows no activity within the OA from 2014—2018.
Pilbara Fish Trawl (Interim) Managed Fishery (Area 5)	Trawl operations between 116°E -120°E; essentially within the 50—100m depth contours	Unlikely—Fishcube shows no activity within the OA from 2014—2018.
Pilbara Trap Managed Fishery	Fishing at depths of 30-200 metres, north of 21°35'S and between 114°9'36" - 120°E. Part of the area is in Commonwealth waters but managed by the state fishery	Unlikely—Fishcube shows no activity within the OA from 2014—2018.

Other State Fisheries that have jurisdiction over the area include those listed below. Catch and effort data sourced from DPIRD (Fish Cube WA) indicates that there has been no activity by these fisheries in the vicinity of the Operations Area since 2014. WAFIC and DPIRD will be consulted to confirm.

- Abalone Managed Fishery (Zone 8)
- Broome Prawn Managed Fishery
- Kimberley Crab Managed Fishery
- Marine Aquarium Fish Managed Fishery
- Nickol Bay Prawn Managed Fishery
- Pearl Oyster Managed Fishery
- Pilbara Crab Managed Fishery
- Pilbara Line Fishery
- South-west Coast Salmon Managed Fishery
- Specimen Shell Managed Fishery
- West Coast Deep-Sea Crustacean Managed Fishery

Invitation for Consultation

Possum 3D Marine Seismic Survey

23 December 2019

Introduction

Searcher Seismic Pty Ltd (Searcher) is proposing to acquire a multiclient three-dimensional (3D) marine seismic survey (MSS) in the North-west Marine Region (NWMR) offshore from Western Australia.

This flyer is to inform you of the details of the survey with location and to invite you, as a potentially relevant person, to "register" and be involved in the consultation process for the regulatory environmental approvals procedure, as well as relevant communications related to the survey activity.

Throughout the project development, Searcher will provide each relevant person sufficient information to allow them to make an informed assessment of the possible consequences of the proposed survey on their functions, interests or activities.

Searcher will provide all stakeholder feedback to NOPSEMA, within the proposed activity's Environment Plan. Under recent changes to Environment Regulations, all environment plans for offshore oil and gas activities will be published, and draft environment plans for offshore seismic surveys and exploration drilling activities will be open for an additional 30-day public comment period prior to NOPSEMA assessment.

Please formally register using your preferred method from the contact details below. Alternatively, you may "opt-out" if you do not wish to receive further project updates or believe that this activity will not affect your functions, interests or activities.

Key Activity Information

- The proposed Possum 3D Multiclient Marine Seismic Survey ('Possum 3D MSS') Operational Area lies entirely within the NWMR and incorporates Exploration Permits WA-436-P, WA-479-P, WA-487-P, WA-527-P and WA-540-P (as shown on the following page)
- The proposed Possum 3D MSS is planned to be conducted over a maximum operational survey area of approximately 13,447 sq km.
- The proposed activity is scheduled to commence sometime between July 2020 and April 2022.
- Maximum expected survey duration with contingency time is 70 days; 24 hour operations.
- Final survey timing will be dependent on environmental considerations, regulatory approvals, vessel availability and weather conditions. Based on these unknown influences, the option to conduct the activity at any time between July 2020 and June 2022 whilst adhering to any identified environmental constraints, will be sought for approval from the relevant government regulators.
- Every effort will be made to time the activity to minimise any potential adverse effects on relevant stakeholders.

About Searcher

Searcher has a history of effectively conducting marine seismic surveys in the waters offshore of Western Australia with successful environmental outcomes attained from rigorous operating rules, environmental risk assessment, planning and management.

Searcher are committed to open and honest communications about the planned activity and to listening to relevant stakeholder concerns. Your valuable feedback will assist us in identifying all relevant stakeholders for the planned survey and assessing how it may affect your functions, interests or activities.

If you have any feedback, comments or questions on this activity you may contact us or opt-out via:-

Register

Contact

Possum 3D Consultation Team

PHONE:
+61 (0)8 9327 0301

WEBSITE:
searcherseismic.com/stakeholderFeedback

EMAIL:
feedback@searcherseismic.com

Opt Out

Stakeholders are to advise if any feedback is to remain confidential and not to be made available for public release within the draft or final Environment Plan. This is a one click option in the online feedback form, or can be requested via the alternative contact methods provided.

Searcher Seismic

Possum 3D Survey Area WGS84

Idx	Longitude	Latitude
1	120° 09' 48.3452" E	16° 36' 29.8442" S
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Possum 3D Operational Area WGS84

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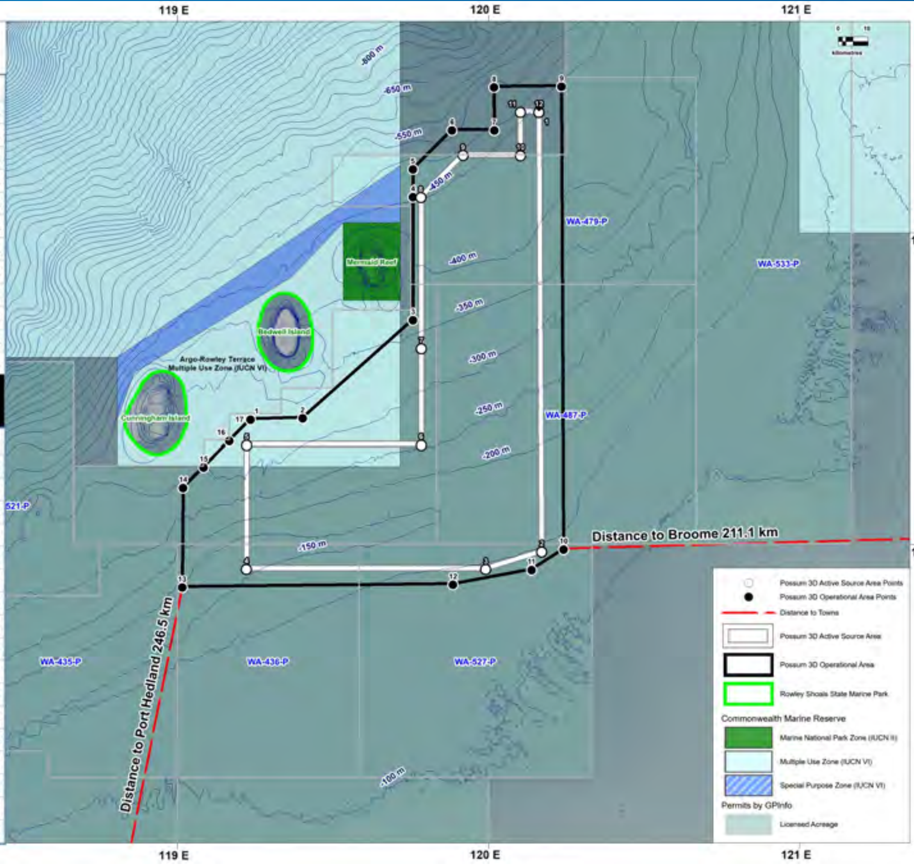

The Possum 3D MSS seismic survey area is located entirely in offshore Commonwealth waters within the NWMR incorporating Exploration Permits WA-436-P, WA-479-P, WA-487-P, WA-527-P and WA-540-P. Boundary co-ordinates are provided above.

At the closest point, the operational area is located ~211 km west of Broome ~246 km north-east of Port Hedland and >180 km north of Eighty Mile Beach. The survey area is in close proximity to, but has been designed to avoid, the Mermaid Reef Commonwealth Marine Reserve (MRCMR) boundary (4.4 km to Operational Area; 7.2km to Active Source area) and the Rowley Shoals Marine Park boundary at Imperieuse Reef (11.9km to Operational Area; 21.65km to Active Source area). The operational area also avoids the ancient coastline. Water depths across the survey area range from ~118–566m, with the deepest water depths situated in the northern half of the survey area. Seismic activities will not occur in water shallower than 100m.

Proposed Activity

A marine seismic survey is a method of determining geological features below the sea floor, by sending sound waves into the rock layers beneath the sea floor and then recording the time is takes for each wave to bounce back as well as measuring the strength of each returning wave along a towed cable ("streamer") of acoustic recorders.

The Possum 3D MSS will be acquired from a vessel towing approximately 10 streamers extending ~8.5km behind the survey vessel and nominally ~20m below the sea surface. The sound wave is generated by the use of a seismic source, consisting of an airgun array towed at a water depth of ~5–7m. The source generates acoustic pulses by periodically discharging compressed air into the water column at regular intervals, as the vessel transits along acquisition lines within the Active Source Area (ASA).

Seismic data will be acquired along pre-defined parallel lines, for a period of up to 70 days operating 24 hours a day. This time also includes shut downs for routine and reactive maintenance, repairs, transit and line turns, fauna and stakeholder avoidance. The process will continue until all survey lines, plus any re-acquisitions or 'infill' lines have been acquired.

Survey and Operational areas

• The full-fold 'Acquisition Area' (AA) covering ~5,400 sqkm is the focus area where the 3D seismic data will be acquired.

• The 'Active Source Area' (ASA) of ~8,584 sqkm includes a buffer around the Acquisition Area and is the area within which the seismic energy source may be operational, including soft start procedures and line run-outs (required to obtain full fold coverage). The full seismic source will not be operational outside of this area, although small, individual source elements may be tested during maintenance outside the ASA but still within the Operations Area.

• The entire 'Operations Area' (OA) covering ~13,447 sqkm provides an additional buffer area around the survey area. This buffer is required for routine vessel manoeuvring and other activities including potential streamer deployment and retrieval and maintenance. Vessel survey operations, other than transit to and from the activity areas, will not take place outside the OA.

Environment Impact Assessment

Searcher have engaged an experienced environmental consultancy company to coordinate and compile the environmental baseline study and impact assessments required by the Commonwealth regulator, NOPSEMA.

Particular considerations in the proposal survey area include, but are not limited to, the following:

- Proximity to the Mermaid Reef Commonwealth Marine Reserve (Sanctuary Zone IUCN-II) and the Rowley Shoals State Marine Park; environmental considerations and potential impact on recreational diving activities
- Survey Operational Area extending into Argo-Rowley Terrace Commonwealth Marine Park (Multiple Use Zone IUCN-VI)
- Acquisition and Operational Areas overlap well-used commercial shipping lanes
- Overlapping Commercial Commonwealth and State Fisheries
- Potential Impact on Marine Fauna, Plankton, Fish from this activity, as well as cumulative impact from other planned activities in the region
- Ensuring adherence to the strict requirements of the biosecurity legislation administered by the Australian Department of Agriculture and Water Resources for any vessel that will be temporarily imported into Australia
- Searcher will incorporate relevant findings from the North West Shoals to Shore Research Program being run by AIMS, including the impacts of marine noise from seismic surveys.

Due to the seismic streamers extending ~8.5 km behind the seismic vessel and the data acquisition process, the survey vessel will be restricted in its ability to manoeuvre. There will also be support vessel/s assisting with survey activities including redirecting any marine traffic away from the survey vessel and towed streamers. Because of the physical presence of these vessels, other marine users may be temporarily displaced from their intended area of operation or transit route.

Underwater sound emissions from the seismic array

As studies show that underwater noise can affect marine fauna in a variety of ways, acoustic sound modelling has been commissioned as part of this process. The objective of this acoustic modelling study is to evaluate the effects of sound on marine fauna including marine mammals, marine reptiles, fishes, elasmobranchs, benthic invertebrates and zooplankton, and on socio-economic receptors such as commercial fisheries and Australian Marine Parks. The modelling methodology considers source directivity and range-dependent environmental properties in each of the areas assessed. The results of the sound modelling is compared against sound exposure thresholds for marine fauna and other receptors.

This will have a specific focus on the impact due to the proximity of the nearby Rowley Shoals State Marine Park and Mermaid Reef Commonwealth Marine Reserve.

The modelling process and comparison against threshold limits will be used to complete an impact assessment based on the setting of 'standard control measures'. Controls will be put in place to address Compliance with legislative requirements, as well as Compliance with Company and industry standards. The results of these studies and intended implemented controls will be shared on request with identified relevant stakeholders.

Simultaneous Operations

There are three other marine seismic surveys potentially planned in the vicinity during the period anticipated for acquisition of the Possum 3D MSS:

- Keraudren Extension 3D MSS located to the south and southwest (acquisition windows 1 Feb to 31 July in 2020, 2021 and possibly 2022) - *EP under assessment*
- Sauropod 3D MSS located immediately to the south of Possum 3D (acquisition windows January to April 2020, or January to April 2021) - *EP under assessment with titleholder*
- Inpex 2D Seismic MSS located immediately to the east (Acquisition grid of 3—6km; acquisition planned between 1 Nov to 31 May in either 2020/2021 or 2021/2022) - *EP under assessment with titleholder*

The potential for simultaneous operations and cumulative impact effects will be addressed in the Environmental Plan. Searcher will also remain in contact with the operators of these surveys and will review all opportunities to minimise impact on the marine fauna, fisheries and operations of relevant Stakeholders. Where possible, plans will be made to avoid overlapping seismic and diving activities. Where this is not possible, the activities should be prioritised and a simultaneous operations (SIMOPS) plan developed. Controls will be adopted to ensure that the impacts associated with underwater sound emissions from the seismic array are As Low As Reasonably Practicable (ALARP) and acceptable; and will be discussed with any concerned and relevant Stakeholders during further consultation.

INVITATION FOR CONSULTATION—UPDATE

Possum 3D Marine Seismic Survey

30th March 2020

Introduction

Searcher Seismic Pty Ltd (Searcher) is proposing to acquire a multiclient three-dimensional (3D) marine seismic survey (MSS) in the North-west Marine Region (NWMR) offshore from Western Australia.

The purpose of this updated flyer is to provide further details of the survey to relevant and interested stakeholders, and to enable you to continue to be involved in the consultation process for the regulatory environmental approvals procedure, as well as relevant communications related to the survey activity.

Throughout the project development, Searcher will provide each relevant person sufficient information to allow them to make an informed assessment of the possible consequences of the proposed survey on their functions, interests or activities.

Searcher will provide all stakeholder feedback to NOPSEMA, within the proposed activity's Environment Plan. Under recent changes to Environment Regulations, all environment plans for offshore oil and gas activities will be published, and draft environment plans for offshore seismic surveys and exploration drilling activities will be open for an additional 30-day public comment period prior to NOPSEMA assessment.

Key Activity Information

- The proposed Possum 3D Multiclient Marine Seismic Survey ('Possum 3D MSS') Operational Area lies entirely within the NWMR and incorporates Exploration Permits WA-436-P, WA-479-P, WA-487-P, WA-527-P and WA-540-P (as shown on the following page).
- The proposed Possum 3D MSS is planned to be conducted over a maximum operational survey area of approximately 13,447 sq km.
- Maximum expected survey duration with contingency time is 70 days; 24 hour operations.
- The acquisition window is expected to be between Dec and end April, but may extend to July with additional controls implemented.
- Environment Plan will be requested for 24 month validity between December 2020 and end July 2022 with survey scheduled in the acquisition windows as above.
- Every effort will be made to time the activity to minimise any potential adverse effects on relevant stakeholders.

About Searcher

Searcher has a history of effectively conducting marine seismic surveys in the waters offshore of Western Australia with successful environmental outcomes attained from rigorous operating rules, environmental risk assessment, planning and management.

Searcher are committed to open and honest communications about the planned activity and to listening to relevant stakeholder concerns. Your valuable feedback will assist us in identifying all relevant stakeholders for the planned survey and assessing how it may affect your functions, interests or activities.

If you have not previously registered you may formally register your interest using any of the following contact methods. Alternatively you may "opt-out" if you do not wish to receive further project updates or believe that his activity will not affect you functions, interests of activities.

Contact

Possum 3D Consultation Team

PHONE:
+61 (0)8 9327 0301

WEBSITE:
searcherseismic.com/stakeholderfeedback

EMAIL:
feedback@searcherseismic.com

Register

Opt Out

Stakeholders are to advise if any feedback is to remain confidential and not to be made available for public release within the draft or final Environment Plan. This is a one click option in the online feedback form, or can be requested via the alternative contact methods provided.

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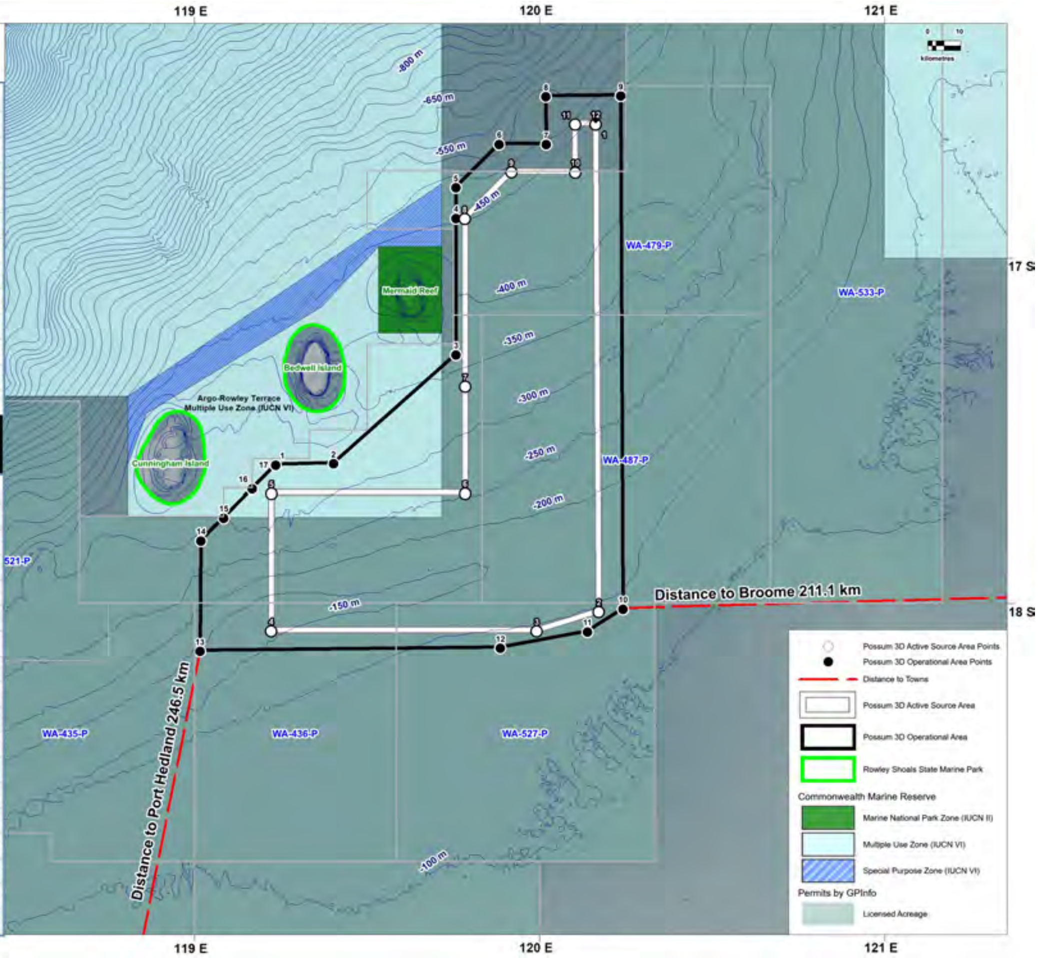


Figure 1—Proposed Activity Location Map

The Possum 3D MSS seismic survey area is located entirely in offshore Commonwealth waters within the NWMR incorporating Exploration Permits WA-436-P, WA-479-P, WA-487-P, WA-527-P and WA-540-P. Boundary co-ordinates are provided above.

The operational area is located ~211 km west of Broome, ~246 km north-east of Port Hedland and >180 km north of Eighty Mile Beach. The survey area is in close proximity to, but has been designed to avoid, the Mermaid Reef Commonwealth Marine Reserve (MRCMR) boundary (4.4 km to Operational Area; 7.2km to Active Source area), the Rowley Shoals Marine Park boundary at Imperieuse Reef (11.9km to Operational Area; 21.65km to Active Source area) and the ancient coastline. Water depths across the survey area range from ~118–566m, with the deepest water depths situated in the northern half of the survey area. Seismic activities will not occur in water shallower than 100m.

- The **'Acquisition Area' (AA)** covering ~5,400 sqkm is the focus area where the full-fold 3D seismic data will be acquired.
- The **'Active Source Area' (ASA)** of ~8,584 sqkm includes a buffer around the Acquisition Area and is the area within which the seismic energy source may be operational, including soft start procedures and line run-outs (required to obtain full fold coverage). The full seismic source will not be operational outside of this area, although small, individual source elements may be tested during maintenance outside the ASA but still within the Operations Area.
- The **'Operational Area' (OA)** covers ~13,447 sqkm providing an ASA 'operational buffer', required for activities including streamer deployment, retrieval, maintenance or recovery, routine vessel manoeuvring and other non-seismic vessel activities.

A marine seismic survey is a method of determining geological features below the sea floor, by sending sound waves into the rock layers beneath the sea floor and then recording the time is takes for each wave to bounce back as well as measuring the strength of each returning wave along a towed cable ("streamer") of acoustic recorders.

The Possum 3D MSS will be acquired from a vessel towing approximately 10 streamers extending ~8.5km behind the survey vessel and nominally ~20m below the sea surface. The sound wave is generated by the use of a seismic source, consisting of an airgun array towed at a water depth of ~5–7m. The source generates acoustic pulses by periodically discharging compressed air into the water column at regular intervals, as the vessel transits along acquisition lines within the Active Source Area (ASA). Passive magnetic and gravity readings may also be recorded.

Seismic data will be acquired along pre-defined parallel lines, for a period of up to 70 days operating 24 hours a day. This time also includes shut downs for routine and reactive maintenance, repairs, transit and line turns, fauna and stakeholder avoidance. The process will continue until all survey lines, plus any re-acquisitions or 'infill' lines have been acquired.

Environmental Impact Assessment

As required by Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS(E) Regulations), Searcher is undertaking an assessment of the planned environmental impacts and unplanned environmental risks associated with the proposed seismic survey. This includes assessment of impacts and risks to other marine users including fishers, divers, government agencies and ship owners. A number of species covered under the "Matters of National Environmental Significance" and "Other Matters" protected by the Environment Protection and Biodiversity Conservation Act 1999, have also been identified as potentially occurring within the survey ASA and OA. Species listed as Vulnerable or Endangered will be the subject of a comprehensive impact and risk assessment in order to minimise these to as low as reasonably practicable (ALARP) and acceptable levels. Commonwealth or State Marine Reserves and Parks or listed Key Ecological Features (KEFs) in proximity to the survey's OA have been identified (Figure 1). Risks posed by a fuel spill from the survey vessel to environment receptors are also being assessed and reduced to ALARP and acceptable levels.

The seismic survey vessel, and any support vessels that may be imported into Australia to conduct this seismic survey activity, will do so under the strict requirements of the biosecurity legislation administered by the Australian Department of Agriculture and Water Resources. An Oil Pollution Emergency Plan (OPEP) specific to the activity will also be developed, as required by the OPGGS(E) Regulations.

Potential Impacts to Stakeholders

Marine seismic surveys can potentially impact other marine users, including temporary displacement of commercial or recreational fishers and interaction with divers, commercial shipping and other marine traffic. It is also possible that pelagic or demersal fish stocks may temporarily relocate during the activity. Searcher will be closely consulting with all relevant licensed fishers in the survey during the planning phase in an effort to minimise any negative operational or commercial impacts to those fishers and their livelihoods. An initial Impact Assessment of the commercial fishing activities in each of the overlapping Commonwealth and State Managed fisheries is included In the following pages.

Further information regarding seismic surveying methods and their potential effects can be found on the International Association of Geophysical Contractors (IAGC) web site on the "Resources" page:- https://www.iagc.org/resources.html, or by completing the online form, via email or by phone and asking for further information to enable you to adequately assess whether the activity might affect your functions, interests or activities .

Stakeholder Engagement

Searcher encourages open, two-way communication with stakeholders throughout the planning and implementation of the proposed activities. Reviewing this update to the Invitation For Consultation is the part of a more comprehensive stakeholder engagement process. All persons or organisations that wish to continue to be included in the consultation process to register their interest via the simple online registration form that can be accessed through the Searcher web site address listed on the first page, or via scanning the QR code and completing the form on a mobile device. Some basic multiple choice question options and fields for additional feedback are provided within the feedback questionnaire, including the option to request direct communications with Searcher's Project Management Team. The option to opt out of any further communications on this matter also exists.

Under the regulations, stakeholder consultation is a mandatory process for the proponent (Searcher) but voluntary for potential stakeholders. Searcher recognises the risk of "stakeholder fatigue" and the inconvenience consultation may cause for those that have no interest in the proposed activity. Unfortunately, failure to respond to this invitation to consult will not be accepted by the regulator NOPSEMA as a lack of interest, so your assistance in completing the online feedback form would be greatly appreciated and will help avoid further contact from us if you do decide to opt out of future correspondence in relation to this activity. If we do not hear from you then we will continue to provide you with updates to allow for circumstances such as extended post delivery times and perusal of this information.

Searcher will provide all stakeholder feedback to NOPSEMA, within the proposed activity's environment plan. Under recent changes to environment regulations, all environment plans for offshore oil and gas activities will be published, and draft environment plans for offshore seismic surveys and exploration drilling activities will be open for an additional 30-day public comment period prior to NOPSEMA assessment.

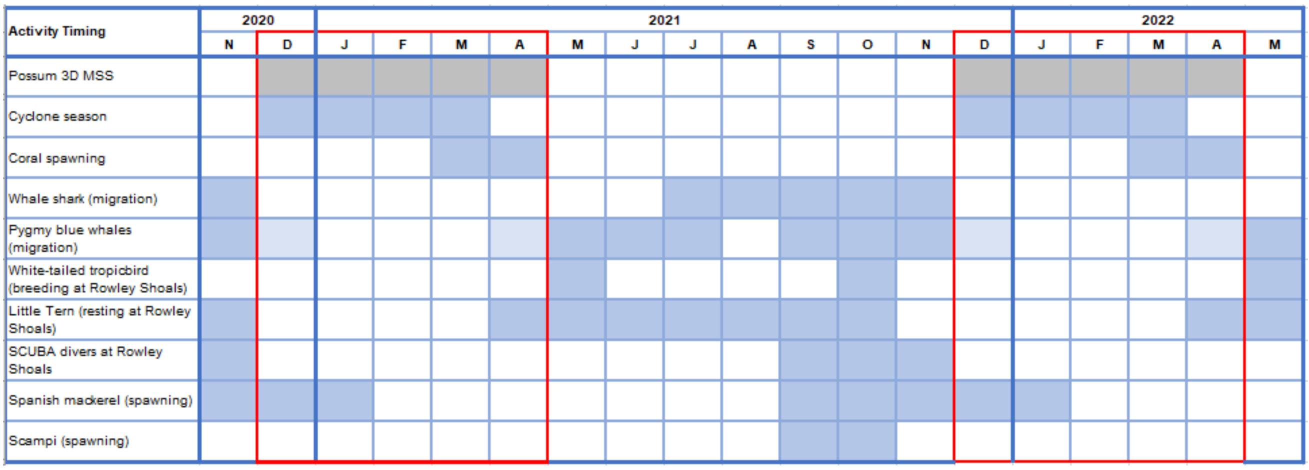
Survey Operating Window

At all times, the best window(s) of opportunity for the acquisition of Searcher's Marine Seismic Surveys are considered within the environmental, social constraints and regulatory approvals; the vessel availability within that nominated operational window is then addressed.

Particular considerations in the proposed Possum 3D MSS area include, but are not limited to, the following:

- Overlapping Commercial Commonwealth and State Fisheries
- Proximity to the Mermaid Reef Commonwealth Marine Reserve (Sanctuary Zone IUCN-II) and the Rowley Shoals State Marine Park; environmental considerations and potential impact on recreational diving activities
- Survey Operational Area extending into Argo-Rowley Terrace Commonwealth Marine Park (Multiple Use Zone IUCN-VI)
- Acquisition and Operational Areas overlap well-used commercial shipping lanes
- Potential Impact on Marine Fauna, Plankton, Fish from this activity, as well as cumulative impact from other planned activities in the region

Searcher have determined the most appropriate acquisition window considering key environmental sensitivities within the operational area to be December to end April but may extend to July with additional controls implemented.



Simultaneous Operations

Searcher is aware of three other potential marine seismic surveys planned in the vicinity during the period anticipated for acquisition of the Possum 3D MSS. These surveys all have limited spatial overlap with the proposed activity, as shown in the Figure 2 below. None of these surveys yet have EP's approved by the regulator.

Titleholder	Project Name (All Eps under assessment with NOPSEMA)	Activity Window
INPEX Browse E&P Pty Ltd	2D Seismic Survey WA-532-P, WA-533-P and WA-50-L - *EP under assessment with NOPSEMA*	1 Nov 2020 – 31 May 2021 (timing of the activity within proximity to Possum 3D MSS is unknown). Max 140 days
3D Oil Limited	Sauropod 3D Marine Seismic Survey (WA-527-P) - *EP under assessment with NOPSEMA*	Jan – April 2020 or 2021 (Max 60 days)
Santos WA Northwest Pty Ltd	Keraudren 3D Extension - *EP under assessment with NOPSEMA*	1st Feb – 31st July 2020-2022 (Est 132 days total)

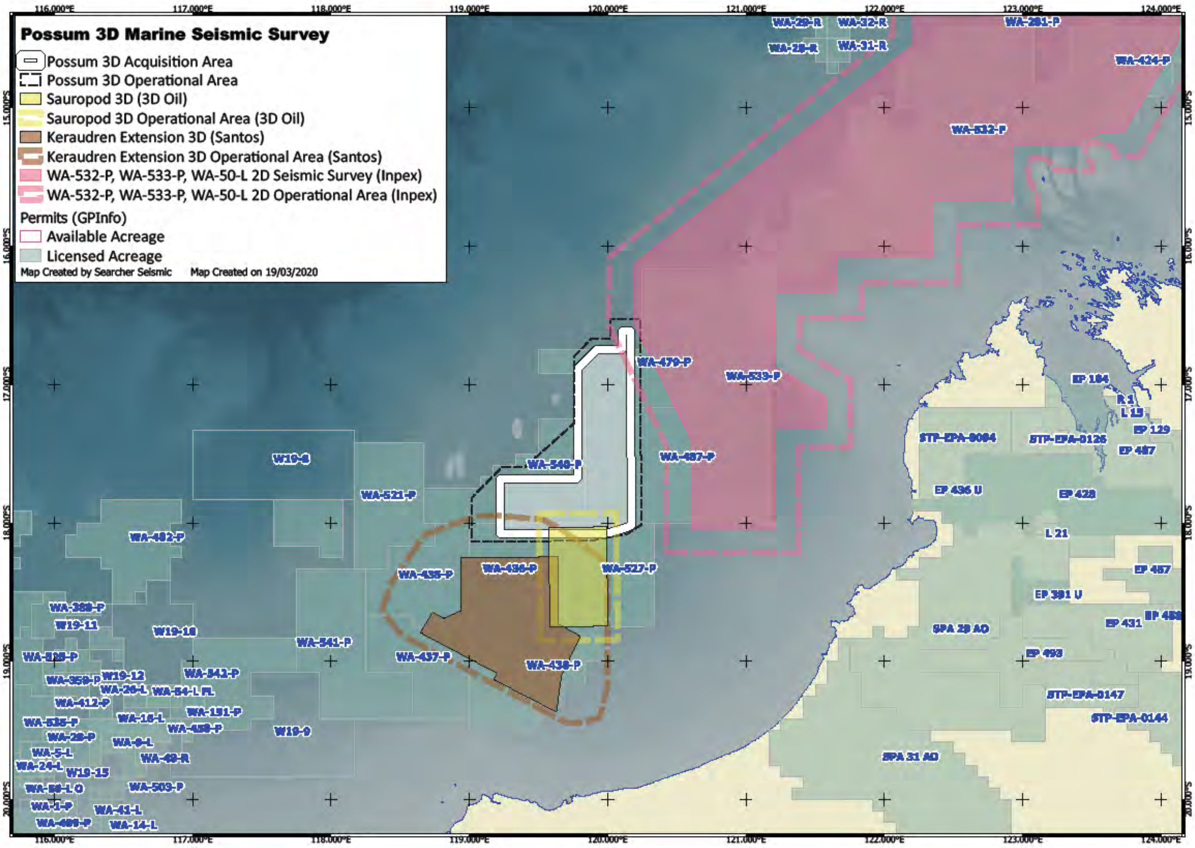


Figure 2— Potentially Overlapping Marine Seismic Surveys

Searcher will remain in contact with the operators of these surveys and will review all opportunities to minimise impact on the marine fauna, fisheries and operations of relevant Stakeholders. Where possible, plans will be made to avoid overlapping seismic activities. Where this is not possible, the activities will be prioritised and a simultaneous operations (SIMOPS) plan developed. Proposed controls to mitigate the impact of simultaneous seismic surveys and cumulative impact effects will include:

- Searcher will engage with proponents for potential seismic activities prior to commencing the Possum 3D MSS and will develop a SIMOPS plan for any concurrent surveys identified within 60 km of the acquisition area
- A minimum separation distance of 40 km will be maintained between the Possum 3D MSS survey vessel and other operating seismic sources
- Use the smallest practicable seismic array size to meet the geophysical objectives of the survey

Temporary Displacement of Others

Marine users that may be present in the OA during the survey period include commercial fishing vessels, commercial vessels undertaking oil and gas industry activities, Australian Border Force or navy and large vessels within the well-used commercial shipping route to and from Port Hedland. The seismic survey vessel will acquire data over a period of up to 70 days during which time it will operate 24 hours a day. Due to the seismic streamers extending ~8.5 km behind the seismic vessel and the data acquisition process, the survey vessel will be restricted in its ability to manoeuvre. There will be support vessel(s) assisting with survey activities including redirecting any marine traffic away from the survey vessel and towed streamers. Because of the physical presence of these vessels, other marine users including fishing vessels and other commercial or recreational shipping traffic may be temporarily displaced from their intended area of operation or transit route. The seismic streamers also present a navigational hazard to other marine users, and fishing equipment deployed within the OA may become entangled in the streamers or run over by the survey or support vessels.

Review of fishing activity by operators within Commonwealth and State fisheries shows that only fishers in the North West Slope Trawl Fishery (NWSTF) are likely to be active in the OA. The proposed survey area overlaps an extremely small portion of the fishery with over 97% of the fishery unaffected by the survey.

Standard control measures that will assist in limiting adverse interactions with other vessels during the Possum 3D MSS include compliance with legislative requirements for maintenance of appropriate navigation, communications and maritime lighting in order to inform other uses of the position and intentions of the survey vessels, and compliance with Searcher and industry standards.

The following controls measures will be implemented :

- Consultation with other users during the development of the Possum 3D MSS, and prior to and during the survey activity
- Survey areas minimised as much as practicable whilst still achieving the survey objectives
- ASA and OA designed to minimise overlap with commercial fishing areas
- Tail buoys clearly marked to identify streamer ends to other users
- Survey vessels will be equipped with Automatic Radar Plotting Aid (ARPA) and active Automatic identification system (AIS) for detection of vessels, speed, heading
- Maintain appropriate navigation lights and day shapes at all times, in accordance with COLREGS to inform other users of the vessel's actions. Additional communications will be carried out, as required, during the activity using a range of other means e.g. marine VHF radio, telephone, signal lights etc
- Use of support vessel(s) to interact and manage interactions with other vessels and to scout well ahead of the seismic survey vessel for inwater hazards
- Notification of the start and end of activity to the AMSA/JRCC and AHS which will issue Notice to Mariners and AusCoast Warning in relation to the activity
- 24—48 hour notification to commercial fishers (communications at sea) regarding look-ahead activities
- In the event of equipment loss, other users to be notified as required (including AMSA and NOPSEMA)

Based on the above considerations the potential impacts due to physical presence of survey vessels during the Possum 3D MSS are considered to be slight and short-term.

Underwater sound emissions from the seismic array

Acquisition of the Possum 3D MSS will involve the use of a seismic source, consisting of an airgun array towed at a water depth of 5 – 7 m. The source will be used to generate acoustic pulses by periodically discharging compressed air into the water column, as the vessel transits along acquisition lines within the Active Source Area (ASA). Underwater noise can affect marine fauna in three main ways:

- By causing direct physical effects on hearing or other organs. Hearing loss may be temporary (temporary threshold shift – TTS), or permanent (PTS), with PTS considered to represent injury;
- Through disturbance leading to behavioural changes or displacement of fauna. The occurrence and intensity of disturbance is highly variable and depends on a range of factors relating to the animal and situation; and
- By masking or interference with other biologically important sounds (including vocal communication, echolocation, signals and sounds produced by predators or prey).

To assess the potential magnitude and extent of impacts from underwater noise produced during the Possum 3D MSS, Searcher commissioned JASCO Applied Sciences to model the source levels and sound propagation. The Possum 3D MSS Acoustic Modelling Report (JASCO 2020) is available from Searchers website via http://www.searcherseismic.com/stakeholderfeedback, or may be requested via any of the listed contact methods. Several locations were modelled, with a specific focus on the impact due to the proximity of the nearby Rowley Shoals State Marine Park and Mermaid Reef Commonwealth Marine Reserve, that were representative of the different water depths, bathymetry and seabed properties within the ASA.

The objective of this acoustic modelling study was to evaluate the effects of sound on marine fauna including marine mammals, marine reptiles, fishes, elasmobranchs, benthic invertebrates and zooplankton, and on socio-economic receptors such as commercial fisheries and Australian Marine Parks. The modelling methodology considers source directivity and range-dependent environmental properties in each of the areas assessed. The results of the sound modelling is compared against sound exposure thresholds for marine fauna and other receptors. The assessment of impacts are presented on the following page.

The modelling process and comparison against threshold limits was then used to complete an impact assessment based on the setting of 'standard control measures':

- Compliance with legislative requirements;
- Part A Standard Management Measures of EPBC Policy Statement 2.1 will be applied in full to mitigate potential impacts to whales. One EPBC Policy Statement 2.1 Part B Additional Management Measure will also be applied;
- OPGGS Act: Residual risks must be reduced to ALARP;
- Compliance with Company and industry standards;
- Alignment with objectives and compliance requirements of applicable management, recovery and /or conservation plans.

In addition to the above, the following controls will be adopted to ensure that the impacts associated with underwater sound emissions from the seismic array are As Low As Reasonably Practicable (ALARP) and acceptable:

- Minimum source size selected to acquire survey data and meet the geophysical objectives of the survey (based on specific sound source modelling)
- Two Marine Fauna Observers will be on board the seismic vessel and on duty during daylight hours during the survey
- 100 m 'turtle pause' when a turtle is within 100 m of the active source
- Searcher will engage with proponents identified and develop a SIMOPS plan for any concurrent surveys identified within 60 km of the acquisition area.
- A minimum separation distance of 40 km will be maintained between the Possum 3D MSS survey vessel and other operating seismic sources
- Searcher will engage with any individual fishers or tourism operators identified operating in or adjacent to the OA.

With these controls in place, the potential impacts of underwater sound emissions from the seismic source on marine fauna during acquisition of the Possum 3D MSS are considered to be slight and short-term, and restricted to temporary behavioural changes (avoidance) in any individuals that may inhabit areas or transit the area in close proximity to the operating seismic source. With the control measures in place, the underwater sound emissions from the Possum 3D MSS will not result in any significant impacts to tourism operators, marine park values and commercial fisheries overlapping the OA.

Underwater sound emissions from the seismic array

With the listed controls in place, the following assessment of impacts have been made:

Marine mammals: Due to the timing, duration and location of the survey, the survey is not predicted to impact on critical habitats for any species of marine mammal (i.e. feeding, breeding, calving areas) or constrict the migratory pathway within the operational area and surrounding waters for Blue Whales. The control measures proposed will significantly reduce the likelihood of injury (PTS) effects, or any ecologically significant impacts at a population level for any species of marine mammal that may be present within or adjacent to the OA during the survey. Additional controls will be implemented should the survey extend beyond the end of April.

Marine reptiles: Based on the timing and duration of the survey, the separation distances to nesting BIAs and 'Habitat Critical' areas, and the control measures proposed, predicted noise levels from seismic acquisition are not considered likely to cause PTS effects, displace any individuals from inter-nesting BIAs or 'Habitat Critical' areas, or result in any ecologically significant impacts at a population level for any species of turtle that may be present within or adjacent to the OA during the survey.

Fishes and sharks (demersal, pelagic species including key indicator species of commercial interest, site-attached reef species and whale sharks): The potential impacts of underwater sound emissions from the seismic source on fishes and elasmobranchs during the Possum 3D MSS are considered to be localised and of no lasting effect, restricted to within 60m of the source and TTS in individuals (which is recoverable with 24hrs) that may be present within 9.13km the acquisition area. Based on the timing, duration and location of seismic acquisition, and the control measures that will be implemented, predicted noise levels from seismic acquisition are not considered likely to result in any ecologically significant impacts at a population level for any species of fish that may be present within or adjacent to the OA during the Possum 3D MSS.

Benthic invertebrates (corals, prawns, molluscs) or Zooplankton: The potential impacts of underwater sound emissions from the seismic source on benthic invertebrates or Zoopankton during the Possum 3D MSS are considered to be slight and short-term, as the activity is not likely to result in any mortality of individuals or ecologically significant impacts at a population level for any species of invertebrate that may be present on the seafloor within or adjacent to the ASA.

Marine Parks: Based on the timing and duration of the Possum 3D MSS, spatial separation from the Mermaid Reef Australian Marine Park (MRAMP) boundary (4.4 km to Operational Area; 7.2km to aquisition area) and the Rowley Shoals Marine Park (RSMP) boundary at Imperieuse Reef (11.9km to Operational Area; 21.65km to aquisition area), and the control measures that will be implemented, predicted noise levels from seismic acquisition are not considered likely to cause any impacts to the natural, cultural heritage values of the MRAMP, RSMP or any other Marine Park in the region.

Tourism & Diving operations : Information provided by the (Diving Medical Advisory Committee (DMAC) Guidance number 12 (DMAC 12 Rev. 2 (2019)) on safe diving distances from seismic survey operations notes that there is limited understanding of the effects of seismic pressure waves on divers, and that the multiple factors involved make it difficult to determine a safe or tolerable distance for diving operations from seismic surveying operations. Based on the proposed timing, duration and consultation with relevant stakeholders regarding the Possum 3D MSS, it is assessed that there is unlikely to be any recreational or research diving activities conducted in the area during the planned activity window. However should ongoing consultation identify any diving operations planned within 30 km of the OA, Searcher will follow the DMAC guidance as a pragmatic means of mitigating impacts to divers from seismic sound and conduct a SIMOPS plan for communication and observation of any constraints or buffer distances to be applied.

Operational discharges and emissions from survey vessels

(light, atmospheric, liquid, underwater sound)

The seismic survey vessel and any support vessels that may be imported into Australia to conduct this seismic survey activity, will do so under the strict requirements of the biosecurity legislation administered by the Australian Department of Agriculture and Water Resources, and will be required to undertake inspections by a department biosecurity officer prior to mobilisation to the OA.

Operational discharges from survey vessels include those required for normal ship functions including deck lighting, engine operations. During the 70 days of the MSS the following controls will be instigated in addition to 'standard controls' (eg legislative requirements) to minimise potential impacts to marine fauna from these discharges and emissions:

- External lighting will be directed only onto working decks to avoid impacts to light-sensitive species (eg turtles, birds)
- Atmospheric emissions will be minimised by ensuring only vessels using marine diesel or marine gas oil are used (instead of vessels using heavy fuel oils), and by ensuring all vessels have a planned maintenance system for engine equipment.
- Underwater sound emissions will be minimised by ensuring vessel engines are maintained in accordance with the planned maintenance system
- All discharges of bilge water, deck drainage and engine cooling water are compliant with MARPOL Annex 1 to minimise water degradation

Potential Impact on State and Commonwealth Commercial Fishers

The purpose of this document is to provide updated information to relevant commercial fishers. All the Commonwealth and WA state fisheries that have jurisdictions overlapping the Possum 3D Operational Area (OA) have been reviewed (refer to Invitation for Consultation Possum 3D Marine Seismic Survey, 23 December 2019 or via "searcherseismic.com/stakeholderFeedback"). Fisheries with jurisdiction overlapping the Possum OA and with historic fishing effort in the OA have been identified through review of the Fishery status reports 2019, DPIRD's FishCube database and confirmed by email from WAFIC and specific fishers.

	Commonwealth Fishery	State Fishery
Identified Relevant Fisheries	North-West Slope Trawl (Scampi) Fishery (NWSTF)	Mackerel Managed Fishery (Area 2; Class 2A and Class 2B)
Reporting Authority	Australian Fisheries Management Authority (AFMA)	Department of Primary Industries and Regional Development (DPIRD)
Overlap of Possum OA with Fishery Management area	~9,211km2 (2.33%)	~13,420km2 (~2.7%) of total size of Area 2.
Historic fishing effort (2014—2018)	One fisher is intermittently active throughout year within Possum OA	One record of catch in 2018. However by and large mackerel fishers do not operate in water depths more than 70 m (via consultation with WAFIC 7/01/2020) [1]
Source	Direct communication with individual Fisher	WAFIC (via email 7th January 2020) and DPIRD (via phone 21st January 2020) confirmed that the Mackerel Managed Fishery (Area 2; Class 2A and Class 2B) are the relevant license holders.

[1] **Searcher** has designed the survey to be in water depths of >100m. While Mackerel fishers are not expected to be encountered or excluded from fishing grounds due to the Possum 3D MSS, consultation will be continued with MMF Area 2 fishers due to the one record of effort in 2018.

Searcher has used the best available science to describe and understand the existing marine environment within the Possum 3D MSS operational and acquisition areas, including reviewing literature published from surveys conducted on the Rowley Shoals, This includes developing an understanding of fish behavioural activities during seismic acquisition activity. Noise modelling results for the Possum 3D MSS (JASCO, 2020) indicate that fish behaviour may be impacted up to 10 km distance from the acquisition area. However the body of peer-reviewed literature does not indicate any long-term abandonment of fishing grounds by commercial species due to seismic activity, with several studies indicating that catch levels returned to pre-survey levels after seismic activity had ceased (Carroll et al. 2017). While it is possible that fish may be displaced from a survey footprint to adjacent areas, the total number of fish within the fishery stock remains unchanged (Przeslawski et al., 2016). Effects on fish behaviour are expected to be temporary as the seismic vessel traverses each survey line, and fish are expected to move away as the airgun array approaches.

Searcher is an active member of the NERA managed Collaborative Seismic EP (CSEP) project and, as such, intend to accept and adopt any protocols that are henceforth developed and mutually ratified by both the Consortium and the WA commercial fishing industry during the Possum 3D MSS acquisition.

Potential Impact on Spawning Pattern of Fisheries

Searcher have identified the fish spawning periods for all key or target commercial fish species for all fisheries that have jurisdictions overlapping the Possum 3D MSS operational area. It is not possible to avoid overlap with the spawning periods for all these key or target commercial fish species, as their spawning periods may be spread throughout the year, indicating that there is no specific period of higher sensitivity.

Noise modelling results for the Possum 3D MSS indicate that fish behaviour may be impacted up to 10 km distance from the acquisition area (JASCO, 2020). Spawning periods of the key or target commercial species for fisheries active since 2014 within 10km of the Possum 3D MSS acquisition area are outlined in the table below. There are no known spawning aggregations for these key or indicator species within 10 km of the Possum 3D MSS acquisition area.

Fishery	Key Species	J	F	M	A	M	J	J	A	S	O	N	D	Distribution
Mackerel Managed fishery (WA)	Spanish mackerel	■								■	■	■	■	Single genetic stock along the WA coast. Adults in waters up to 50 m; spawning probably occurs at large number of sites over protracted season (Mackie and Lewis, 2001; Mackie *et al.* 2003; Mackie *et al.* 2010)
North-west Slope Trawl Fishery (Cwlth)	Scampi									■	■			Benthic, in tropical Australian waters from 420-500 m throughout the North-West Shelf (AFMA 2020)

The modelling from JASCO (2020) for the Possum 3D MSS survey shows that noise at the seabed that could cause statocyst damage to crustaceans is predicted to 141m either side of each sail line in shallower waters (e.g. in the southern part of Operational Area). The minor statocyst impacts are not expected to be lethal and are predicted to repair through time. No other sub-lethal effects are known to occur and effects on behaviour are very unlikely. These impacts are also likely to be partially recoverable after successive moulting (Day et al 2019). As the vessel moves into deeper water, this propagation distance at the seabed will become smaller and any impact will be reduced.

Any effects to stocks in the 2.33% of the North West Slope Trawl Fishery (NWSTF) are unlikely to be permanent (Day et al 2019). The best available scientific evidence shows that seismic noise exposure did not change catch rates of prawns in much shallower waters (Andriguetto-Filho et al 2005). Furthermore, a review of all the available scientific evidence found exposure to seismic noise did not affect catch rates in invertebrates (Carroll et al 2017). As the proposed survey area overlaps an extremely small portion of the NWSTF, with over 97% of the fishery unaffected by the survey, it is reasonably predicted that the Possum 3D survey is unlikely to affect the overall catch rates of scampi in the NWSTF.

While the historic catch data show activity from the Mackerel Managed Fishery (MMF) in the Possum 3D MSS area, interaction with stakeholders confirm that fishing activity in the area during the proposed seismic activity is unlikely due to the water depth.

Proposed control measures to mitigate the impact to commercial fishing from underwater noise include:

- Use of the smallest array size that will achieve the survey objectives
- Most efficient survey design possible to reduce survey time
- Avoidance of identified spawning period for scampi (Sept-Oct)
- Strict policy of no fishing from any seismic or support vessel(s)
- Searcher has reduced the operational and acquisition areas to minimise overlap with commercial fishing areas.

References:

Andriguetto-Filho, J.M., Ostrensky, A., Pie, M.R., Silva, U.A. and Boeger, W.A. (2005). Evaluating the impact of seismic prospecting on artisanal shrimp fisheries. Continental Shelf Research 25(14): 1720-1727.

Carroll, A. G., Przeslawski, R., Duncan, A., Gunning, M., and Bruce, B. (2017). A critical review of the potential impacts of marine seismic surveys on fish & invertebrates. Marine Pollution Bulletin, 114(1), 9-24.

Day, R.D., McCauley, R.D, Fitzgibbon, Q.P, Hartmann, K. and Semmens, J.M. (2019). Seismic air guns damage rock lobster mechanosensory organs and impair righting reflex. Proceedings of the Royal Society B 286(1907). https://doi.org/10.1098/rspb.2019.1424.

JASCO (2020). Possum 3D Acoustic Modelling Report CLICK HERE. viewed 30 March 2020, <http://www.searcherseismic.com/StakeholderFeedback>

Mackie, M. and Lewis, P., 2001. Assessment of gonad staging systems and other methods used in the study of the reproductive biology of narrow-barred Spanish mackerel, Scomberomorus commerson, in Western Australia. North Beach: Department of Fisheries, Government of Western Australia.

Mackie, M.C., Lewis, P.D., Gaughan, D.J. and Buckworth, R.C. 2003. Stock assessment of Spanish mackerel (Scomberomorus commerson) in Western Australia. Final report to Fisheries Research and Development Corporation. Project No. 1999/151. Department of Fisheries, Western Australia.

Mackie, M.C., Lewis, P.D., Kennedy, J., Saville, K., Crowe, F., Newman, S.J. and Smith, K.A. 2010. Western Australia Mackerel Fishery. ESD Report Series No. 7, September 2010. Department of Fisheries, Western Australia.

Przeslawski, R., Hurt, L., Forrest, A., & Carroll, A. (2016). Potential short-term impacts of marine seismic surveys on scallops in the Gippsland Basin. Fisheries Research and Development Corporation, Canberra, 60.

Invitation for Consultation—Update

Possum 3D Marine Seismic Survey

13th May 2020

Introduction

Searcher Seismic Pty Ltd (Searcher) is proposing to acquire a multiclient three-dimensional (3D) marine seismic survey (MSS) in the North-west Marine Region (NWMR) offshore from Western Australia.

The purpose of this updated flyer is to provide further details of the survey to relevant and interested stakeholders, and to enable you to continue to be involved in the consultation process for the regulatory environmental approvals procedure, as well as relevant communications related to the survey activity.

Throughout the project development, Searcher will provide each relevant person sufficient information to allow them to make an informed assessment of the possible consequences of the proposed survey on their functions, interests or activities.

Searcher will provide all stakeholder feedback to NOPSEMA, within the proposed activity's Environment Plan. Under recent changes to Environment Regulations, all environment plans for offshore oil and gas activities will be published, and draft environment plans for offshore seismic surveys and exploration drilling activities will be open for an additional 30-day public comment period prior to NOPSEMA assessment.

Key Activity Information

- The proposed Possum 3D Multiclient Marine Seismic Survey ('Possum 3D MSS') Operational Area lies entirely within the NWMR and incorporates Exploration Permits WA-436-P, WA-479-P, WA-487-P, WA-527-P and WA-540-P (as shown on the following page).
- The proposed Possum 3D MSS is planned to be conducted over a maximum operational survey area of approximately 13,447 sq km.
- Maximum expected survey duration with contingency time is 70 days; 24 hour operations.
- The acquisition window is expected to be between Dec and end April, but may extend to July with additional controls implemented.
- Environment Plan will be requested for 31 month validity between December 2020 and end July 2023 with survey scheduled in the acquisition windows as above.
- Every effort will be made to time the activity to minimise any potential adverse effects on relevant stakeholders.

About Searcher

Searcher has a history of effectively conducting marine seismic surveys in the waters offshore of Western Australia with successful environmental outcomes attained from rigorous operating rules, environmental risk assessment, planning and management.

Searcher are committed to open and honest communications about the planned activity and to listening to relevant stakeholder concerns. Your valuable feedback will assist us in identifying all relevant stakeholders for the planned survey and assessing how it may affect your functions, interests or activities.

If you have not previously registered you may formally register your interest using any of the following contact methods. Alternatively you may "opt-out" if you do not wish to receive further project updates or believe that this activity will not affect your functions, interests of activities.

Contact

Register

Possum 3D Consultation Team

PHONE:
+61 (0)8 9327 0301

WEBSITE:
searcherseismic.com/stakeholderfeedback

EMAIL:
feedback@searcherseismic.com

Opt Out

Stakeholders are to advise if any feedback is to remain confidential and not to be made available for public release within the draft or final Environment Plan. This is a one click option in the online feedback form, or can be requested via the alternative contact methods provided.

Searcher Seismic

Possum 3D Survey Area WGS84

Idx	Longitude	Latitude
1	120° 09' 48.3452" E	16° 36' 29.8442" S
2	120° 10' 19.9223" E	18° 01' 15.5369" S
3	119° 59' 31.5658" E	18° 04' 37.3728" S
4	119° 13' 22.0184" E	18° 04' 36.5951" S
5	119° 13' 24.0593" E	17° 40' 44.8715" S
6	119° 47' 04.8498" E	17° 40' 42.5592" S
7	119° 47' 05.4248" E	17° 22' 09.5827" S
8	119° 47' 00.8030" E	16° 52' 59.3371" S
9	119° 55' 08.0532" E	16° 44' 51.3906" S
10	120° 06' 14.4232" E	16° 44' 54.3980" S
11	120° 06' 14.4233" E	16° 36' 32.2451" S
12	120° 09' 48.3452" E	16° 36' 29.8442" S

Possum 3D Operational Area WGS84

Idx	Longitude	Latitude
1	119° 14' 09.5135" E	17° 35' 48.6890" S
2	119° 24' 12.3661" E	17° 35' 35.4192" S
3	119° 45' 31.0716" E	17° 16' 38.5284" S
4	119° 45' 29.2682" E	16° 52' 53.6267" S
5	119° 45' 28.8612" E	16° 47' 33.0647" S
6	119° 53' 00.2830" E	16° 39' 58.8815" S
7	120° 01' 10.3513" E	16° 40' 01.7724" S
8	120° 01' 07.7448" E	16° 31' 42.8341" S
9	120° 14' 08.1238" E	16° 31' 34.4639" S
10	120° 14' 32.7660" E	18° 00' 46.2925" S
11	120° 08' 21.7465" E	18° 04' 45.2458" S
12	119° 53' 12.5126" E	18° 07' 36.1525" S
13	119° 00' 59.1120" E	18° 08' 06.6299" S
14	119° 01' 08.5223" E	17° 48' 54.9755" S
15	119° 05' 05.7300" E	17° 44' 56.1624" S
16	119° 10' 04.6884" E	17° 39' 55.1734" S
17	119° 14' 09.5135" E	17° 35' 48.6890" S

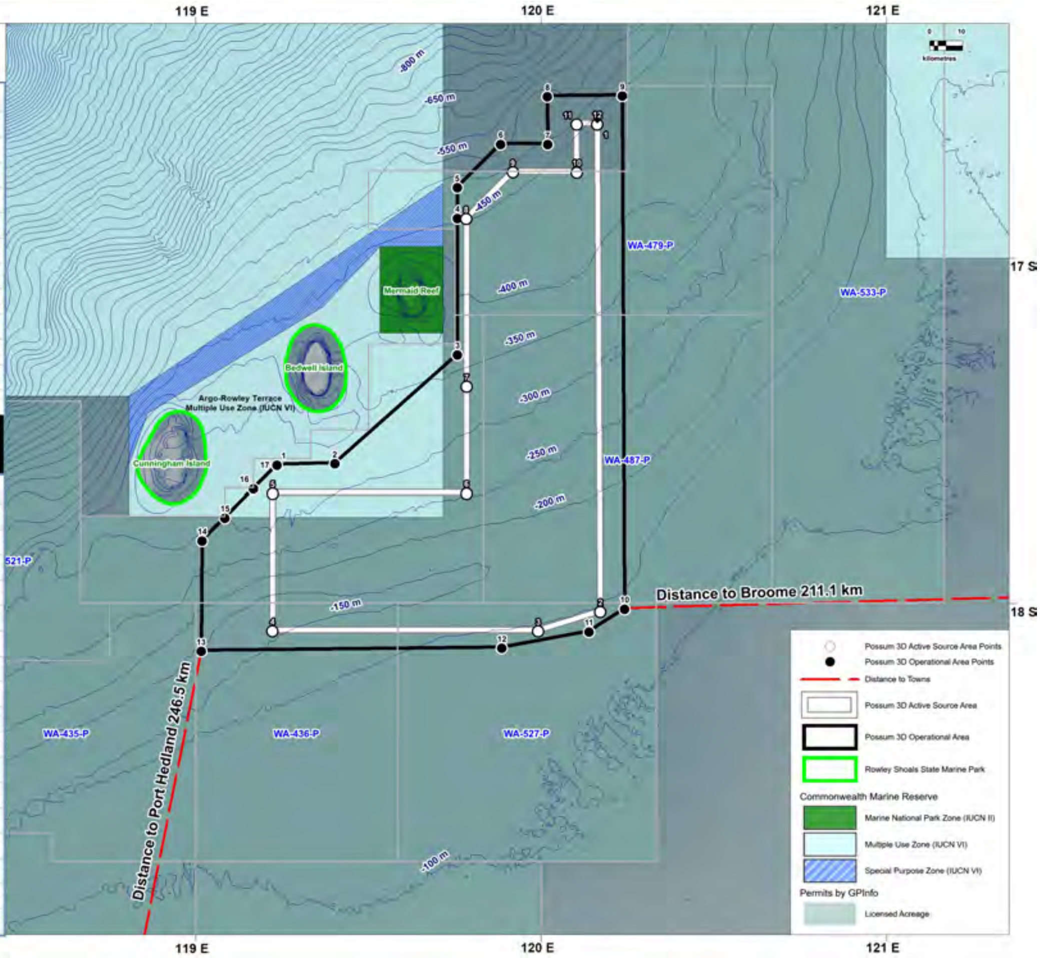


Figure 1—Proposed Activity Location Map

The Possum 3D MSS seismic survey area is located entirely in offshore Commonwealth waters within the NWMR incorporating Exploration Permits WA-436-P, WA-479-P, WA-487-P, WA-527-P and WA-540-P. Boundary co-ordinates are provided above.

The operational area is located ~211 km west of Broome, ~246 km north-east of Port Hedland and >180 km north of Eighty Mile Beach. The survey area is in close proximity to, but has been designed to avoid, the Mermaid Reef Commonwealth Marine Reserve (MRCMR) boundary (4.4 km to Operational Area; 7.2km to Active Source area), the Rowley Shoals Marine Park boundary at Imperieuse Reef (11.9km to Operational Area; 21.65km to Active Source area) and the ancient coastline. Water depths across the survey area range from ~118–566m, with the deepest water depths situated in the northern half of the survey area. Seismic activities will not occur in water shallower than 100m.

- The **'Acquisition Area' (AA)** covering ~5,400 sqkm is the focus area where the full-fold 3D seismic data will be acquired.
- The **'Active Source Area' (ASA)** of ~8,584 sqkm includes a buffer around the Acquisition Area and is the area within which the seismic energy source may be operational, including soft start procedures and line run-outs (required to obtain full fold coverage). The full seismic source will not be operational outside of this area, although small, individual source elements may be tested during maintenance outside the ASA but still within the Operations Area.
- The **'Operational Area' (OA)** covers ~13,447 sqkm providing an ASA 'operational buffer', required for activities including streamer deployment, retrieval, maintenance or recovery, routine vessel manoeuvring and other non-seismic vessel activities.

A marine seismic survey is a method of determining geological features below the sea floor, by sending sound waves into the rock layers beneath the sea floor and then recording the time is takes for each wave to bounce back as well as measuring the strength of each returning wave along a towed cable ("streamer") of acoustic recorders.

The Possum 3D MSS will be acquired from a vessel towing approximately 10 streamers extending ~8.5km behind the survey vessel and nominally ~20m below the sea surface. The sound wave is generated by the use of a seismic source, consisting of an airgun array towed at a water depth of ~5–7m. The source generates acoustic pulses by periodically discharging compressed air into the water column at regular intervals, as the vessel transits along acquisition lines within the Active Source Area (ASA). Passive magnetic and gravity readings may also be recorded.

Seismic data will be acquired along pre-defined parallel lines, for a period of up to 70 days operating 24 hours a day. This time also includes shut downs for routine and reactive maintenance, repairs, transit and line turns, fauna and stakeholder avoidance. The process will continue until all survey lines, plus any re-acquisitions or 'infill' lines have been acquired.

Environmental Impact Assessment

As required by Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS(E) Regulations), Searcher is undertaking an assessment of the planned environmental impacts and unplanned environmental risks associated with the proposed seismic survey. This includes assessment of impacts and risks to other marine users including fishers, divers, government agencies and ship owners. A number of species covered under the “Matters of National Environmental Significance” and “Other Matters” protected by the Environment Protection and Biodiversity Conservation Act 1999, have also been identified as potentially occurring within the survey ASA and OA. Species listed as Vulnerable or Endangered will be the subject of a comprehensive impact and risk assessment in order to minimise these to as low as reasonably practicable (ALARP) and acceptable levels. Commonwealth or State Marine Reserves and Parks or listed Key Ecological Features (KEFs) in proximity to the survey’s OA have been identified (Figure 1). Risks posed by a fuel spill from the survey vessel to environment receptors are also being assessed and reduced to ALARP and acceptable levels.

The seismic survey vessel, and any support vessels that may be imported into Australia to conduct this seismic survey activity, will do so under the strict requirements of the biosecurity legislation administered by the Australian Department of Agriculture and Water Resources. An Oil Pollution Emergency Plan (OPEP) specific to the activity will also be developed, as required by the OPGGS(E) Regulations.

Potential Impacts to Stakeholders

Marine seismic surveys can potentially impact other marine users, including temporary displacement of commercial or recreational fishers and interaction with divers, commercial shipping and other marine traffic. It is also possible that pelagic or demersal fish stocks may temporarily relocate during the activity. Searcher will be closely consulting with all relevant licensed fishers in the survey during the planning phase in an effort to minimise any negative operational or commercial impacts to those fishers and their livelihoods. An initial Impact Assessment of the commercial fishing activities in each of the overlapping Commonwealth and State Managed fisheries is included In the following pages.

Further information regarding seismic surveying methods and their potential effects can be found on the International Association of Geophysical Contractors (IAGC) web site on the “Resources” page:- https://www.iagc.org/resources.html, or by completing the online form, via email or by phone and asking for further information to enable you to adequately assess whether the activity might affect your functions, interests or activities .

Stakeholder Engagement

Searcher encourages open, two-way communication with stakeholders throughout the planning and implementation of the proposed activities. Reviewing this update to the Invitation For Consultation is the part of a more comprehensive stakeholder engagement process. All persons or organisations that wish to continue to be included in the consultation process to register their interest via the simple online registration form that can be accessed through the Searcher web site address listed on the first page, or via scanning the QR code and completing the form on a mobile device. Some basic multiple choice question options and fields for additional feedback are provided within the feedback questionnaire, including the option to request direct communications with Searcher’s Project Management Team. The option to opt out of any further communications on this matter also exists.

Under the regulations, stakeholder consultation is a mandatory process for the proponent (Searcher) but voluntary for potential stakeholders. Searcher recognises the risk of “stakeholder fatigue” and the inconvenience consultation may cause for those that have no interest in the proposed activity. Unfortunately, failure to respond to this invitation to consult will not be accepted by the regulator NOPSEMA as a lack of interest, so your assistance in completing the online feedback form would be greatly appreciated and will help avoid further contact from us if you do decide to opt out of future correspondence in relation to this activity. If we do not hear from you then we will continue to provide you with updates to allow for circumstances such as extended post delivery times and perusal of this information.

Searcher will provide all stakeholder feedback to NOPSEMA, within the proposed activity’s environment plan. Under recent changes to environment regulations, all environment plans for offshore oil and gas activities will be published, and draft environment plans for offshore seismic surveys and exploration drilling activities will be open for an additional 30-day public comment period prior to NOPSEMA assessment.

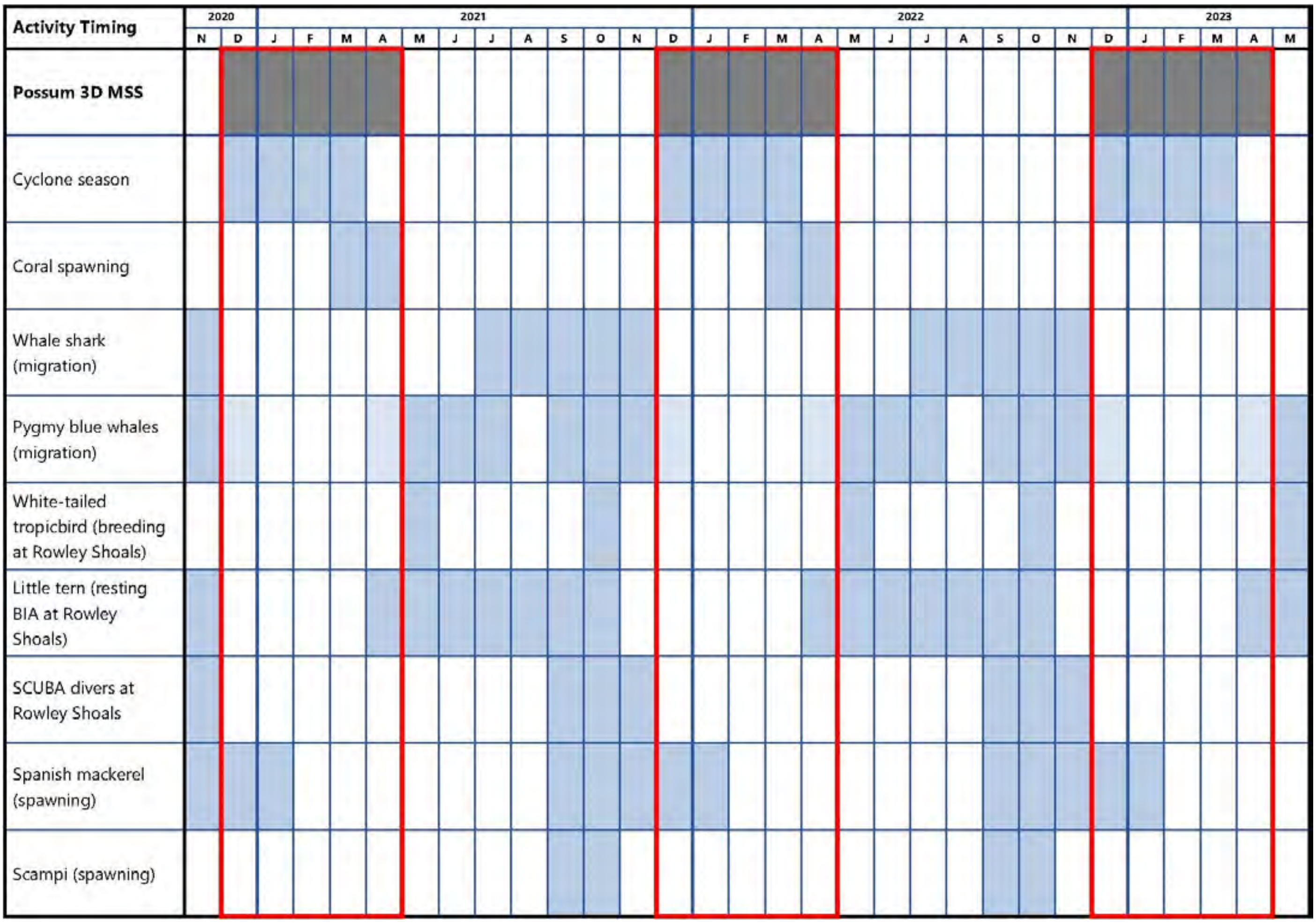
Survey Operating Window

At all times, the best window(s) of opportunity for the acquisition of Searcher's Marine Seismic Surveys are considered within the environmental, social constraints and regulatory approvals; the vessel availability within that nominated operational window is then addressed.

Particular considerations in the proposed Possum 3D MSS area include, but are not limited to, the following:

- Overlapping Commercial Commonwealth and State Fisheries
- Proximity to the Mermaid Reef Commonwealth Marine Reserve (Sanctuary Zone IUCN-II) and the Rowley Shoals State Marine Park; environmental considerations and potential impact on recreational diving activities
- Survey Operational Area extending into Argo-Rowley Terrace Commonwealth Marine Park (Multiple Use Zone IUCN-VI)
- Acquisition and Operational Areas overlap well-used commercial shipping lanes
- Potential Impact on Marine Fauna, Plankton, Fish from this activity, as well as cumulative impact from other planned activities in the region

Searcher have determined the most appropriate acquisition window considering key environmental sensitivities within the operational area to be December to end April but may extend to July with additional controls implemented.



Simultaneous Operations

Searcher is aware of three other potential marine seismic surveys planned in the vicinity during the period anticipated for acquisition of the Possum 3D MSS. These surveys all have limited spatial overlap with the proposed activity, as shown in the Figure 2 below.

Titleholder	Project Name (All Eps under assessment with NOPSEMA)	Activity Window
INPEX Browse E&P Pty Ltd	2D Seismic Survey WA-532-P, WA-533-P and WA-50-L	1 Nov 2020 – 31 May 2021 (timing of the activity within proximity to Possum 3D MSS is unknown). Max 140 days
3D Oil Limited	Sauropod 3D Marine Seismic Survey (WA-527-P) *- EP under assessment with NOPSEMA*	Jan – April 2020 or 2021 (Max 60 days)
Santos WA Northwest Pty Ltd	Keraudren 3D Extension	1st Feb – 31st July 2020-2022 (Est 132 days total)

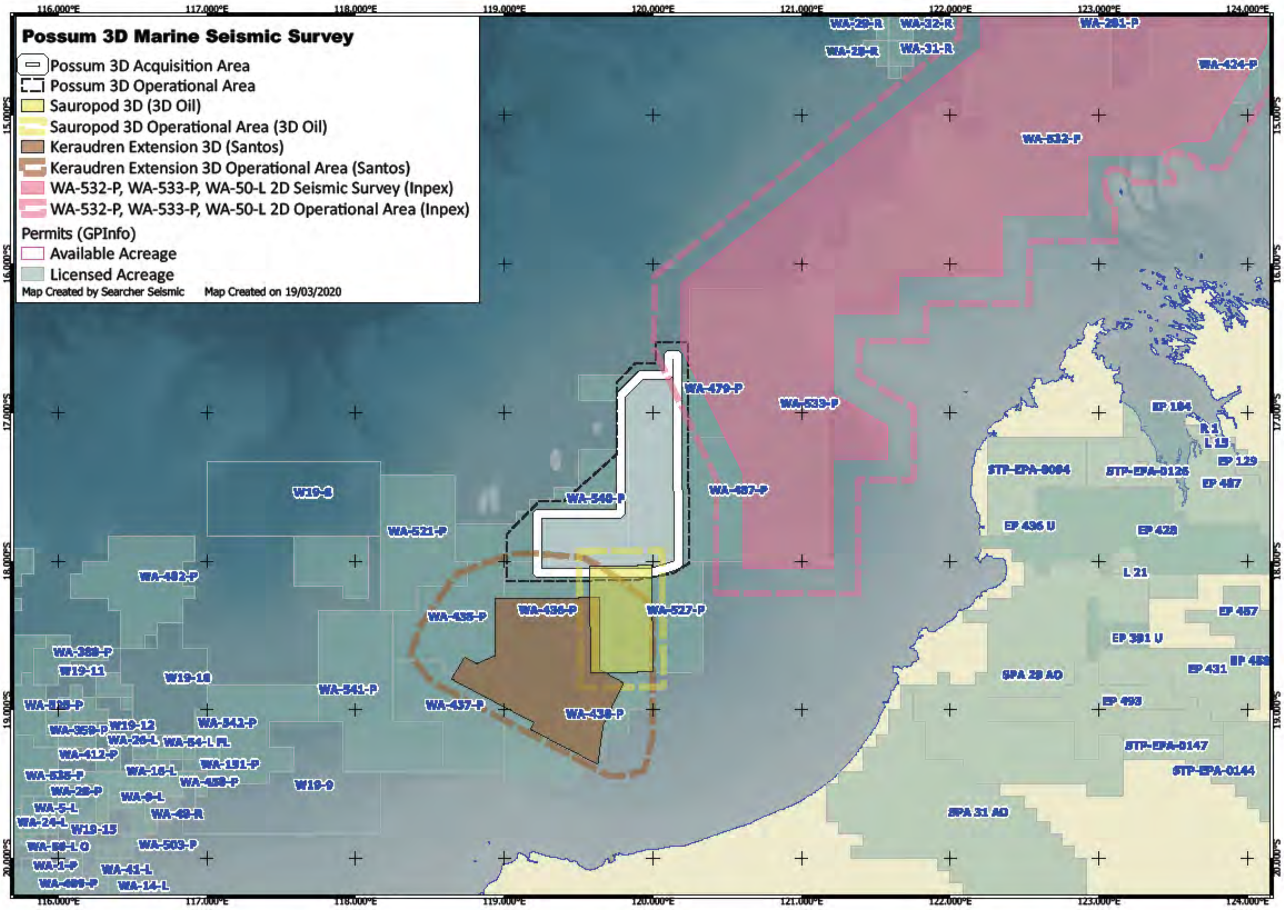


Figure 2— Potentially Overlapping Marine Seismic Surveys

Searcher will remain in contact with the operators of these surveys and will review all opportunities to minimise impact on the marine fauna, fisheries and operations of relevant Stakeholders. Where possible, plans will be made to avoid overlapping seismic activities. Where this is not possible, the activities will be prioritised and a simultaneous operations (SIMOPS) plan developed. Proposed controls to mitigate the impact of simultaneous seismic surveys and cumulative impact effects will include:

- Searcher will engage with proponents for potential seismic activities prior to commencing the Possum 3D MSS and will develop a SIMOPS plan for any concurrent surveys identified within 60 km of the acquisition area
- A minimum separation distance of 40 km will be maintained between the Possum 3D MSS survey vessel and other operating seismic sources
- Use the smallest practicable seismic array size to meet the geophysical objectives of the survey

Temporary Displacement of Others

Marine users that may be present in the OA during the survey period include commercial fishing vessels, commercial vessels undertaking oil and gas industry activities, Australian Border Force or navy and large vessels within the well-used commercial shipping route to and from Port Hedland. The seismic survey vessel will acquire data over a period of up to 70 days during which time it will operate 24 hours a day. Due to the seismic streamers extending ~8.5 km behind the seismic vessel and the data acquisition process, the survey vessel will be restricted in its ability to manoeuvre. There will be support vessel(s) assisting with survey activities including redirecting any marine traffic away from the survey vessel and towed streamers. Because of the physical presence of these vessels, other marine users including fishing vessels and other commercial or recreational shipping traffic may be temporarily displaced from their intended area of operation or transit route. The seismic streamers also present a navigational hazard to other marine users, and fishing equipment deployed within the OA may become entangled in the streamers or run over by the survey or support vessels.

Review of fishing activity by operators within Commonwealth and State fisheries shows that only fishers in the North West Slope Trawl Fishery (NWSTF) are likely to be active in the OA. The proposed survey area overlaps an extremely small portion of the fishery with over 97% of the fishery unaffected by the survey.

Standard control measures that will assist in limiting adverse interactions with other vessels during the Possum 3D MSS include compliance with legislative requirements for maintenance of appropriate navigation, communications and maritime lighting in order to inform other uses of the position and intentions of the survey vessels, and compliance with Searcher and industry standards.

The following controls measures will be implemented :

- Consultation with other users during the development of the Possum 3D MSS, and prior to and during the survey activity
- Survey areas minimised as much as practicable whilst still achieving the survey objectives
- ASA and OA designed to minimise overlap with commercial fishing areas
- Tail buoys clearly marked to identify streamer ends to other users
- Survey vessels will be equipped with Automatic Radar Plotting Aid (ARPA) and active Automatic identification system (AIS) for detection of vessels, speed, heading
- Maintain appropriate navigation lights and day shapes at all times, in accordance with COLREGS to inform other users of the vessel's actions. Additional communications will be carried out, as required, during the activity using a range of other means e.g. marine VHF radio, telephone, signal lights etc
- Use of support vessel(s) to interact and manage interactions with other vessels and to scout well ahead of the seismic survey vessel for inwater hazards
- Notification of the start and end of activity to the AMSA/JRCC and AHS which will issue Notice to Mariners and AusCoast Warning in relation to the activity
- 24—48 hour notification to commercial fishers (communications at sea) regarding look-ahead activities
- In the event of equipment loss, other users to be notified as required (including AMSA and NOPSEMA)

Based on the above considerations the potential impacts due to physical presence of survey vessels during the Possum 3D MSS are considered to be slight and short-term.

Underwater sound emissions from the seismic array

Acquisition of the Possum 3D MSS will involve the use of a seismic source, consisting of an airgun array towed at a water depth of 5 – 7 m. The source will be used to generate acoustic pulses by periodically discharging compressed air into the water column, as the vessel transits along acquisition lines within the Active Source Area (ASA). Underwater noise can affect marine fauna in three main ways:

- By causing direct physical effects on hearing or other organs. Hearing loss may be temporary (temporary threshold shift – TTS), or permanent (PTS), with PTS considered to represent injury;
- Through disturbance leading to behavioural changes or displacement of fauna. The occurrence and intensity of disturbance is highly variable and depends on a range of factors relating to the animal and situation; and
- By masking or interference with other biologically important sounds (including vocal communication, echolocation, signals and sounds produced by predators or prey).

To assess the potential magnitude and extent of impacts from underwater noise produced during the Possum 3D MSS, Searcher commissioned JASCO Applied Sciences to model the source levels and sound propagation. The Possum 3D MSS Acoustic Modelling Report (JASCO 2020) is available from Searchers website via http://www.searcherseismic.com/stakeholderfeedback, or may be requested via any of the listed contact methods. Several locations were modelled, with a specific focus on the impact due to the proximity of the nearby Rowley Shoals State Marine Park and Mermaid Reef Commonwealth Marine Reserve, that were representative of the different water depths, bathymetry and seabed properties within the ASA.

The objective of this acoustic modelling study was to evaluate the effects of sound on marine fauna including marine mammals, marine reptiles, fishes, elasmobranchs, benthic invertebrates and zooplankton, and on socio-economic receptors such as commercial fisheries and Australian Marine Parks. The modelling methodology considers source directivity and range-dependent environmental properties in each of the areas assessed. The results of the sound modelling is compared against sound exposure thresholds for marine fauna and other receptors. The assessment of impacts are presented on the following page.

The modelling process and comparison against threshold limits was then used to complete an impact assessment based on the setting of 'standard control measures':

- Compliance with legislative requirements;
- Part A Standard Management Measures of EPBC Policy Statement 2.1 will be applied in full to mitigate potential impacts to whales. One EPBC Policy Statement 2.1 Part B Additional Management Measure will also be applied;
- OPGGS Act: Residual risks must be reduced to ALARP;
- Compliance with Company and industry standards;
- Alignment with objectives and compliance requirements of applicable management, recovery and /or conservation plans.

In addition to the above, the following controls will be adopted to ensure that the impacts associated with underwater sound emissions from the seismic array are As Low As Reasonably Practicable (ALARP) and acceptable:

- Minimum source size selected to acquire survey data and meet the geophysical objectives of the survey (based on specific sound source modelling)
- Two Marine Fauna Observers will be on board the seismic vessel and on duty during daylight hours during the survey
- 100 m 'turtle pause' when a turtle is within 100 m of the active source
- Searcher will engage with proponents identified and develop a SIMOPS plan for any concurrent surveys identified within 60 km of the acquisition area.
- A minimum separation distance of 40 km will be maintained between the Possum 3D MSS survey vessel and other operating seismic sources
- Searcher will engage with any individual fishers or tourism operators identified operating in or adjacent to the OA.

With these controls in place, the potential impacts of underwater sound emissions from the seismic source on marine fauna during acquisition of the Possum 3D MSS are considered to be slight and short-term, and restricted to temporary behavioural changes (avoidance) in any individuals that may inhabit areas or transit the area in close proximity to the operating seismic source. With the control measures in place, the underwater sound emissions from the Possum 3D MSS will not result in any significant impacts to tourism operators, marine park values and commercial fisheries overlapping the OA.

Underwater sound emissions from the seismic array

With the listed controls in place, the following assessment of impacts have been made:

Marine mammals: Due to the timing, duration and location of the survey, the survey is not predicted to impact on critical habitats for any species of marine mammal (i.e. feeding, breeding, calving areas) or constrict the migratory pathway within the operational area and surrounding waters for Blue Whales. The control measures proposed will significantly reduce the likelihood of injury (PTS) effects, or any ecologically significant impacts at a population level for any species of marine mammal that may be present within or adjacent to the OA during the survey. Additional controls will be implemented should the survey extend beyond the end of April.

Marine reptiles: Based on the timing and duration of the survey, the separation distances to nesting BIAs and 'Habitat Critical' areas, and the control measures proposed, predicted noise levels from seismic acquisition are not considered likely to cause PTS effects, displace any individuals from inter-nesting BIAs or 'Habitat Critical' areas, or result in any ecologically significant impacts at a population level for any species of turtle that may be present within or adjacent to the OA during the survey.

Fishes and sharks (demersal, pelagic species including key indicator species of commercial interest, site-attached reef species and whale sharks): The potential impacts of underwater sound emissions from the seismic source on fishes and elasmobranchs during the Possum 3D MSS are considered to be localised and of no lasting effect, restricted to within 60m of the source and TTS in individuals (which is recoverable with 24hrs) that may be present within 9.13km the acquisition area. Based on the timing, duration and location of seismic acquisition, and the control measures that will be implemented, predicted noise levels from seismic acquisition are not considered likely to result in any ecologically significant impacts at a population level for any species of fish that may be present within or adjacent to the OA during the Possum 3D MSS.

Benthic invertebrates (corals, prawns, molluscs) or Zooplankton: The potential impacts of underwater sound emissions from the seismic source on benthic invertebrates or Zoopankton during the Possum 3D MSS are considered to be slight and short-term, as the activity is not likely to result in any mortality of individuals or ecologically significant impacts at a population level for any species of invertebrate that may be present on the seafloor within or adjacent to the ASA.

Marine Parks: Based on the timing and duration of the Possum 3D MSS, spatial separation from the Mermaid Reef Australian Marine Park (MRAMP) boundary (4.4 km to Operational Area; 7.2km to aquisition area) and the Rowley Shoals Marine Park (RSMP) boundary at Imperieuse Reef (11.9km to Operational Area; 21.65km to aquisition area), and the control measures that will be implemented, predicted noise levels from seismic acquisition are not considered likely to cause any impacts to the natural, cultural heritage values of the MRAMP, RSMP or any other Marine Park in the region.

Tourism & Diving operations : Information provided by the (Diving Medical Advisory Committee (DMAC) Guidance number 12 (DMAC 12 Rev. 2 (2019)) on safe diving distances from seismic survey operations notes that there is limited understanding of the effects of seismic pressure waves on divers, and that the multiple factors involved make it difficult to determine a safe or tolerable distance for diving operations from seismic surveying operations. Based on the proposed timing, duration and consultation with relevant stakeholders regarding the Possum 3D MSS, it is assessed that there is unlikely to be any recreational or research diving activities conducted in the area during the planned activity window. However should ongoing consultation identify any diving operations planned within 30 km of the OA, Searcher will follow the DMAC guidance as a pragmatic means of mitigating impacts to divers from seismic sound and conduct a SIMOPS plan for communication and observation of any constraints or buffer distances to be applied.

Operational discharges and emissions from survey vessels

(light, atmospheric, liquid, underwater sound)

The seismic survey vessel and any support vessels that may be imported into Australia to conduct this seismic survey activity, will do so under the strict requirements of the biosecurity legislation administered by the Australian Department of Agriculture and Water Resources, and will be required to undertake inspections by a department biosecurity officer prior to mobilisation to the OA.

Operational discharges from survey vessels include those required for normal ship functions including deck lighting, engine operations. During the 70 days of the MSS the following controls will be instigated in addition to 'standard controls' (eg legislative requirements) to minimise potential impacts to marine fauna from these discharges and emissions:

- External lighting will be directed only onto working decks to avoid impacts to light-sensitive species (eg turtles, birds)
- Atmospheric emissions will be minimised by ensuring only vessels using marine diesel or marine gas oil are used (instead of vessels using heavy fuel oils), and by ensuring all vessels have a planned maintenance system for engine equipment.
- Underwater sound emissions will be minimised by ensuring vessel engines are maintained in accordance with the planned maintenance system
- All discharges of bilge water, deck drainage and engine cooling water are compliant with MARPOL Annex 1 to minimise water degradation

Potential Impact on State and Commonwealth Commercial Fishers

The purpose of this document is to provide updated information to relevant commercial fishers. All the Commonwealth and WA state fisheries that have jurisdictions overlapping the Possum 3D Operational Area (OA) have been reviewed (refer to Invitation for Consultation Possum 3D Marine Seismic Survey, 23 December 2019 or via "searcherseismic.com/stakeholderfeedback"). Fisheries with jurisdiction overlapping the Possum OA and with historic fishing effort in the OA have been identified through review of the Fishery status reports 2019, DPIRD's FishCube database and confirmed by email from WAFIC and specific fishers.

	Commonwealth Fishery	State Fishery
Identified Relevant Fisheries	North-West Slope Trawl (Scampi) Fishery (NWSTF)	Mackerel Managed Fishery (Area 2; Class 2A and Class 2B)
Reporting Authority	Australian Fisheries Management Authority (AFMA)	Department of Primary Industries and Regional Development (DPIRD)
Overlap of Possum OA with Fishery Management area	~9,211km2 (2.33%)	~13,420km2 (~2.7%) of total size of Area 2.
Historic fishing effort (2014—2018)	One fisher is intermittently active throughout year within Possum OA	One record of catch in 2018. However by and large mackerel fishers do not operate in water depths more than 70 m (via consultation with WAFIC 7/01/2020) [1]
Source	Direct communication with individual Fisher	WAFIC (via email 7th January 2020) and DPIRD (via phone 21st January 2020) confirmed that the Mackerel Managed Fishery (Area 2; Class 2A and Class 2B) are the relevant license holders.

[1] **Searcher** has designed the survey to be in water depths of >100m. While Mackerel fishers are not expected to be encountered or excluded from fishing grounds due to the Possum 3D MSS, consultation will be continued with MMF Area 2 fishers due to the one record of effort in 2018.

Searcher has used the best available science to describe and understand the existing marine environment within the Possum 3D MSS operational and acquisition areas, including reviewing literature published from surveys conducted on the Rowley Shoals, This includes developing an understanding of fish behavioural activities during seismic acquisition activity. Noise modelling results for the Possum 3D MSS (JASCO, 2020) indicate that fish behaviour may be impacted up to 10 km distance from the acquisition area. However the body of peer-reviewed literature does not indicate any long-term abandonment of fishing grounds by commercial species due to seismic activity, with several studies indicating that catch levels returned to pre-survey levels after seismic activity had ceased (Carroll et al. 2017). While it is possible that fish may be displaced from a survey footprint to adjacent areas, the total number of fish within the fishery stock remains unchanged (Przeslawski et al., 2016). Effects on fish behaviour are expected to be temporary as the seismic vessel traverses each survey line, and fish are expected to move away as the airgun array approaches.

Searcher is an active member of the NERA managed Collaborative Seismic EP (CSEP) project and, as such, intend to accept and adopt any protocols that are henceforth developed and mutually ratified by both the Consortium and the WA commercial fishing industry during the Possum 3D MSS acquisition.

Potential Impact on Spawning Pattern of Fisheries

Searcher have identified the fish spawning periods for all key or target commercial fish species for all fisheries that have jurisdictions overlapping the Possum 3D MSS operational area. It is not possible to avoid overlap with the spawning periods for all these key or target commercial fish species, as their spawning periods may be spread throughout the year, indicating that there is no specific period of higher sensitivity.

Noise modelling results for the Possum 3D MSS indicate that fish behaviour may be impacted up to 10 km distance from the acquisition area (JASCO, 2020). Spawning periods of the key or target commercial species for fisheries active since 2014 within 10km of the Possum 3D MSS acquisition area are outlined in the table below. There are no known spawning aggregations for these key or indicator species within 10 km of the Possum 3D MSS acquisition area.

Fishery	Key Species	J	F	M	A	M	J	J	A	S	O	N	D	Distribution
Mackerel Managed fishery (WA)	Spanish mackerel													Single genetic stock along the WA coast. Adults in waters up to 50 m, not known to form spawning aggregations within the operational area (Mackie and Lewis, 2001; Mackie *et al.* 2003)
North-west Slope Trawl Fishery (Cwlth)	Scampi													Benthic, in tropical Australian waters from 420-500 m throughout the North-West Shelf (AFMA 2020)

The modelling from JASCO (2020) for the Possum 3D MSS survey shows that noise at the seabed that could cause statocyst damage to crustaceans is predicted to 141m either side of each sail line in shallower waters (e.g. in the southern part of Operational Area). The minor statocyst impacts are not expected to be lethal and are predicted to repair through time. No other sub-lethal effects are known to occur and effects on behaviour are very unlikely. These impacts are also likely to be partially recoverable after successive moulting (Day et al 2019). As the vessel moves into deeper water, this propagation distance at the seabed will become smaller and any impact will be reduced.

Any effects to stocks in the 2.33% of the North West Slope Trawl Fishery (NWSTF) are unlikely to be permanent (Day et al 2019). The best available scientific evidence shows that seismic noise exposure did not change catch rates of prawns in much shallower waters (Andriguetto-Filho et al 2005). Furthermore, a review of all the available scientific evidence found exposure to seismic noise did not affect catch rates in invertebrates (Carroll et al 2017). As the proposed survey area overlaps an extremely small portion of the NWSTF, with over 97% of the fishery unaffected by the survey, it is reasonably predicted that the Possum 3D survey is unlikely to affect the overall catch rates of scampi in the NWSTF.

While the historic catch data show activity from the Mackerel Managed Fishery (MMF) in the Possum 3D MSS area, interaction with stakeholders confirm that fishing activity in the area during the proposed seismic activity is unlikely due to the water depth.

Proposed control measures to mitigate the impact to commercial fishing from underwater noise include:

- Use of the smallest array size that will achieve the survey objectives
- Most efficient survey design possible to reduce survey time
- Avoidance of identified spawning period for scampi (Sept-Oct)
- Strict policy of no fishing from any seismic or support vessel(s)
- Searcher has reduced the operational and acquisition areas to minimise overlap with commercial fishing areas.

References:

Andriguetto-Filho, J.M., Ostrensky, A., Pie, M.R., Silva, U.A. and Boeger, W.A. (2005). Evaluating the impact of seismic prospecting on artisanal shrimp fisheries. Continental Shelf Research 25(14): 1720-1727.

Carroll, A. G., Przeslawski, R., Duncan, A., Gunning, M., and Bruce, B. (2017). A critical review of the potential impacts of marine seismic surveys on fish & invertebrates. Marine Pollution Bulletin, 114(1), 9-24.

Day, R.D., McCauley, R.D, Fitzgibbon, Q.P, Hartmann, K. and Semmens, J.M. (2019). Seismic air guns damage rock lobster mechanosensory organs and impair righting reflex. Proceedings of the Royal Society B 286(1907). https://doi.org/10.1098/rspb.2019.1424.

JASCO (2020). Possum 3D Acoustic Modelling Report CLICK HERE. viewed 30 March 2020, <http://www.searcherseismic.com/StakeholderFeedback>

Mackie, M. and Lewis, P., 2001. Assessment of gonad staging systems and other methods used in the study of the reproductive biology of narrow-barred Spanish mackerel, Scomberomorus commerson, in Western Australia. North Beach: Department of Fisheries, Government of Western Australia.

Mackie, M.C., Lewis, P.D., Gaughan, D.J. and Buckworth, R.C. 2003. Stock assessment of Spanish mackerel (Scomberomorus commerson) in Western Australia. Final report to Fisheries Research and Development Corporation. Project No. 1999/151. Department of Fisheries, Western Australia.

Mackie, M.C., Lewis, P.D., Kennedy, J., Saville, K., Crowe, F., Newman, S.J. and Smith, K.A. 2010. Western Australia Mackerel Fishery. ESD Report Series No. 7, September 2010. Department of Fisheries, Western Australia.

Przeslawski, R., Hurt, L., Forrest, A., & Carroll, A. (2016). Potential short-term impacts of marine seismic surveys on scallops in the Gippsland Basin. Fisheries Research and Development Corporation, Canberra, 60.

Invitation for Consultation—Update

Possum 3D Marine Seismic Survey

1st June 2021

Introduction

Searcher Seismic Pty Ltd (Searcher) is proposing to acquire a multiclient three-dimensional (3D) marine seismic survey (MSS) in the North-west Marine Region (NWMR) offshore from Western Australia.

The purpose of this updated flyer is to provide further details of the survey to relevant and interested stakeholders, and to enable you to continue to be involved in the consultation process for the regulatory environmental approvals procedure, as well as relevant communications related to the survey activity.

Throughout the project development, Searcher will provide each relevant person sufficient information to allow them to make an informed assessment of the possible consequences of the proposed survey on their functions, interests or activities.

Searcher will provide all stakeholder feedback to NOPSEMA, within the proposed activity's Environment Plan. Under recent changes to Environment Regulations, all environment plans for offshore oil and gas activities will be published, and draft environment plans for offshore seismic surveys and exploration drilling activities will be open for an additional 30-day public comment period prior to NOPSEMA assessment.

Key Activity Information

- The proposed Possum 3D Multiclient Marine Seismic Survey ('Possum 3D MSS') Operational Area lies entirely within the NWMR and incorporates Exploration Permits WA-436-P, WA-479-P, WA-487-P, WA-527-P and WA-540-P (as shown on the following page).
- The proposed Possum 3D MSS is planned to be conducted over a maximum operational survey area of approximately 13,447 sq km.
- Maximum expected survey duration with contingency time is 70 days; 24 hour operations.
- The acquisition window is expected to be between Dec and end April, but may extend to July with additional controls implemented.
- Environment Plan will be requested for 20 month validity between December 2021 and end July 2023 with survey scheduled in the acquisition windows as above.
- Every effort will be made to time the activity to minimise any potential adverse effects on relevant stakeholders.

About Searcher

Searcher has a history of effectively conducting marine seismic surveys in the waters offshore of Western Australia with successful environmental outcomes attained from rigorous operating rules, environmental risk assessment, planning and management.

Searcher are committed to open and honest communications about the planned activity and to listening to relevant stakeholder concerns. Your valuable feedback will assist us in identifying all relevant stakeholders for the planned survey and assessing how it may affect your functions, interests or activities.

If you have not previously registered you may formally register your interest using any of the following contact methods. Alternatively you may "opt-out" if you do not wish to receive further project updates or believe that this activity will not affect your functions, interests of activities.

Contact

Register

Possum 3D Consultation Team

PHONE:
+61 (0)8 9327 0301

WEBSITE:
searcherseismic.com/stakeholderfeedback

EMAIL:
feedback@searcherseismic.com

Opt Out

Stakeholders are to advise if any feedback is to remain confidential and not to be made available for public release within the draft or final Environment Plan. This is a one click option in the online feedback form, or can be requested via the alternative contact methods provided.

Searcher

Possum 3D Survey Area WGS84

Idx	Longitude	Latitude
1	120° 09' 48.3452" E	16° 36' 29.8442" S
2	120° 10' 19.9223" E	18° 01' 15.5369" S
3	119° 59' 31.5658" E	18° 04' 37.3728" S
4	119° 13' 22.0184" E	18° 04' 36.5951" S
5	119° 13' 24.0593" E	17° 40' 44.8715" S
6	119° 47' 04.8498" E	17° 40' 42.5592" S
7	119° 47' 05.4248" E	17° 22' 09.5827" S
8	119° 47' 00.8030" E	16° 52' 59.3371" S
9	119° 55' 08.0532" E	16° 44' 51.3906" S
10	120° 06' 14.4232" E	16° 44' 54.3980" S
11	120° 06' 14.4233" E	16° 36' 32.2451" S
12	120° 09' 48.3452" E	16° 36' 29.8442" S

Possum 3D Operational Area WGS84

Idx	Longitude	Latitude
1	119° 14' 09.5135" E	17° 35' 48.6890" S
2	119° 24' 12.3661" E	17° 35' 35.4192" S
3	119° 45' 31.0716" E	17° 16' 38.5284" S
4	119° 45' 29.2682" E	16° 52' 53.6267" S
5	119° 45' 28.8612" E	16° 47' 33.0647" S
6	119° 53' 00.2830" E	16° 39' 58.8815" S
7	120° 01' 10.3513" E	16° 40' 01.7724" S
8	120° 01' 07.7448" E	16° 31' 42.8341" S
9	120° 14' 08.1238" E	16° 31' 34.4639" S
10	120° 14' 32.7660" E	18° 00' 46.2925" S
11	120° 08' 21.7465" E	18° 04' 45.2458" S
12	119° 53' 12.5126" E	18° 07' 36.1525" S
13	119° 00' 59.1120" E	18° 08' 06.6299" S
14	119° 01' 08.5223" E	17° 48' 54.9755" S
15	119° 05' 05.7300" E	17° 44' 56.1624" S
16	119° 10' 04.6884" E	17° 39' 55.1734" S
17	119° 14' 09.5135" E	17° 35' 48.6890" S

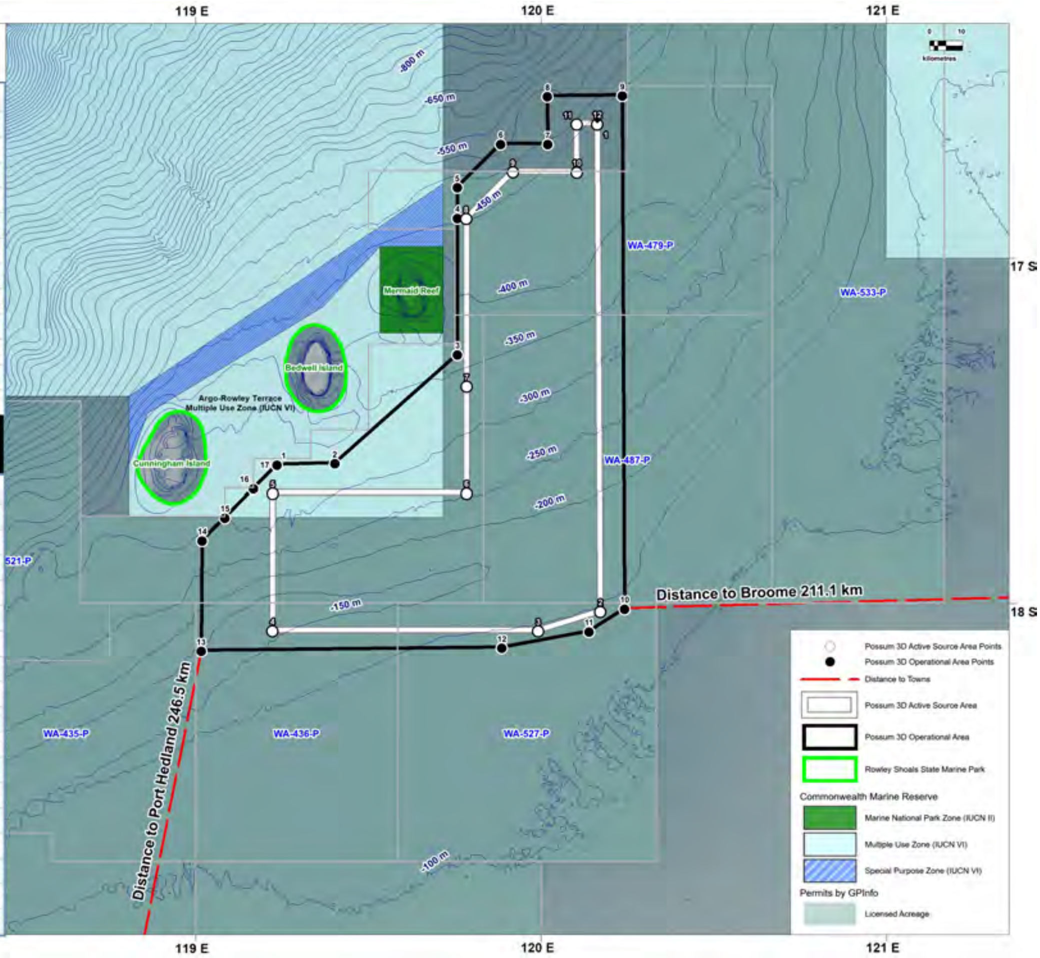


Figure 1—Proposed Activity Location Map

The Possum 3D MSS seismic survey area is located entirely in offshore Commonwealth waters within the NWMR incorporating Exploration Permits WA-436-P, WA-479-P, WA-487-P, WA-527-P and WA-540-P. Boundary co-ordinates are provided above.

The operational area is located ~211 km west of Broome, ~246 km north-east of Port Hedland and >180 km north of Eighty Mile Beach. The survey area is in close proximity to, but has been designed to avoid, the Mermaid Reef Commonwealth Marine Reserve (MRCMR) boundary (4.4 km to Operational Area; 7.2km to Active Source area), the Rowley Shoals Marine Park boundary at Imperieuse Reef (11.9km to Operational Area; 21.65km to Active Source area) and the ancient coastline. Water depths across the survey area range from ~118–566m, with the deepest water depths situated in the northern half of the survey area. Seismic activities will not occur in water shallower than 100m.

- The **'Acquisition Area' (AA)** covering ~5,400 sqkm is the focus area where the full-fold 3D seismic data will be acquired.
- The **'Active Source Area' (ASA)** of ~8,584 sqkm includes a buffer around the Acquisition Area and is the area within which the seismic energy source may be operational, including soft start procedures and line run-outs (required to obtain full fold coverage). The full seismic source will not be operational outside of this area, although small, individual source elements may be tested during maintenance outside the ASA but still within the Operations Area.
- The **'Operational Area' (OA)** covers ~13,447 sqkm providing an ASA 'operational buffer', required for activities including streamer deployment, retrieval, maintenance or recovery, routine vessel manoeuvring and other non-seismic vessel activities.

A marine seismic survey is a method of determining geological features below the sea floor, by sending sound waves into the rock layers beneath the sea floor and then recording the time is takes for each wave to bounce back as well as measuring the strength of each returning wave along a towed cable ("streamer") of acoustic recorders.

The Possum 3D MSS will be acquired from a vessel towing approximately 10 streamers extending ~8.5km behind the survey vessel and nominally ~20m below the sea surface. The sound wave is generated by the use of a seismic source, consisting of an airgun array towed at a water depth of ~5–7m. The source generates acoustic pulses by periodically discharging compressed air into the water column at regular intervals, as the vessel transits along acquisition lines within the Active Source Area (ASA). Passive magnetic and gravity readings may also be recorded.

Seismic data will be acquired along pre-defined parallel lines, for a period of up to 70 days operating 24 hours a day. This time also includes shut downs for routine and reactive maintenance, repairs, transit and line turns, fauna and stakeholder avoidance. The process will continue until all survey lines, plus any re-acquisitions or 'infill' lines have been acquired.

Environmental Impact Assessment

As required by Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS(E) Regulations), Searcher is undertaking an assessment of the planned environmental impacts and unplanned environmental risks associated with the proposed seismic survey. This includes assessment of impacts and risks to other marine users including fishers, divers, government agencies and ship owners. A number of species covered under the "Matters of National Environmental Significance" and "Other Matters" protected by the Environment Protection and Biodiversity Conservation Act 1999, have also been identified as potentially occurring within the survey ASA and OA. Species listed as Vulnerable or Endangered will be the subject of a comprehensive impact and risk assessment in order to minimise these to as low as reasonably practicable (ALARP) and acceptable levels. Commonwealth or State Marine Reserves and Parks or listed Key Ecological Features (KEFs) in proximity to the survey's OA have been identified (Figure 1). Risks posed by a fuel spill from the survey vessel to environment receptors are also being assessed and reduced to ALARP and acceptable levels.

The seismic survey vessel, and any support vessels that may be imported into Australia to conduct this seismic survey activity, will do so under the strict requirements of the biosecurity legislation administered by the Australian Department of Agriculture and Water Resources. An Oil Pollution Emergency Plan (OPEP) specific to the activity will also be developed, as required by the OPGGS(E) Regulations.

Potential Impacts to Stakeholders

Marine seismic surveys can potentially impact other marine users, including temporary displacement of commercial or recreational fishers and interaction with divers, commercial shipping and other marine traffic. It is also possible that pelagic or demersal fish stocks may temporarily relocate during the activity. Searcher will be closely consulting with all relevant licensed fishers in the survey during the planning phase in an effort to minimise any negative operational or commercial impacts to those fishers and their livelihoods. An initial Impact Assessment of the commercial fishing activities in each of the overlapping Commonwealth and State Managed fisheries is included In the following pages.

Further information regarding seismic surveying methods and their potential effects can be found on the International Association of Geophysical Contractors (IAGC) web site on the "Resources" page:- https://iagc.org/our-industry/geophysical-surveys or by completing the online form, via email or by phone and asking for further information to enable you to adequately assess whether the activity might affect your functions, interests or activities .

Stakeholder Engagement

Searcher encourages open, two-way communication with stakeholders throughout the planning and implementation of the proposed activities. Reviewing this update to the Invitation For Consultation is the part of a more comprehensive stakeholder engagement process. All persons or organisations that wish to continue to be included in the consultation process to register their interest via the simple online registration form that can be accessed through the Searcher web site address listed on the first page, or via scanning the QR code and completing the form on a mobile device. Some basic multiple choice question options and fields for additional feedback are provided within the feedback questionnaire, including the option to request direct communications with Searcher's Project Management Team. The option to opt out of any further communications on this matter also exists.

Under the regulations, stakeholder consultation is a mandatory process for the proponent (Searcher) but voluntary for potential stakeholders. Searcher recognises the risk of "stakeholder fatigue" and the inconvenience consultation may cause for those that have no interest in the proposed activity. Unfortunately, failure to respond to this invitation to consult will not be accepted by the regulator NOPSEMA as a lack of interest, so your assistance in completing the online feedback form would be greatly appreciated and will help avoid further contact from us if you do decide to opt out of future correspondence in relation to this activity. If we do not hear from you then we will continue to provide you with updates to allow for circumstances such as extended post delivery times and perusal of this information.

Searcher will provide all stakeholder feedback to NOPSEMA, within the proposed activity's environment plan. Under recent changes to environment regulations, all environment plans for offshore oil and gas activities will be published, and draft environment plans for offshore seismic surveys and exploration drilling activities will be open for an additional 30-day public comment period prior to NOPSEMA assessment.

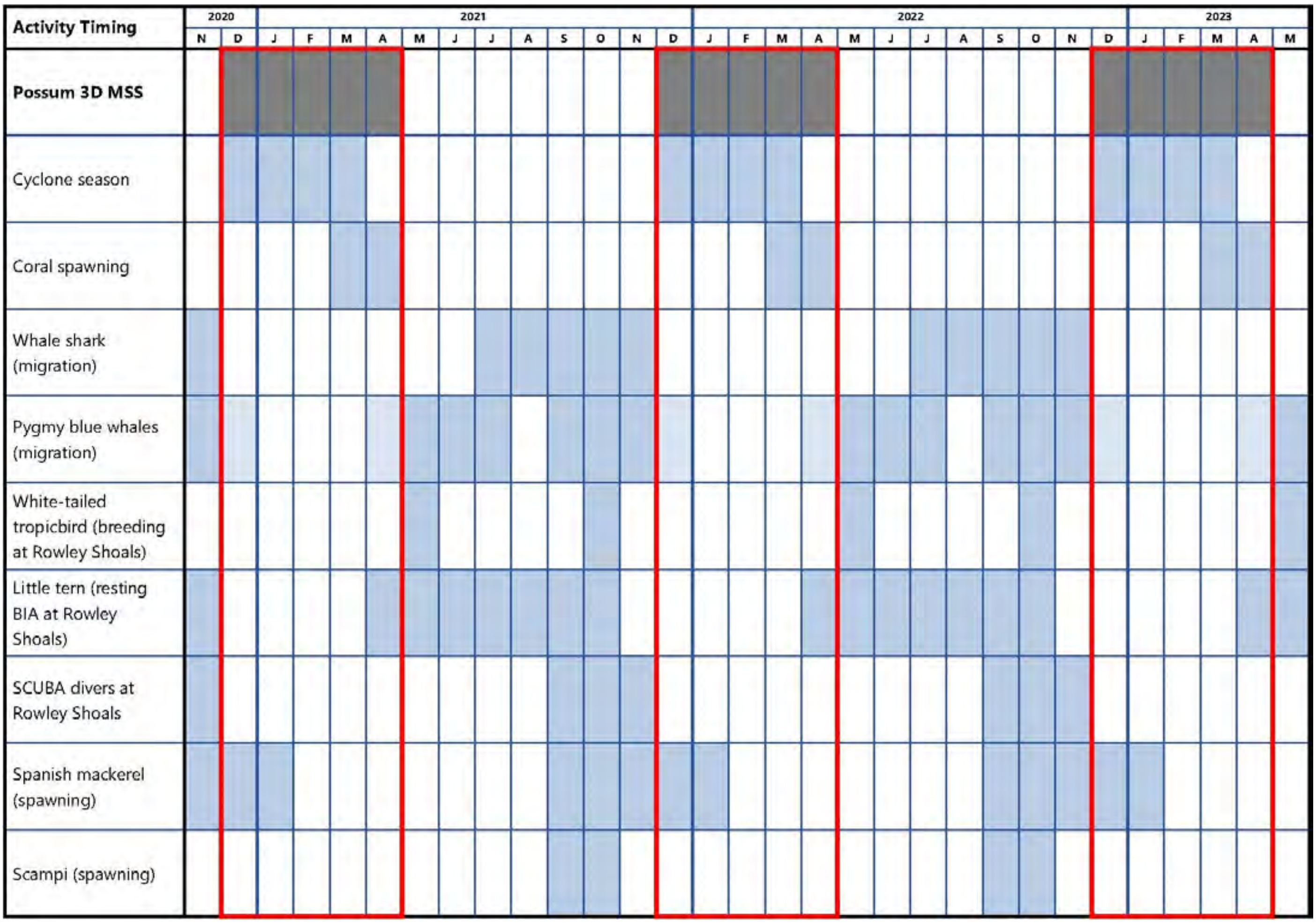
Survey Operating Window

At all times, the best window(s) of opportunity for the acquisition of Searcher's Marine Seismic Surveys are considered within the environmental, social constraints and regulatory approvals; the vessel availability within that nominated operational window is then addressed.

Particular considerations in the proposed Possum 3D MSS area include, but are not limited to, the following:

- Overlapping Commercial Commonwealth and State Fisheries
- Proximity to the Mermaid Reef Commonwealth Marine Reserve (Sanctuary Zone IUCN-II) and the Rowley Shoals State Marine Park; environmental considerations and potential impact on recreational diving activities
- Survey Operational Area extending into Argo-Rowley Terrace Commonwealth Marine Park (Multiple Use Zone IUCN-VI)
- Acquisition and Operational Areas overlap well-used commercial shipping lanes
- Potential Impact on Marine Fauna, Plankton, Fish from this activity, as well as cumulative impact from other planned activities in the region

Searcher have determined the most appropriate acquisition window considering key environmental sensitivities within the operational area to be December to end April but may extend to July with additional controls implemented.



Simultaneous Operations

Searcher is aware of three other potential marine seismic surveys planned in the vicinity during the period anticipated for acquisition of the Possum 3D MSS. These surveys all have limited spatial overlap with the proposed activity, as shown in the Figure 2 below.

Titleholder	Project Name (All Eps under assessment with NOPSEMA)	Activity Window
INPEX Browse E&P Pty Ltd	2D Seismic Survey WA-532-P, WA-533-P and WA-50-L	1 Nov to 31 May 2021 (timing of the activity within proximity to Possum 3D MSS is unknown). Max 140 days
3D Oil Limited	Sauropod 3D Marine Seismic Survey (WA-527-P) *- EP under assessment with NOPSEMA*	Jan – April 2021 (Max 60 days)
Santos WA Northwest Pty Ltd	Keraudren 3D Extension	1st Feb – 31st July 2020-2022 (Est 132 days total)

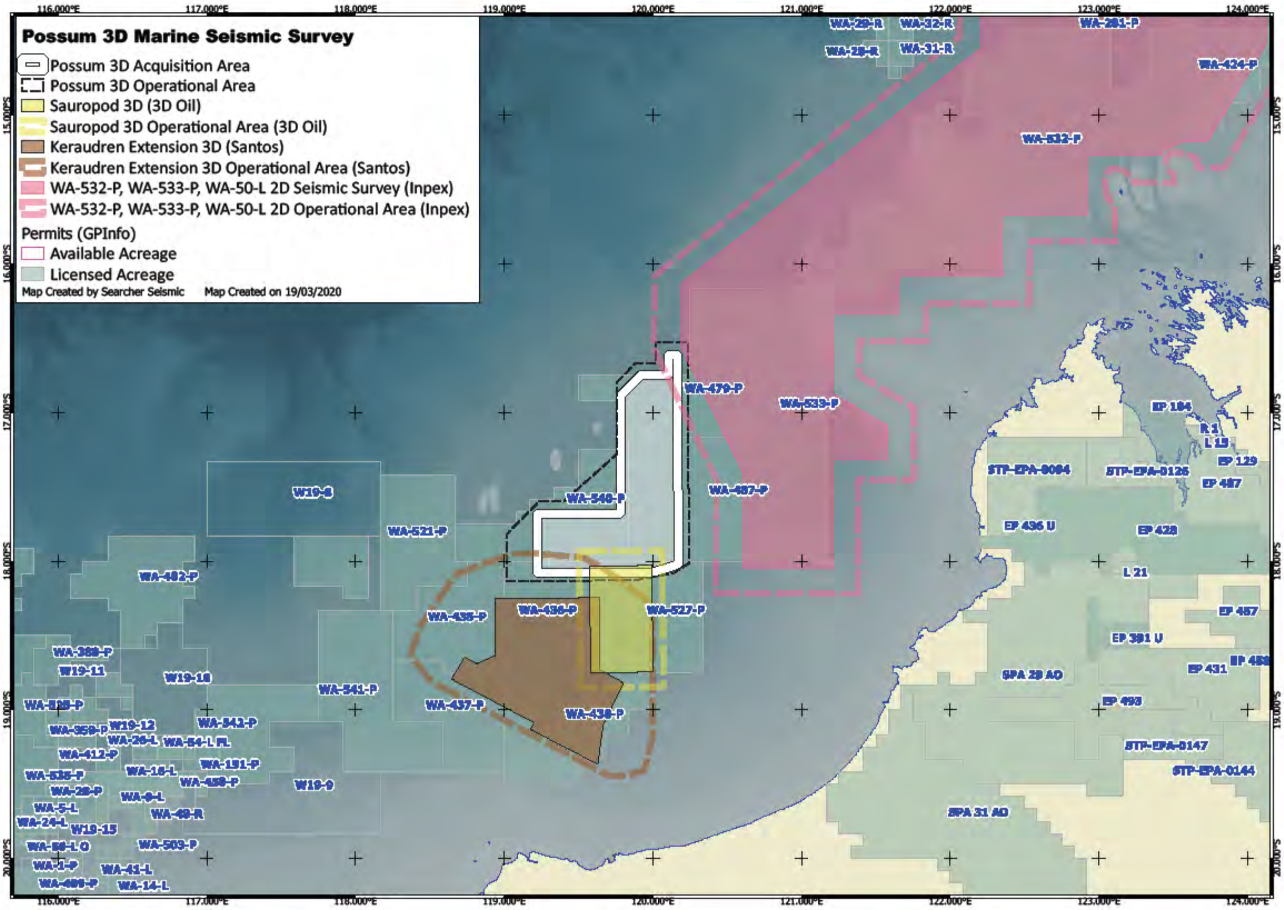


Figure 2— Potentially Overlapping Marine Seismic Surveys

Searcher will remain in contact with the operators of these surveys and will review all opportunities to minimise impact on the marine fauna, fisheries and operations of relevant Stakeholders. Where possible, plans will be made to avoid overlapping seismic activities. Where this is not possible, the activities will be prioritised and a simultaneous operations (SIMOPS) plan developed. Proposed controls to mitigate the impact of simultaneous seismic surveys and cumulative impact effects will include:

- Searcher will engage with proponents for potential seismic activities prior to commencing the Possum 3D MSS and will develop a SIMOPS plan for any concurrent surveys identified within 60 km of the acquisition area
- A minimum separation distance of 40 km will be maintained between the Possum 3D MSS survey vessel and other operating seismic sources
- Use the smallest practicable seismic array size to meet the geophysical objectives of the survey

Temporary Displacement of Others

Marine users that may be present in the OA during the survey period include commercial fishing vessels, commercial vessels undertaking oil and gas industry activities, Australian Border Force or navy and large vessels within the well-used commercial shipping route to and from Port Hedland. The seismic survey vessel will acquire data over a period of up to 70 days during which time it will operate 24 hours a day. Due to the seismic streamers extending ~8.5 km behind the seismic vessel and the data acquisition process, the survey vessel will be restricted in its ability to manoeuvre. There will be support vessel(s) assisting with survey activities including redirecting any marine traffic away from the survey vessel and towed streamers. Because of the physical presence of these vessels, other marine users including fishing vessels and other commercial or recreational shipping traffic may be temporarily displaced from their intended area of operation or transit route. The seismic streamers also present a navigational hazard to other marine users, and fishing equipment deployed within the OA may become entangled in the streamers or run over by the survey or support vessels.

Review of fishing activity by operators within Commonwealth and State fisheries shows that only fishers in the North West Slope Trawl Fishery (NWSTF) are likely to be active in the OA. The proposed survey area overlaps an extremely small portion of the fishery with over 97% of the fishery unaffected by the survey.

Standard control measures that will assist in limiting adverse interactions with other vessels during the Possum 3D MSS include compliance with legislative requirements for maintenance of appropriate navigation, communications and maritime lighting in order to inform other uses of the position and intentions of the survey vessels, and compliance with Searcher and industry standards.

The following controls measures will be implemented :

- Consultation with other users during the development of the Possum 3D MSS, and prior to and during the survey activity
- Survey areas minimised as much as practicable whilst still achieving the survey objectives
- ASA and OA designed to minimise overlap with commercial fishing areas
- Tail buoys clearly marked to identify streamer ends to other users
- Survey vessels will be equipped with Automatic Radar Plotting Aid (ARPA) and active Automatic identification system (AIS) for detection of vessels, speed, heading
- Maintain appropriate navigation lights and day shapes at all times, in accordance with COLREGS to inform other users of the vessel's actions. Additional communications will be carried out, as required, during the activity using a range of other means e.g. marine VHF radio, telephone, signal lights etc
- Use of support vessel(s) to interact and manage interactions with other vessels and to scout well ahead of the seismic survey vessel for inwater hazards
- Notification of the start and end of activity to the AMSA/JRCC and AHS which will issue Notice to Mariners and AusCoast Warning in relation to the activity
- 24—48 hour notification to commercial fishers (communications at sea) regarding look-ahead activities
- In the event of equipment loss, other users to be notified as required (including AMSA and NOPSEMA)

Based on the above considerations the potential impacts due to physical presence of survey vessels during the Possum 3D MSS are considered to be slight and short-term.

Underwater sound emissions from the seismic array

Acquisition of the Possum 3D MSS will involve the use of a seismic source, consisting of an airgun array towed at a water depth of 5 – 7 m. The source will be used to generate acoustic pulses by periodically discharging compressed air into the water column, as the vessel transits along acquisition lines within the Active Source Area (ASA). Underwater noise can affect marine fauna in three main ways:

- By causing direct physical effects on hearing or other organs. Hearing loss may be temporary (temporary threshold shift – TTS), or permanent (PTS), with PTS considered to represent injury;
- Through disturbance leading to behavioural changes or displacement of fauna. The occurrence and intensity of disturbance is highly variable and depends on a range of factors relating to the animal and situation; and
- By masking or interference with other biologically important sounds (including vocal communication, echolocation, signals and sounds produced by predators or prey).

To assess the potential magnitude and extent of impacts from underwater noise produced during the Possum 3D MSS, Searcher commissioned JASCO Applied Sciences to model the source levels and sound propagation. The Possum 3D MSS Acoustic Modelling Report (JASCO 2020) is available from Searchers website via http://www.searcherseismic.com/stakeholderfeedback, or may be requested via any of the listed contact methods. Several locations were modelled, with a specific focus on the impact due to the proximity of the nearby Rowley Shoals State Marine Park and Mermaid Reef Commonwealth Marine Reserve, that were representative of the different water depths, bathymetry and seabed properties within the ASA.

The objective of this acoustic modelling study was to evaluate the effects of sound on marine fauna including marine mammals, marine reptiles, fishes, elasmobranchs, benthic invertebrates and zooplankton, and on socio-economic receptors such as commercial fisheries and Australian Marine Parks. The modelling methodology considers source directivity and range-dependent environmental properties in each of the areas assessed. The results of the sound modelling is compared against sound exposure thresholds for marine fauna and other receptors. The assessment of impacts are presented on the following page.

The modelling process and comparison against threshold limits was then used to complete an impact assessment based on the setting of 'standard control measures':

- Compliance with legislative requirements;
- Part A Standard Management Measures of EPBC Policy Statement 2.1 will be applied in full to mitigate potential impacts to whales. One EPBC Policy Statement 2.1 Part B Additional Management Measure will also be applied;
- OPGGS Act: Residual risks must be reduced to ALARP;
- Compliance with Company and industry standards;
- Alignment with objectives and compliance requirements of applicable management, recovery and /or conservation plans.

In addition to the above, the following controls will be adopted to ensure that the impacts associated with underwater sound emissions from the seismic array are As Low As Reasonably Practicable (ALARP) and acceptable:

- Minimum source size selected to acquire survey data and meet the geophysical objectives of the survey (based on specific sound source modelling)
- Two Marine Fauna Observers will be on board the seismic vessel and on duty during daylight hours during the survey
- 100 m 'turtle pause' when a turtle is within 100 m of the active source
- Searcher will engage with proponents identified and develop a SIMOPS plan for any concurrent surveys identified within 60 km of the acquisition area.
- A minimum separation distance of 40 km will be maintained between the Possum 3D MSS survey vessel and other operating seismic sources
- Searcher will engage with any individual fishers or tourism operators identified operating in or adjacent to the OA.

With these controls in place, the potential impacts of underwater sound emissions from the seismic source on marine fauna during acquisition of the Possum 3D MSS are considered to be slight and short-term, and restricted to temporary behavioural changes (avoidance) in any individuals that may inhabit areas or transit the area in close proximity to the operating seismic source. With the control measures in place, the underwater sound emissions from the Possum 3D MSS will not result in any significant impacts to tourism operators, marine park values and commercial fisheries overlapping the OA.

Underwater sound emissions from the seismic array

With the listed controls in place, the following assessment of impacts have been made:

Marine mammals: Due to the timing, duration and location of the survey, the survey is not predicted to impact on critical habitats for any species of marine mammal (i.e. feeding, breeding, calving areas) or constrict the migratory pathway within the operational area and surrounding waters for Blue Whales. The control measures proposed will significantly reduce the likelihood of injury (PTS) effects, or any ecologically significant impacts at a population level for any species of marine mammal that may be present within or adjacent to the OA during the survey. Additional controls will be implemented should the survey extend beyond the end of April.

Marine reptiles: Based on the timing and duration of the survey, the separation distances to nesting BIAs and 'Habitat Critical' areas, and the control measures proposed, predicted noise levels from seismic acquisition are not considered likely to cause PTS effects, displace any individuals from inter-nesting BIAs or 'Habitat Critical' areas, or result in any ecologically significant impacts at a population level for any species of turtle that may be present within or adjacent to the OA during the survey.

Fishes and sharks (demersal, pelagic species including key indicator species of commercial interest, site-attached reef species and whale sharks): The potential impacts of underwater sound emissions from the seismic source on fishes and elasmobranchs during the Possum 3D MSS are considered to be localised and of no lasting effect, restricted to within 60m of the source and TTS in individuals (which is recoverable with 24hrs) that may be present within 9.13km the acquisition area. Based on the timing, duration and location of seismic acquisition, and the control measures that will be implemented, predicted noise levels from seismic acquisition are not considered likely to result in any ecologically significant impacts at a population level for any species of fish that may be present within or adjacent to the OA during the Possum 3D MSS.

Benthic invertebrates (corals, prawns, molluscs) or Zooplankton: The potential impacts of underwater sound emissions from the seismic source on benthic invertebrates or Zoopankton during the Possum 3D MSS are considered to be slight and short-term, as the activity is not likely to result in any mortality of individuals or ecologically significant impacts at a population level for any species of invertebrate that may be present on the seafloor within or adjacent to the ASA.

Marine Parks: Based on the timing and duration of the Possum 3D MSS, spatial separation from the Mermaid Reef Australian Marine Park (MRAMP) boundary (4.4 km to Operational Area; 7.2km to aquisition area) and the Rowley Shoals Marine Park (RSMP) boundary at Imperieuse Reef (11.9km to Operational Area; 21.65km to aquisition area), and the control measures that will be implemented, predicted noise levels from seismic acquisition are not considered likely to cause any impacts to the natural, cultural heritage values of the MRAMP, RSMP or any other Marine Park in the region.

Tourism & Diving operations : Information provided by the (Diving Medical Advisory Committee (DMAC) Guidance number 12 (DMAC 12 Rev. 2 (2019)) on safe diving distances from seismic survey operations notes that there is limited understanding of the effects of seismic pressure waves on divers, and that the multiple factors involved make it difficult to determine a safe or tolerable distance for diving operations from seismic surveying operations. Based on the proposed timing, duration and consultation with relevant stakeholders regarding the Possum 3D MSS, it is assessed that there is unlikely to be any recreational or research diving activities conducted in the area during the planned activity window. However should ongoing consultation identify any diving operations planned within 30 km of the OA, Searcher will follow the DMAC guidance as a pragmatic means of mitigating impacts to divers from seismic sound and conduct a SIMOPS plan for communication and observation of any constraints or buffer distances to be applied.

Operational discharges and emissions from survey vessels

(light, atmospheric, liquid, underwater sound)

The seismic survey vessel and any support vessels that may be imported into Australia to conduct this seismic survey activity, will do so under the strict requirements of the biosecurity legislation administered by the Australian Department of Agriculture and Water Resources, and will be required to undertake inspections by a department biosecurity officer prior to mobilisation to the OA.

Operational discharges from survey vessels include those required for normal ship functions including deck lighting, engine operations. During the 70 days of the MSS the following controls will be instigated in addition to 'standard controls' (eg legislative requirements) to minimise potential impacts to marine fauna from these discharges and emissions:

- External lighting will be directed only onto working decks to avoid impacts to light-sensitive species (eg turtles, birds)
- Atmospheric emissions will be minimised by ensuring only vessels using marine diesel or marine gas oil are used (instead of vessels using heavy fuel oils), and by ensuring all vessels have a planned maintenance system for engine equipment.
- Underwater sound emissions will be minimised by ensuring vessel engines are maintained in accordance with the planned maintenance system
- All discharges of bilge water, deck drainage and engine cooling water are compliant with MARPOL Annex 1 to minimise water degradation

Potential Impact on State and Commonwealth Commercial Fishers

The purpose of this document is to provide updated information to relevant commercial fishers. All the Commonwealth and WA state fisheries that have jurisdictions overlapping the Possum 3D Operational Area (OA) have been reviewed (refer to Invitation for Consultation Possum 3D Marine Seismic Survey, 23 December 2019 or via "searcherseismic.com/stakeholderfeedback"). Fisheries with jurisdiction overlapping the Possum OA and with historic fishing effort in the OA have been identified through review of the Fishery status reports, DPIRD's FishCube database and confirmed by email from WAFIC or specific fishers. These identified relevant fisheries have been consulted:

	Commonwealth Fishery	State Fishery
Identified Relevant Fisheries	North-West Slope Trawl (Scampi) Fishery (NWSTF)	Mackerel Managed Fishery (Area 2; Class 2A and Class 2B)
Reporting Authority	Australian Fisheries Management Authority (AFMA)	Department of Primary Industries and Regional Development (DPIRD)
Overlap of Possum OA with Fishery Management area	~9,211km2 (2.33%)	~13,420km2 (~2.7%) of total size of Area 2.
Historic fishing effort (2014—2018)	One fisher is intermittently active throughout year within Possum OA	One record of catch in 2018. However by and large mackerel fishers do not operate in water depths more than 70 m (via consultation with WAFIC 7/01/2020) [1]
Source	Direct communication with individual Fisher	WAFIC (via email 7th January 2020) and DPIRD (via phone 21st January 2020) confirmed that the Mackerel Managed Fishery (Area 2; Class 2A and Class 2B) are the relevant license holders.

[1] **Searcher** has designed the survey to be in water depths of >100m. While Mackerel fishers are not expected to be encountered or excluded from fishing grounds due to the Possum 3D MSS, consultation will be continued with MMF Area 2 fishers due to the one record of effort in 2018.

Searcher has used the best available science to describe and understand the existing marine environment within the Possum 3D MSS operational and acquisition areas, including reviewing literature published from surveys conducted on the Rowley Shoals, This includes developing an understanding of fish behavioural activities during seismic acquisition activity. Noise modelling results for the Possum 3D MSS (JASCO, 2020) indicate that fish behaviour may be impacted up to 10 km distance from the acquisition area. However the body of peer-reviewed literature does not indicate any long-term abandonment of fishing grounds by commercial species due to seismic activity, with several studies indicating that catch levels returned to pre-survey levels after seismic activity had ceased (Carroll et al. 2017). While it is possible that fish may be displaced from a survey footprint to adjacent areas, the total number of fish within the fishery stock remains unchanged (Przeslawski et al., 2016). Effects on fish behaviour are expected to be temporary as the seismic vessel traverses each survey line, and fish are expected to move away as the airgun array approaches.

Searcher is an active member of the NERA managed Collaborative Seismic EP (CSEP) project and, as such, intend to accept and adopt any protocols that are henceforth developed and mutually ratified by both the Consortium and the WA commercial fishing industry during the Possum 3D MSS acquisition.

Potential Impact on Spawning Pattern of Fisheries

Searcher have identified the fish spawning periods for all key or target commercial fish species for all fisheries that have jurisdictions overlapping the Possum 3D MSS operational area. It is not possible to avoid overlap with the spawning periods for all these key or target commercial fish species, as their spawning periods may be spread throughout the year, indicating that there is no specific period of higher sensitivity.

Noise modelling results for the Possum 3D MSS indicate that fish behaviour may be impacted up to 10 km distance from the acquisition area (JASCO, 2020). Spawning periods of the key or target commercial species for fisheries active since 2014 within 10km of the Possum 3D MSS acquisition area are outlined in the table below. There are no known spawning aggregations for these key or indicator species within 10 km of the Possum 3D MSS acquisition area.

Fishery	Key Species	J	F	M	A	M	J	J	A	S	O	N	D	Distribution
Mackerel Managed fishery (WA)	Spanish mackerel													Single genetic stock along the WA coast. Adults in waters up to 50 m, not known to form spawning aggregations within the operational area (Mackie and Lewis, 2001; Mackie *et al.* 2003)
North-west Slope Trawl Fishery (Cwlth)	Scampi													Benthic, in tropical Australian waters from 420-500 m throughout the North-West Shelf (AFMA 2020)

The modelling from JASCO (2020) for the Possum 3D MSS survey shows that noise at the seabed that could cause statocyst damage to crustaceans is predicted to 141m either side of each sail line in shallower waters (e.g. in the southern part of Operational Area). The minor statocyst impacts are not expected to be lethal and are predicted to repair through time. No other sub-lethal effects are known to occur and effects on behaviour are very unlikely. These impacts are also likely to be partially recoverable after successive moulting (Day et al 2019). As the vessel moves into deeper water, this propagation distance at the seabed will become smaller and any impact will be reduced.

Any effects to stocks in the 2.33% of the North West Slope Trawl Fishery (NWSTF) are unlikely to be permanent (Day et al 2019). The best available scientific evidence shows that seismic noise exposure did not change catch rates of prawns in much shallower waters (Andriguetto-Filho et al 2005). Furthermore, a review of all the available scientific evidence found exposure to seismic noise did not affect catch rates in invertebrates (Carroll et al 2017). As the proposed survey area overlaps an extremely small portion of the NWSTF, with over 97% of the fishery unaffected by the survey, it is reasonably predicted that the Possum 3D survey is unlikely to affect the overall catch rates of scampi in the NWSTF.

While the historic catch data show activity from the Mackerel Managed Fishery (MMF) in the Possum 3D MSS area, interaction with stakeholders confirm that fishing activity in the area during the proposed seismic activity is unlikely due to the water depth.

Proposed control measures to mitigate the impact to commercial fishing from underwater noise include:

- Use of the smallest array size that will achieve the survey objectives
- Most efficient survey design possible to reduce survey time
- Avoidance of identified spawning period for scampi (Sept-Oct)
- Strict policy of no fishing from any seismic or support vessel(s)
- Searcher has reduced the operational and acquisition areas to minimise overlap with commercial fishing areas.

References:

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Mackie, M.C., Lewis, P.D., Gaughan, D.J. and Buckworth, R.C. 2003. Stock assessment of Spanish mackerel (Scomberomorus commerson) in Western Australia. Final report to Fisheries Research and Development Corporation. Project No. 1999/151. Department of Fisheries, Western Australia.

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INVITATION FOR CONSULTATION—UPDATE

Possum 3D Marine Seismic Survey

28th October 2021

Introduction

Searcher Seismic Pty Ltd (Searcher) is proposing to acquire a multiclient three-dimensional (3D) marine seismic survey (MSS) in the North-west Marine Region (NWMR) offshore from Western Australia.

The purpose of this updated flyer is to provide further details of the survey to relevant and interested stakeholders, and to enable you to continue to be involved in the consultation process for the regulatory environmental approvals procedure, as well as relevant communications related to the survey activity.

Throughout the project development, Searcher will provide each relevant person sufficient information to allow them to make an informed assessment of the possible consequences of the proposed survey on their functions, interests or activities.

Searcher will provide all stakeholder feedback to NOPSEMA, within the proposed activity's Environment Plan. Under recent changes to Environment Regulations, all environment plans for offshore oil and gas activities will be published, and draft environment plans for offshore seismic surveys and exploration drilling activities will be open for an additional 30-day public comment period prior to NOPSEMA assessment.

Key Activity Information

- The proposed Possum 3D Multiclient Marine Seismic Survey ('Possum 3D MSS') Operational Area lies entirely within the NWMR and incorporates Exploration Permits WA-436-P, WA-479-P, WA-487-P, WA-527-P and WA-540-P (as shown on the following page).
- The proposed Possum 3D MSS is planned to be conducted over a maximum operational survey area of approximately 13,447 sq km.
- Maximum expected survey duration with contingency time is 70 days; 24 hour operations.
- The acquisition window is expected to be between Dec and end April, but may extend to July with additional controls implemented.
- Environment Plan will be requested for 20 month validity between December 2021 and end July 2023 with survey scheduled in the acquisition windows as above.
- Every effort will be made to time the activity to minimise any potential adverse effects on relevant stakeholders.

About Searcher

Searcher has a history of effectively conducting marine seismic surveys in the waters offshore of Western Australia with successful environmental outcomes attained from rigorous operating rules, environmental risk assessment, planning and management.

Searcher are committed to open and honest communications about the planned activity and to listening to relevant stakeholder concerns. Your valuable feedback will assist us in identifying all relevant stakeholders for the planned survey and assessing how it may affect your functions, interests or activities.

If you have not previously registered you may formally register your interest using any of the following contact methods. Alternatively you may "opt-out" if you do not wish to receive further project updates or believe that this activity will not affect your functions, interests of activities.

Contact

Possum 3D Consultation Team

PHONE:
+61 (0)8 9327 0301

WEBSITE:
searcherseismic.com/stakeholderfeedback

EMAIL:
feedback@searcherseismic.com

Register

Opt Out

Stakeholders are to advise if any feedback is to remain confidential and not to be made available for public release within the draft or final Environment Plan. This is a one click option in the online feedback form, or can be requested via the alternative contact methods provided.

Searcher

Possum 3D Survey Area WGS84

Idx	Longitude	Latitude
1	120° 09' 48.3452" E	16° 36' 29.8442" S
2	120° 10' 19.9223" E	18° 01' 15.5369" S
3	119° 59' 31.5658" E	18° 04' 37.3728" S
4	119° 13' 22.0184" E	18° 04' 36.5951" S
5	119° 13' 24.0593" E	17° 40' 44.8715" S
6	119° 47' 04.8498" E	17° 40' 42.5592" S
7	119° 47' 05.4248" E	17° 22' 09.5827" S
8	119° 47' 00.8030" E	16° 52' 59.3371" S
9	119° 55' 08.0532" E	16° 44' 51.3906" S
10	120° 06' 14.4232" E	16° 44' 54.3980" S
11	120° 06' 14.4233" E	16° 36' 32.2451" S
12	120° 09' 48.3452" E	16° 36' 29.8442" S

Possum 3D Operational Area WGS84

Idx	Longitude	Latitude
1	119° 14' 09.5135" E	17° 35' 48.6890" S
2	119° 24' 12.3661" E	17° 35' 35.4192" S
3	119° 45' 31.0716" E	17° 16' 38.5284" S
4	119° 45' 29.2682" E	16° 52' 53.6267" S
5	119° 45' 28.8612" E	16° 47' 33.0647" S
6	119° 53' 00.2830" E	16° 39' 58.8815" S
7	120° 01' 10.3513" E	16° 40' 01.7724" S
8	120° 01' 07.7448" E	16° 31' 42.8341" S
9	120° 14' 08.1238" E	16° 31' 34.4639" S
10	120° 14' 32.7660" E	18° 00' 46.2925" S
11	120° 08' 21.7465" E	18° 04' 45.2458" S
12	119° 53' 12.5126" E	18° 07' 36.1525" S
13	119° 00' 59.1120" E	18° 08' 06.6299" S
14	119° 01' 08.5223" E	17° 48' 54.9755" S
15	119° 05' 05.7300" E	17° 44' 56.1624" S
16	119° 10' 04.6884" E	17° 39' 55.1734" S
17	119° 14' 09.5135" E	17° 35' 48.6890" S

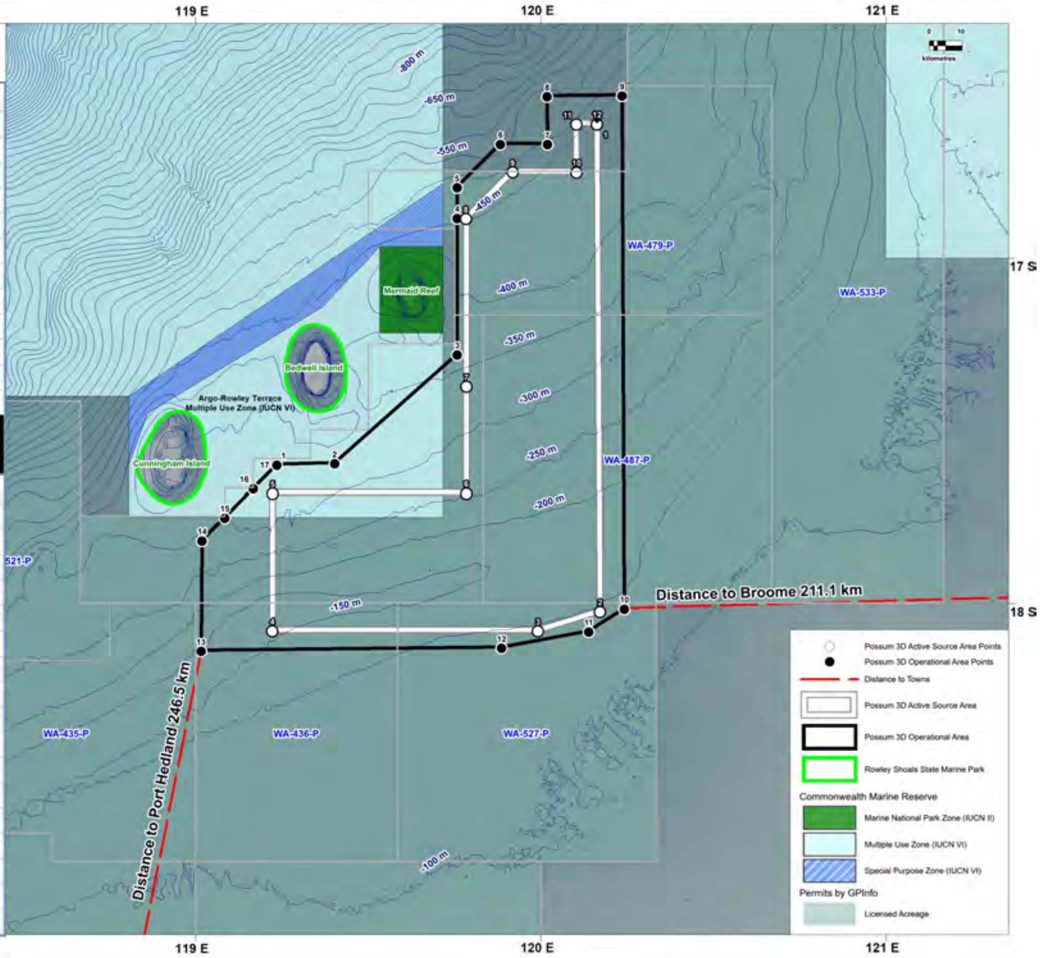


Figure 1—Proposed Activity Location Map

The Possum 3D MSS seismic survey area is located entirely in offshore Commonwealth waters within the NWMR incorporating Exploration Permits WA-436-P, WA-479-P, WA-487-P, WA-527-P and WA-540-P. Boundary co-ordinates are provided above.

The operational area is located ~211 km west of Broome, ~246 km north-east of Port Hedland and >180 km north of Eighty Mile Beach. The survey area is in close proximity to, but has been designed to avoid, the Mermaid Reef Commonwealth Marine Reserve (MRCMR) boundary (4.4 km to Operational Area; 7.2km to Active Source area), the Rowley Shoals Marine Park boundary at Imperieuse Reef (11.9km to Operational Area; 21.65km to Active Source area) and the ancient coastline. Water depths across the survey area range from ~118–566m, with the deepest water depths situated in the northern half of the survey area. Seismic activities will not occur in water shallower than 100m.

- The **'Acquisition Area' (AA)** covering ~5,400 sqkm is the focus area where the full-fold 3D seismic data will be acquired.
- The **'Active Source Area' (ASA)** of ~8,584 sqkm includes a buffer around the Acquisition Area and is the area within which the seismic energy source may be operational, including soft start procedures and line run-outs (required to obtain full fold coverage). The full seismic source will not be operational outside of this area, although small, individual source elements may be tested during maintenance outside the ASA but still within the Operations Area.
- The **'Operational Area' (OA)** covers ~13,447 sqkm providing an ASA 'operational buffer', required for activities including streamer deployment, retrieval, maintenance or recovery, routine vessel manoeuvring and other non-seismic vessel activities.

A marine seismic survey is a method of determining geological features below the sea floor, by sending sound waves into the rock layers beneath the sea floor and then recording the time is takes for each wave to bounce back as well as measuring the strength of each returning wave along a towed cable ("streamer") of acoustic recorders.

The Possum 3D MSS will be acquired from a vessel towing approximately 10 streamers extending ~8.5km behind the survey vessel and nominally ~20m below the sea surface. The sound wave is generated by the use of a seismic source, consisting of an airgun array towed at a water depth of ~5–7m. The source generates acoustic pulses by periodically discharging compressed air into the water column at regular intervals, as the vessel transits along acquisition lines within the Active Source Area (ASA). Passive magnetic and gravity readings may also be recorded.

Seismic data will be acquired along pre-defined parallel lines, for a period of up to 70 days operating 24 hours a day. This time also includes shut downs for routine and reactive maintenance, repairs, transit and line turns, fauna and stakeholder avoidance. The process will continue until all survey lines, plus any re-acquisitions or 'infill' lines have been acquired.

Environmental Impact Assessment

As required by Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS(E) Regulations), Searcher is undertaking an assessment of the planned environmental impacts and unplanned environmental risks associated with the proposed seismic survey. This includes assessment of impacts and risks to other marine users including fishers, divers, government agencies and ship owners. A number of species covered under the "Matters of National Environmental Significance" and "Other Matters" protected by the Environment Protection and Biodiversity Conservation Act 1999, have also been identified as potentially occurring within the survey ASA and OA. Species listed as Vulnerable or Endangered will be the subject of a comprehensive impact and risk assessment in order to minimise these to as low as reasonably practicable (ALARP) and acceptable levels. Commonwealth or State Marine Reserves and Parks or listed Key Ecological Features (KEFs) in proximity to the survey's OA have been identified (Figure 1). Risks posed by a fuel spill from the survey vessel to environment receptors are also being assessed and reduced to ALARP and acceptable levels.

The seismic survey vessel, and any support vessels that may be imported into Australia to conduct this seismic survey activity, will do so under the strict requirements of the biosecurity legislation administered by the Australian Department of Agriculture and Water Resources. An Oil Pollution Emergency Plan (OPEP) specific to the activity will also be developed, as required by the OPGGS(E) Regulations.

Potential Impacts to Stakeholders

Marine seismic surveys can potentially impact other marine users, including temporary displacement of commercial or recreational fishers and interaction with divers, commercial shipping and other marine traffic. It is also possible that pelagic or demersal fish stocks may temporarily relocate during the activity. Searcher will be closely consulting with all relevant licensed fishers in the survey during the planning phase in an effort to minimise any negative operational or commercial impacts to those fishers and their livelihoods. An initial Impact Assessment of the commercial fishing activities in each of the overlapping Commonwealth and State Managed fisheries is included In the following pages.

Further information regarding seismic surveying methods and their potential effects can be found on the International Association of Geophysical Contractors (IAGC) web site on the "Resources" page:- https://iagc.org/our-industry/geophysical-surveys or by completing the online form, via email or by phone and asking for further information to enable you to adequately assess whether the activity might affect your functions, interests or activities .

Stakeholder Engagement

Searcher encourages open, two-way communication with stakeholders throughout the planning and implementation of the proposed activities. Reviewing this update to the Invitation For Consultation is the part of a more comprehensive stakeholder engagement process. All persons or organisations that wish to continue to be included in the consultation process to register their interest via the simple online registration form that can be accessed through the Searcher web site address listed on the first page, or via scanning the QR code and completing the form on a mobile device. Some basic multiple choice question options and fields for additional feedback are provided within the feedback questionnaire, including the option to request direct communications with Searcher's Project Management Team. The option to opt out of any further communications on this matter also exists.

Under the regulations, stakeholder consultation is a mandatory process for the proponent (Searcher) but voluntary for potential stakeholders. Searcher recognises the risk of "stakeholder fatigue" and the inconvenience consultation may cause for those that have no interest in the proposed activity. Unfortunately, failure to respond to this invitation to consult will not be accepted by the regulator NOPSEMA as a lack of interest, so your assistance in completing the online feedback form would be greatly appreciated and will help avoid further contact from us if you do decide to opt out of future correspondence in relation to this activity. If we do not hear from you then we will continue to provide you with updates to allow for circumstances such as extended post delivery times and perusal of this information.

Searcher will provide all stakeholder feedback to NOPSEMA, within the proposed activity's environment plan. Under recent changes to environment regulations, all environment plans for offshore oil and gas activities will be published, and draft environment plans for offshore seismic surveys and exploration drilling activities will be open for an additional 30-day public comment period prior to NOPSEMA assessment.

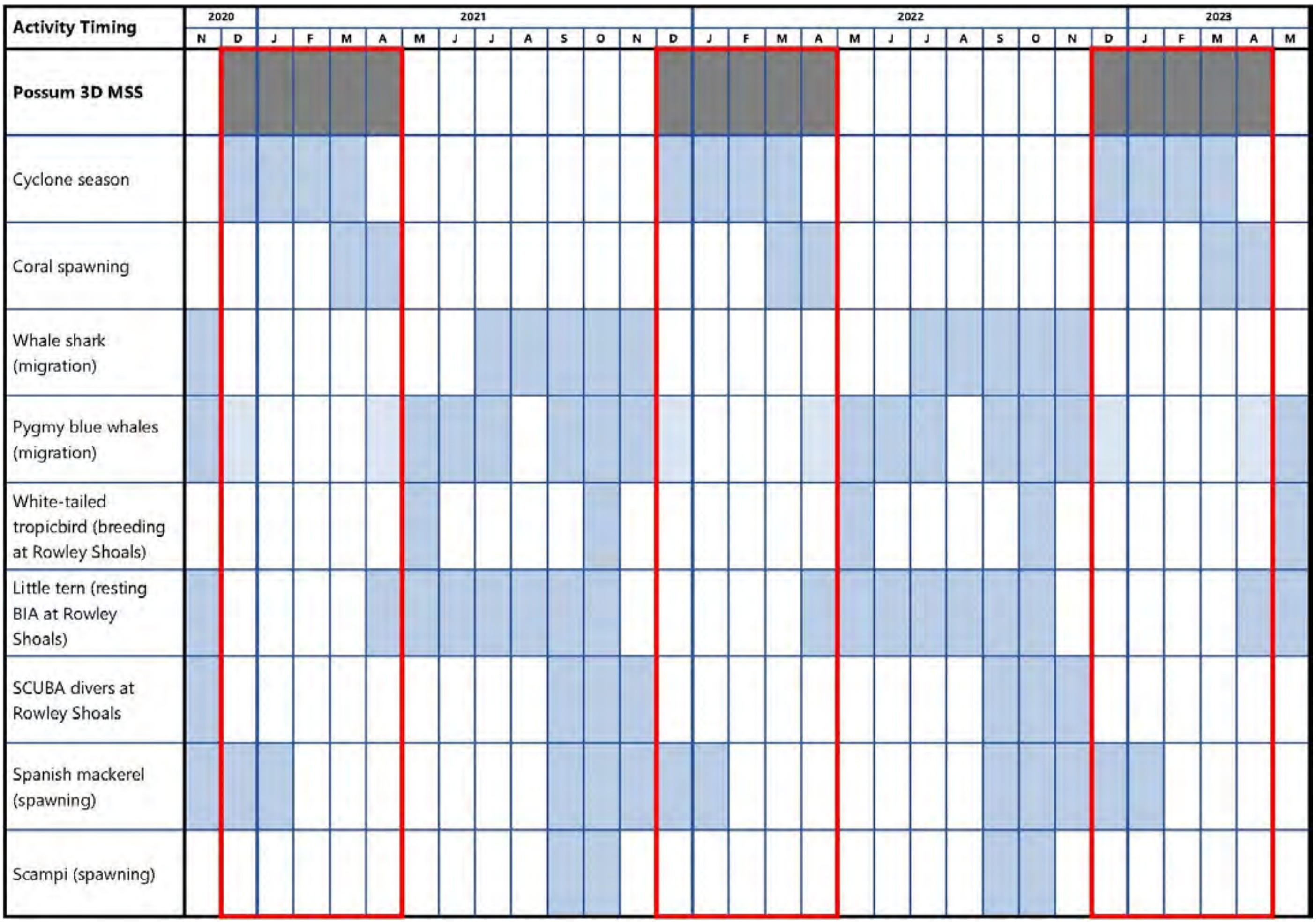
Survey Operating Window

At all times, the best window(s) of opportunity for the acquisition of Searcher's Marine Seismic Surveys are considered within the environmental, social constraints and regulatory approvals; the vessel availability within that nominated operational window is then addressed.

Particular considerations in the proposed Possum 3D MSS area include, but are not limited to, the following:

- Overlapping Commercial Commonwealth and State Fisheries
- Proximity to the Mermaid Reef Commonwealth Marine Reserve (Sanctuary Zone IUCN-II) and the Rowley Shoals State Marine Park; environmental considerations and potential impact on recreational diving activities
- Survey Operational Area extending into Argo-Rowley Terrace Commonwealth Marine Park (Multiple Use Zone IUCN-VI)
- Acquisition and Operational Areas overlap well-used commercial shipping lanes
- Potential Impact on Marine Fauna, Plankton, Fish from this activity, as well as cumulative impact from other planned activities in the region

Searcher have determined the most appropriate acquisition window considering key environmental sensitivities within the operational area to be December to end April but may extend to July with additional controls implemented.



Simultaneous Operations

Searcher is aware of three other potential marine seismic surveys planned in the vicinity during the period anticipated for acquisition of the Possum 3D MSS. These surveys all have limited spatial overlap with the proposed activity, as shown in the Figure 2 below.

Titleholder	Project Name (All Eps under assessment with NOPSEMA)	Activity Window
INPEX Browse E&P Pty Ltd	2D Seismic Survey WA-532-P, WA-533-P and WA-50-L	20 Dec 2021 to 31 May 2022 (Est 90 days)
3D Oil Limited	Sauropod 3D Marine Seismic Survey (WA-527-P)	Jan – May 2022 (Max 60 days)
Santos WA Northwest Pty Ltd	Keraudren 3D Extension	1st Feb – 31st July 2020-2022 (Est 132 days total)

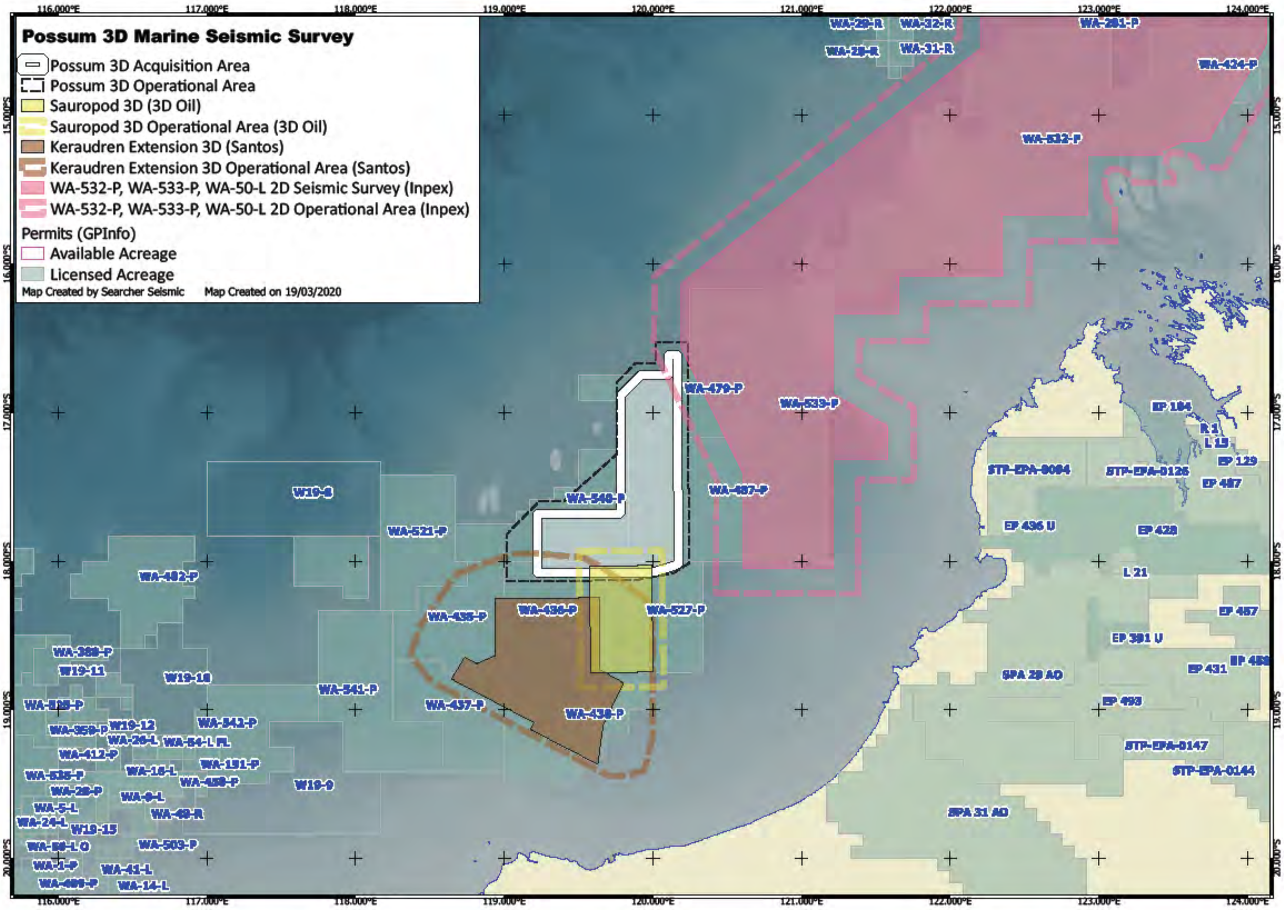


Figure 2— Potentially Overlapping Marine Seismic Surveys

Searcher will remain in contact with the operators of these surveys and will review all opportunities to minimise impact on the marine fauna, fisheries and operations of relevant Stakeholders. Where possible, plans will be made to avoid overlapping seismic activities. Where this is not possible, the activities will be prioritised and a simultaneous operations (SIMOPS) plan developed. Proposed controls to mitigate the impact of simultaneous seismic surveys and cumulative impact effects will include:

- Searcher will engage with proponents for potential seismic activities prior to commencing the Possum 3D MSS and will develop a SIMOPS plan for any concurrent surveys identified within 60 km of the acquisition area
- A minimum separation distance of 40 km will be maintained between the Possum 3D MSS survey vessel and other operating seismic sources
- Use the smallest practicable seismic array size to meet the geophysical objectives of the survey

Temporary Displacement of Others

Marine users that may be present in the OA during the survey period include commercial fishing vessels, commercial vessels undertaking oil and gas industry activities, Australian Border Force or navy and large vessels within the well-used commercial shipping route to and from Port Hedland. The seismic survey vessel will acquire data over a period of up to 70 days during which time it will operate 24 hours a day. Due to the seismic streamers extending ~8.5 km behind the seismic vessel and the data acquisition process, the survey vessel will be restricted in its ability to manoeuvre. There will be support vessel(s) assisting with survey activities including redirecting any marine traffic away from the survey vessel and towed streamers. Because of the physical presence of these vessels, other marine users including fishing vessels and other commercial or recreational shipping traffic may be temporarily displaced from their intended area of operation or transit route. The seismic streamers also present a navigational hazard to other marine users, and fishing equipment deployed within the OA may become entangled in the streamers or run over by the survey or support vessels.

Review of fishing activity by operators within Commonwealth and State fisheries shows that only fishers in the North West Slope Trawl Fishery (NWSTF) are likely to be active in the OA. The proposed survey area overlaps an extremely small portion of the fishery with over 97% of the fishery unaffected by the survey.

Standard control measures that will assist in limiting adverse interactions with other vessels during the Possum 3D MSS include compliance with legislative requirements for maintenance of appropriate navigation, communications and maritime lighting in order to inform other uses of the position and intentions of the survey vessels, and compliance with Searcher and industry standards.

The following controls measures will be implemented :

- Consultation with other users during the development of the Possum 3D MSS, and prior to and during the survey activity
- Survey areas minimised as much as practicable whilst still achieving the survey objectives
- ASA and OA designed to minimise overlap with commercial fishing areas
- Tail buoys clearly marked to identify streamer ends to other users
- Survey vessels will be equipped with Automatic Radar Plotting Aid (ARPA) and active Automatic identification system (AIS) for detection of vessels, speed, heading
- Maintain appropriate navigation lights and day shapes at all times, in accordance with COLREGS to inform other users of the vessel's actions. Additional communications will be carried out, as required, during the activity using a range of other means e.g. marine VHF radio, telephone, signal lights etc
- Use of support vessel(s) to interact and manage interactions with other vessels and to scout well ahead of the seismic survey vessel for inwater hazards
- Notification of the start and end of activity to the AMSA/JRCC and AHS which will issue Notice to Mariners and AusCoast Warning in relation to the activity
- 24—48 hour notification to commercial fishers (communications at sea) regarding look-ahead activities
- In the event of equipment loss, other users to be notified as required (including AMSA and NOPSEMA)

Based on the above considerations the potential impacts due to physical presence of survey vessels during the Possum 3D MSS are considered to be slight and short-term.

Underwater sound emissions from the seismic array

Acquisition of the Possum 3D MSS will involve the use of a seismic source, consisting of an airgun array towed at a water depth of 5 – 7 m. The source will be used to generate acoustic pulses by periodically discharging compressed air into the water column, as the vessel transits along acquisition lines within the Active Source Area (ASA). Underwater noise can affect marine fauna in three main ways:

- By causing direct physical effects on hearing or other organs. Hearing loss may be temporary (temporary threshold shift – TTS), or permanent (PTS), with PTS considered to represent injury;
- Through disturbance leading to behavioural changes or displacement of fauna. The occurrence and intensity of disturbance is highly variable and depends on a range of factors relating to the animal and situation; and
- By masking or interference with other biologically important sounds (including vocal communication, echolocation, signals and sounds produced by predators or prey).

To assess the potential magnitude and extent of impacts from underwater noise produced during the Possum 3D MSS, Searcher commissioned JASCO Applied Sciences to model the source levels and sound propagation. The Possum 3D MSS Acoustic Modelling Report (JASCO 2020) is available from Searchers website via http://www.searcherseismic.com/stakeholderfeedback, or may be requested via any of the listed contact methods. Several locations were modelled, with a specific focus on the impact due to the proximity of the nearby Rowley Shoals State Marine Park and Mermaid Reef Commonwealth Marine Reserve, that were representative of the different water depths, bathymetry and seabed properties within the ASA.

The objective of this acoustic modelling study was to evaluate the effects of sound on marine fauna including marine mammals, marine reptiles, fishes, elasmobranchs, benthic invertebrates and zooplankton, and on socio-economic receptors such as commercial fisheries and Australian Marine Parks. The modelling methodology considers source directivity and range-dependent environmental properties in each of the areas assessed. The results of the sound modelling is compared against sound exposure thresholds for marine fauna and other receptors. The assessment of impacts are presented on the following page.

The modelling process and comparison against threshold limits was then used to complete an impact assessment based on the setting of 'standard control measures':

- Compliance with legislative requirements;
- Part A Standard Management Measures of EPBC Policy Statement 2.1 will be applied in full to mitigate potential impacts to whales. One EPBC Policy Statement 2.1 Part B Additional Management Measure will also be applied;
- OPGGS Act: Residual risks must be reduced to ALARP;
- Compliance with Company and industry standards;
- Alignment with objectives and compliance requirements of applicable management, recovery and /or conservation plans.

In addition to the above, the following controls will be adopted to ensure that the impacts associated with underwater sound emissions from the seismic array are As Low As Reasonably Practicable (ALARP) and acceptable:

- Minimum source size selected to acquire survey data and meet the geophysical objectives of the survey (based on specific sound source modelling)
- Two Marine Fauna Observers will be on board the seismic vessel and on duty during daylight hours during the survey
- 100 m 'turtle pause' when a turtle is within 100 m of the active source
- Searcher will engage with proponents identified and develop a SIMOPS plan for any concurrent surveys identified within 60 km of the acquisition area.
- A minimum separation distance of 40 km will be maintained between the Possum 3D MSS survey vessel and other operating seismic sources
- Searcher will engage with any individual fishers or tourism operators identified operating in or adjacent to the OA.

With these controls in place, the potential impacts of underwater sound emissions from the seismic source on marine fauna during acquisition of the Possum 3D MSS are considered to be slight and short-term, and restricted to temporary behavioural changes (avoidance) in any individuals that may inhabit areas or transit the area in close proximity to the operating seismic source. With the control measures in place, the underwater sound emissions from the Possum 3D MSS will not result in any significant impacts to tourism operators, marine park values and commercial fisheries overlapping the OA.

Underwater sound emissions from the seismic array

With the listed controls in place, the following assessment of impacts have been made:

Marine mammals: Due to the timing, duration and location of the survey, the survey is not predicted to impact on critical habitats for any species of marine mammal (i.e. feeding, breeding, calving areas) or constrict the migratory pathway within the operational area and surrounding waters for Blue Whales. The control measures proposed will significantly reduce the likelihood of injury (PTS) effects, or any ecologically significant impacts at a population level for any species of marine mammal that may be present within or adjacent to the OA during the survey. Additional controls will be implemented should the survey extend beyond the end of April.

Marine reptiles: Based on the timing and duration of the survey, the separation distances to nesting BIAs and 'Habitat Critical' areas, and the control measures proposed, predicted noise levels from seismic acquisition are not considered likely to cause PTS effects, displace any individuals from inter-nesting BIAs or 'Habitat Critical' areas, or result in any ecologically significant impacts at a population level for any species of turtle that may be present within or adjacent to the OA during the survey.

Fishes and sharks (demersal, pelagic species including key indicator species of commercial interest, site-attached reef species and whale sharks): The potential impacts of underwater sound emissions from the seismic source on fishes and elasmobranchs during the Possum 3D MSS are considered to be localised and of no lasting effect, restricted to within 60m of the source and TTS in individuals (which is recoverable with 24hrs) that may be present within 9.13km the acquisition area. Based on the timing, duration and location of seismic acquisition, and the control measures that will be implemented, predicted noise levels from seismic acquisition are not considered likely to result in any ecologically significant impacts at a population level for any species of fish that may be present within or adjacent to the OA during the Possum 3D MSS.

Benthic invertebrates (corals, prawns, molluscs) or Zooplankton: The potential impacts of underwater sound emissions from the seismic source on benthic invertebrates or Zoopankton during the Possum 3D MSS are considered to be slight and short-term, as the activity is not likely to result in any mortality of individuals or ecologically significant impacts at a population level for any species of invertebrate that may be present on the seafloor within or adjacent to the ASA.

Marine Parks: Based on the timing and duration of the Possum 3D MSS, spatial separation from the Mermaid Reef Australian Marine Park (MRAMP) boundary (4.4 km to Operational Area; 7.2km to aquisition area) and the Rowley Shoals Marine Park (RSMP) boundary at Imperieuse Reef (11.9km to Operational Area; 21.65km to aquisition area), and the control measures that will be implemented, predicted noise levels from seismic acquisition are not considered likely to cause any impacts to the natural, cultural heritage values of the MRAMP, RSMP or any other Marine Park in the region.

Tourism & Diving operations : Information provided by the (Diving Medical Advisory Committee (DMAC) Guidance number 12 (DMAC 12 Rev. 2 (2019)) on safe diving distances from seismic survey operations notes that there is limited understanding of the effects of seismic pressure waves on divers, and that the multiple factors involved make it difficult to determine a safe or tolerable distance for diving operations from seismic surveying operations. Based on the proposed timing, duration and consultation with relevant stakeholders regarding the Possum 3D MSS, it is assessed that there is unlikely to be any recreational or research diving activities conducted in the area during the planned activity window. However should ongoing consultation identify any diving operations planned within 30 km of the OA, Searcher will follow the DMAC guidance as a pragmatic means of mitigating impacts to divers from seismic sound and conduct a SIMOPS plan for communication and observation of any constraints or buffer distances to be applied.

Operational discharges and emissions from survey vessels

(light, atmospheric, liquid, underwater sound)

The seismic survey vessel and any support vessels that may be imported into Australia to conduct this seismic survey activity, will do so under the strict requirements of the biosecurity legislation administered by the Australian Department of Agriculture and Water Resources, and will be required to undertake inspections by a department biosecurity officer prior to mobilisation to the OA.

Operational discharges from survey vessels include those required for normal ship functions including deck lighting, engine operations. During the 70 days of the MSS the following controls will be instigated in addition to 'standard controls' (eg legislative requirements) to minimise potential impacts to marine fauna from these discharges and emissions:

- External lighting will be directed only onto working decks to avoid impacts to light-sensitive species (eg turtles, birds)
- Atmospheric emissions will be minimised by ensuring only vessels using marine diesel or marine gas oil are used (instead of vessels using heavy fuel oils), and by ensuring all vessels have a planned maintenance system for engine equipment.
- Underwater sound emissions will be minimised by ensuring vessel engines are maintained in accordance with the planned maintenance system
- All discharges of bilge water, deck drainage and engine cooling water are compliant with MARPOL Annex 1 to minimise water degradation

Potential Impact on State and Commonwealth Commercial Fishers

The purpose of this document is to provide updated information to relevant commercial fishers. All the Commonwealth and WA state fisheries that have jurisdictions overlapping the Possum 3D Operational Area (OA) have been reviewed (refer to Invitation for Consultation Possum 3D Marine Seismic Survey, 23 December 2019 or via "searcherseismic.com/stakeholderfeedback"). Fisheries with jurisdiction overlapping the Possum OA and with historic fishing effort in the OA have been identified through review of the Fishery status reports, DPIRD's FishCube database and confirmed by email from WAFIC or specific fishers. These identified relevant fisheries have been consulted:

	Commonwealth Fishery	State Fishery
Identified Relevant Fisheries	North-West Slope Trawl (Scampi) Fishery (NWSTF)	Mackerel Managed Fishery (Area 2; Class 2A and Class 2B)
Reporting Authority	Australian Fisheries Management Authority (AFMA)	Department of Primary Industries and Regional Development (DPIRD)
Overlap of Possum OA with Fishery Management area	~9,211km2 (2.33%)	~13,420km2 (~2.7%) of total size of Area 2.
Historic fishing effort (2014—2018)	One fisher is intermittently active throughout year within Possum OA	One record of catch in 2018. However by and large mackerel fishers do not operate in water depths more than 70 m (via consultation with WAFIC 7/01/2020) [1]
Source	Direct communication with individual Fisher	WAFIC (via email 7th January 2020) and DPIRD (via phone 21st January 2020) confirmed that the Mackerel Managed Fishery (Area 2; Class 2A and Class 2B) are the relevant license holders.

[1] **Searcher** has designed the survey to be in water depths of >100m. While Mackerel fishers are not expected to be encountered or excluded from fishing grounds due to the Possum 3D MSS, consultation will be continued with MMF Area 2 fishers due to the one record of effort in 2018.

Searcher has used the best available science to describe and understand the existing marine environment within the Possum 3D MSS operational and acquisition areas, including reviewing literature published from surveys conducted on the Rowley Shoals, This includes developing an understanding of fish behavioural activities during seismic acquisition activity. Noise modelling results for the Possum 3D MSS (JASCO, 2020) indicate that fish behaviour may be impacted up to 10 km distance from the acquisition area. However the body of peer-reviewed literature does not indicate any long-term abandonment of fishing grounds by commercial species due to seismic activity, with several studies indicating that catch levels returned to pre-survey levels after seismic activity had ceased (Carroll et al. 2017). While it is possible that fish may be displaced from a survey footprint to adjacent areas, the total number of fish within the fishery stock remains unchanged (Przeslawski et al., 2016). Effects on fish behaviour are expected to be temporary as the seismic vessel traverses each survey line, and fish are expected to move away as the airgun array approaches.

Searcher is an active member of the NERA managed Collaborative Seismic EP (CSEP) project and, as such, intend to accept and adopt any protocols that are henceforth developed and mutually ratified by both the Consortium and the WA commercial fishing industry during the Possum 3D MSS acquisition.

Potential Impact on Spawning Pattern of Fisheries

Searcher have identified the fish spawning periods for all key or target commercial fish species for all fisheries that have jurisdictions overlapping the Possum 3D MSS operational area. It is not possible to avoid overlap with the spawning periods for all these key or target commercial fish species, as their spawning periods may be spread throughout the year, indicating that there is no specific period of higher sensitivity.

Noise modelling results for the Possum 3D MSS indicate that fish behaviour may be impacted up to 10 km distance from the acquisition area (JASCO, 2020). Spawning periods of the key or target commercial species for fisheries active since 2014 within 10km of the Possum 3D MSS acquisition area are outlined in the table below. There are no known spawning aggregations for these key or indicator species within 10 km of the Possum 3D MSS acquisition area.

Fishery	Key Species	J	F	M	A	M	J	J	A	S	O	N	D	Distribution
Mackerel Managed fishery (WA)	Spanish mackerel													Single genetic stock along the WA coast. Adults in waters up to 50 m, not known to form spawning aggregations within the operational area (Mackie and Lewis, 2001; Mackie *et al.* 2003)
North-west Slope Trawl Fishery (Cwlth)	Scampi													Benthic, in tropical Australian waters from 420-500 m throughout the North-West Shelf (AFMA 2020)

The modelling from JASCO (2020) for the Possum 3D MSS survey shows that noise at the seabed that could cause statocyst damage to crustaceans is predicted to 141m either side of each sail line in shallower waters (e.g. in the southern part of Operational Area). The minor statocyst impacts are not expected to be lethal and are predicted to repair through time. No other sub-lethal effects are known to occur and effects on behaviour are very unlikely. These impacts are also likely to be partially recoverable after successive moulting (Day et al 2019). As the vessel moves into deeper water, this propagation distance at the seabed will become smaller and any impact will be reduced.

Any effects to stocks in the 2.33% of the North West Slope Trawl Fishery (NWSTF) are unlikely to be permanent (Day et al 2019). The best available scientific evidence shows that seismic noise exposure did not change catch rates of prawns in much shallower waters (Andriguetto-Filho et al 2005). Furthermore, a review of all the available scientific evidence found exposure to seismic noise did not affect catch rates in invertebrates (Carroll et al 2017). As the proposed survey area overlaps an extremely small portion of the NWSTF, with over 97% of the fishery unaffected by the survey, it is reasonably predicted that the Possum 3D survey is unlikely to affect the overall catch rates of scampi in the NWSTF.

While the historic catch data show activity from the Mackerel Managed Fishery (MMF) in the Possum 3D MSS area, interaction with stakeholders confirm that fishing activity in the area during the proposed seismic activity is unlikely due to the water depth.

Proposed control measures to mitigate the impact to commercial fishing from underwater noise include:

- Use of the smallest array size that will achieve the survey objectives
- Most efficient survey design possible to reduce survey time
- Avoidance of identified spawning period for scampi (Sept-Oct)
- Strict policy of no fishing from any seismic or support vessel(s)
- Searcher has reduced the operational and acquisition areas to minimise overlap with commercial fishing areas.

References:

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APPENDIX H OIL SPILL MODELLING REPORT

RPS SEARCHER SEISMIC OSM

Report

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EXECUTIVE SUMMARY

RPS Ocean Science Technology (OST) was commissioned by the RPS Energy & Resources Environment group on behalf of Searcher Seismic (Searcher) to undertake a quantitative spill risk assessment of a hydrocarbon spill scenario associated with marine seismic survey activities in the vicinity of the Rowley Shoals.

The main objectives of the study were: (i) to quantify the movement and fate of spilled hydrocarbons that would result from an accidental, uncontrolled release; and (ii) to investigate the risk to sensitive receptors (emergent features, submerged features and shorelines) posed by the release.

Searcher identified one hypothetical hydrocarbon spill scenario for analysis, this scenario was modelled and assessed for any season of the year. Details of the scenario are as follows:

- <u>Scenario 1:</u> A short-term (instantaneous) release of 321 m^3 of marine gas oil onto the water surface resulting from a vessel collision during marine seismic survey operations near Rowley Shoals.

Risks were calculated for release of the oil from a single site within the survey area that was identified as presenting the greatest probability for transport of hydrocarbons to any part of the Rowley Shoals, based on distance and prevailing current patterns. This site was 10 km to the north west of Mermaid Reef.

Oil spill modelling was undertaken using a three-dimensional oil spill trajectory and weathering model, SIMAP (Spill Impact Mapping and Analysis Program), which is designed to simulate the transport, spreading and weathering of specific oil types under the influence of changing meteorological and oceanographic forces.

Risks of oil contact with surrounding locations, given that this spill scenario were to occur in the first place, were calculated via stochastic modelling: 100 replicate simulations of the spill scenario were completed with each simulation applying a unique sample of wind and current data. Samples were selected by defining a list of unique start times for a spill relative to a 10-year long database of wind and current data (2006-2015 inclusive). Start times were evenly distributed throughout months and years of the database to represent spills starting in any month and to capture interannual variability. This process is designed to identify trends in the meteorological and oceanographic forces that will control the trajectory and weathering of spilled oil. All simulations calculated the trajectory and fate of oil components for 28 days post-spill.

During each simulation, the spatial distribution of oil was calculated over time, separately, for:

- Oil floating on the water surface;
- Oil stranded on coastlines (for land that is above sea level at all tide levels);
- Oil physically entrained into the water column as oil droplets;
- Soluble aromatic hydrocarbons dissolved into the water column;

Following completion of all replicate simulations, each replicate simulation was analysed to determine if a range of threshold concentrations were ever equalled or exceeded at individual locations (defined by a grid cell).

- Floating oil: 1, 10, 50, 100 g/m^2
- Stranded oil: 10, 100, 250, 1000 g/m^2
- Entrained oil: 10, 100, 500 ppb
- Dissolved aromatic hydrocarbons: 10, 50, 400, 500 ppb.

For each grid cell, and threshold, a count was then made of the replicate simulations where the relevant threshold was ever equalled or exceeded. This count divided by the total number of replicate simulations (i.e. 100) was used to indicate the probability of contact for each grid cell, and threshold. For example, if $\geq$ 1 g/m^2 of floating oil was calculated at the same grid cell during 23 replicates out of 100, that grid cell was treated as having 23% probability of contact by floating oil at $\geq$ 1 g/m^2. Note that comparison to all thresholds were made for instantaneous (single model time-step) concentrations.

In addition, calculations were made for accumulation of floating oil over time on all grid cells that represented coastal land (shoreline accumulation). No minimum threshold was applied to these calculations. The highest concentrations and volumes calculated during any replicate simulation was defined as the worst-case.

The main findings of the study are as follows:

Oil Characteristics and Weathering Behaviour

- Marine gas oil is a mixture of volatile and persistent hydrocarbons. If exposed constantly to the atmosphere, as slicks floating on the water surface, around 40% of the mass would be expected to evaporate in around 24 hours under prevailing wind and temperature conditions typical of the site. Another 54% would likely evaporate within a few days, eventually leaving around 6% by volume that will be resistant to evaporation but will be subject to degradation. Degradation would occur over weeks.
- Marine gas oil has relatively low viscosity and will also be susceptible to entrainment (physical mixing) into the wave-mixed layer of the water column (upper 3-5 m) under typical wind conditions. The proportion of oil that is entrained into the water column, will not undergo evaporative weathering. This proportion will vary over time depending on the level of wave energy.

Metocean Influence

- In general, oil floating on the water surface as slicks will be subject to movement due to both the prevailing surface current and the prevailing wind at the water surface. By contrast, oil entrained into the upper surface layer will move with the prevailing surface current only.
- Current patterns around the site are variable. The location is subject to both tidal currents, which flow to the south-east on the flood and north-west on the ebb and reverse over time-scales of six hours, and ocean drift-currents that vary in direction in a more complex manner and can persist for longer time-scales.
- Drift currents may flow towards the south-west (in the direction of Mermaid Reef) during all months of the year.
- Wind conditions are also variable, with seasonal trends. The wind most frequently blows from the western sector during the summer months and from the eastern sector during the winter months. Wind speeds frequently exceed speeds that would generate breaking surface waves that would result in entrainment of Marine Gas Oil.

Summary of the Modelling Results

Scenario: Short-term (instantaneous) release of marine gas oil onto the water surface due to a vessel collision during marine seismic survey operations near Rowley Shoals

- Floating oil concentrations at ≥ 1 g/m^2 could potentially occur up to 148 km, from the spill site. Shorter potential effect distances were calculated for higher concentration thresholds, reducing to 84 km for ≥ 10 g/m^2, 32 km for ≥ 50 g/m^2 and 19 km for ≥ 100 g/m^2.
- Highest probabilities of contact with floating oil at ≥ 100 g/m^2 (100%) were calculated for the Commonwealth Fisheries Zones that encompass the release site because concentrations were calculated to exceed 100 g/m^2 initially during all simulations. Similarly, the Biologically Important Area (BIA) for seabirds and whales encompassed the release site and was calculated to have 100% probability of contact at ≥ 100 g/m^2.
- Two Key Ecological Features (KEFs) that were defined by boundaries on the water surface were calculated to have relatively low probability of contact at ≥ 100 g/m^2 but the highest probability of contact by floating oil at ≥ 10 g/m^2: Mermaid Reef Marine Park (1% at ≥ 100 g/m^2; 5% at ≥ 10 g/m^2); Mermaid Reef and Commonwealth waters surrounding Rowley Shoals (1% at ≥ 100 g/m^2; 13% at ≥ 10 g/m^2); Note that this is the probability that such oil concentrations might occur at some part of the boundary of these receptor areas.
- Floating oil ≥ 10 g/m^2 could potentially arrive at the boundaries of Mermaid Reef Marine Park and Mermaid Reef and Commonwealth waters surrounding Rowley Shoals within 1 hour after a spill commencement.
- A low probability of contact (< 1%) with any shoreline is indicated for floating oil concentrations ≥ 1 g/m^2. However, some potential for accumulation of oil that arrives at lower concentrations is indicated on some

shorelines including emergent land within the Mermaid Reef and Commonwealth waters surrounding Rowley Shoals Key Ecological Feature and the Seabirds Biologically Important Areas.

- Entrained oil at concentrations ≥ 10 ppb could occur up to 441 km from the spill site. The effect distance could extend to 280 km at ≥ 100 ppb and 120 km at > 500 ppb.
- Highest probability of contact by entrained oil concentrations ≥ 100 ppb is calculated for North-West Slope Trawl Fishery, Southern Bluefin Tuna Fishery, Western Skipjack Fishery, Western Tuna and Billfish Fishery, Seabirds and Whales Biologically Important Areas, all with a probability of 49%.
- The worst-case, instantaneous, entrained oil concentration at any receptor is calculated for North-West Slope Trawl Fishery, Southern Bluefin Tuna Fishery, Western Skipjack Fishery, Western Tuna and Billfish Fishery, Seabirds and Whales Biologically Important Areas as 58,739 ppb.
- Mermaid Reef Marine Park is calculated to potentially receive instantaneous entrained-oil concentrations of the order of 4,922 ppb.
- Cross-sectional transects of maximum entrained oil concentrations in the vicinity of the release site indicate that entrained oil concentrations ≥ 100 ppb are not likely to occur at depths greater than ~20 m BMSL.
- Dissolved aromatic hydrocarbons at concentrations ≥ 10 ppb are calculated to occur up to 215 km from the spill site. The potential contact zone is calculated to decrease exponentially as the threshold concentration is raised.
- Highest probability of contact by dissolved aromatic hydrocarbon concentrations at ≥ 50 ppb is calculated for North-West Slope Trawl Fishery, Southern Bluefin Tuna Fishery, Western Skipjack Fishery, Western Tuna and Billfish Fishery, Seabirds and Whales Biologically Important Areas, each with a probability of 22%.
- The worst-case dissolved aromatic hydrocarbon concentration at any receptor (671 ppb) is calculated for North-West Slope Trawl Fishery, Southern Bluefin Tuna Fishery, Western Skipjack Fishery, Western Tuna and Billfish Fishery, Seabirds and Whales Biologically Important Areas.
- Mermaid Reef Marine Park is calculated to have a worst-case dissolved aromatic hydrocarbon concentration of 258 ppb.
- Cross-sectional transects of maximum dissolved aromatic hydrocarbon concentrations in the vicinity of the release site indicate that dissolved aromatic hydrocarbon concentrations at ≥ 50 ppb should not reach depths greater than ~40 m BMSL.

1 INTRODUCTION

1.1 Background

RPS Ocean Science Technology (OST) was commissioned by the RPS Energy & Resources Environment group on behalf of Searcher Seismic (Searcher) to undertake a quantitative spill risk assessment of a hydrocarbon spill scenario associated with marine seismic survey activities in the vicinity of the Rowley Shoals.

The main objectives of the study were: (i) to quantify the movement and fate of spilled hydrocarbons that would result from an accidental, uncontrolled release; and (ii) to investigate the risk to sensitive receptors (emergent features, submerged features and shorelines) posed by the release.

Searcher identified one hypothetical hydrocarbon spill scenario for analysis, this scenario was modelled and assessed over an annual period. The regional context of the spill location is shown in Figure 1.1.

Details of the scenario are summarised in Table 1.1 and are as follows:

- Scenario 1: A short-term (instantaneous) release of 321 m^3 of marine gas oil onto the water surface resulting from a vessel collision during marine seismic survey operations near Rowley Shoals.

Table 1.1 Summary of the hydrocarbon spill scenario assessed in this study.

Description	Oil type	Spilled volume (m^3)	Release coordinates	Release depth (BMSL)	Spill duration	Simulation duration	Period	Closest sensitive receptor
Rupture of a fuel tank	Marine gas oil	321	17° 4' 40.08" S 119° 47' 31.92" E	0 m	Instantaneous	28 days	Annual	Mermaid Reef MP located ~10 km west of the spill site

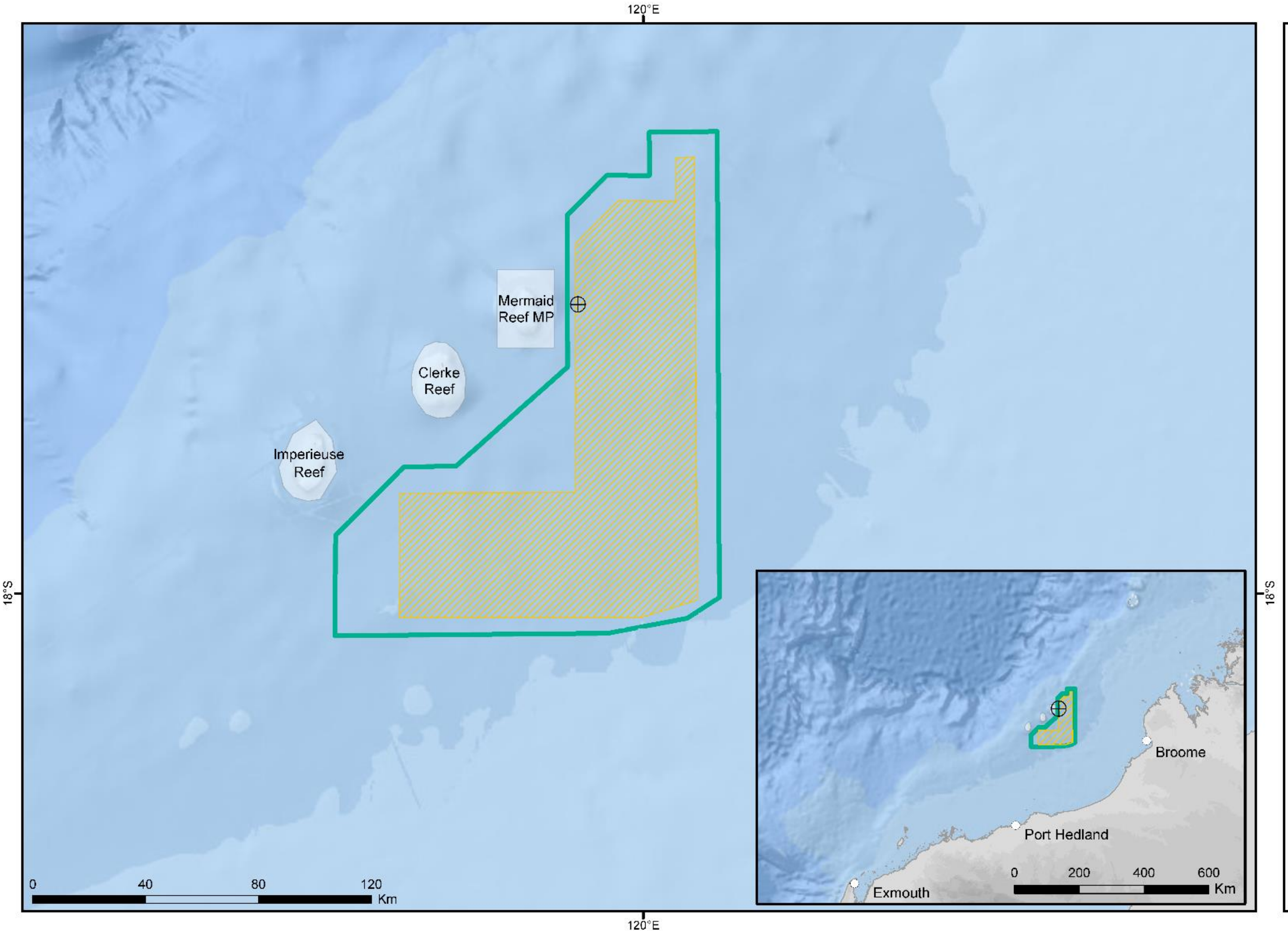

Figure 1.1 Possum 3D Acquisition and Operational Areas and nearby sensitive receptors. The release site considered in this study is marked by the circle enclosing a cross. The green polygon represents the permit area for the seismic survey. The yellow hashed area represents the proposed area of operations for the survey. The inset shows the wider geographic setting.

1.2 What is Oil Spill Modelling?

Oil spill modelling is a valuable tool widely used for risk assessment, emergency response and contingency planning where it can be particularly helpful to proponents and decision makers. By modelling a series of the most likely oil spill scenarios, decisions concerning suitable response measures and strategic locations for deploying equipment and materials can be made, and the locations at most risk can be identified. The two types of oil spill modelling often used are stochastic and deterministic modelling.

In this study, oil spill modelling was undertaken using a three-dimensional oil spill trajectory and weathering model, SIMAP (Spill Impact Mapping and Analysis Program), which is designed to simulate the transport, spreading and weathering of specific oil types under the influence of changing meteorological and oceanographic forces.

1.2.1 Stochastic Modelling (Multiple Spill Simulations)

Stochastic oil spill modelling is created by overlaying a great number (often hundreds) of individual, computer-simulated hypothetical spills (NOPSEMA, 2018; Figure 1.2). Each simulation represents an identical spill scenario (oil type, release site, release rate etc), but representation of the prevailing wind and current conditions are varied in an objective manner, usually by randomly selecting different start times for the spill being simulated relative to the time signature of a long-term sample of wind and current for the spill location.

Stochastic modelling is a common means of assessing the likelihood that surrounding locations might be contacted by spilled oil, the concentrations that might be involved and the minimum times before contact might occur. Models that are designed to simulate the partitioning of oil components through weathering can be applied to calculate for different oil components e.g. oil floating on the water surface, physically mixed into the water column or dissolved in the water column.

The outcomes are often presented as a probability of exposure which is primarily used for risk assessment purposes and to understand the range of environments that could be influenced or impacted by a spill. Elements of the stochastic modelling can also be used in oil spill preparedness and planning.

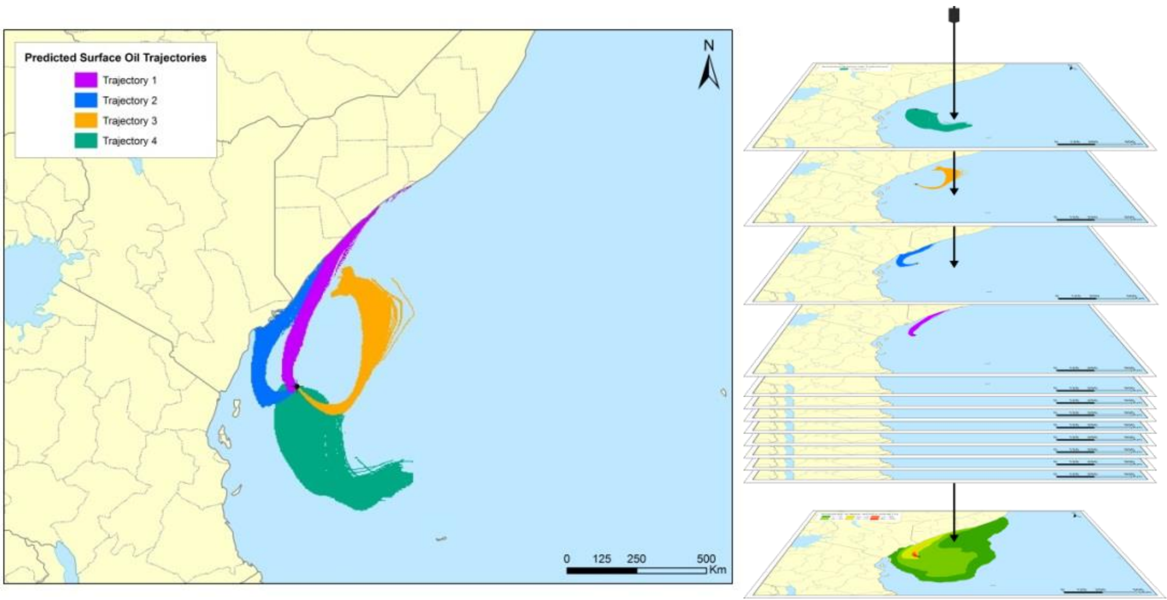

Figure 1.2 Examples of four individual spill trajectories (four replicate simulations) predicted by SIMAP for a spill scenario. The frequency of contact with given locations is used to calculate the probability of impacts during a spill. Essentially, all model runs are overlain (shown as the stacked runs on the right) and the number of times that trajectories contact a given location at a concentration is used to calculate the probability.

1.3 Report Structure

The far-field computational model, risk assessment methodology, environmental data used as input to the models, environmental threshold trigger levels defined for the assessment, and characteristics of the oil type used in the modelling of the defined scenario are described in detail in Section 2.

Contour figures and tabulated results showing risk estimates calculated for surrounding receptors are presented in Section 3. Results are separately reported for floating oil, oil that could strand on shorelines, entrained oil and dissolved aromatic hydrocarbons.

The overall findings of the study are summarised in Section 43.2.

2 MODELLING METHODOLOGY

2.1 Description of the Model

2.1.1 SIMAP

The spill modelling was carried out using a purpose-developed oil spill trajectory and fates model, SIMAP (Spill Impact Mapping and Assessment Program). This model is designed to simulate the transport and weathering processes that affect the outcomes of hydrocarbon spills to the sea, accounting for the specific oil type, spill scenario, and prevailing wind and current patterns.

SIMAP is the evolution of the United States Environmental Protection Agency (US EPA) Natural Resource Damage Assessment model (French & Rines, 1997; French, 1998; French *et al.*, 1999) and is designed to simulate the fate and effects of spilled oils and fuels for both the surface slick and the three-dimensional plume that is generated in the water column. SIMAP includes algorithms to account for both physical transport and weathering processes. The latter are important for accounting for the partitioning of the spilled mass over time between the water surface (surface slick), water column (entrained oil and dissolved compounds), atmosphere (evaporated compounds) and land (stranded oil). The model also accounts for the interaction between weathering and transport processes.

The physical algorithms calculate transport spreading by physical forces, including surface tension, gravity and wind and current forces for both surface slicks and oil within the water column. The fates algorithms calculate all of the weathering processes known to be important for oil spilled to marine waters. These include droplet and slick formation, entrainment by wave action, emulsification, dissolution of soluble components, sedimentation, evaporation, bacterial and photo-chemical decay and shoreline interactions. These algorithms account for the specific oil type being considered.

Entrainment is the physical process where globules of oil are transported from the sea surface into the water column by wind and wave-induced turbulence or be generated subsea by a pressurised discharge at depth. It has been observed that entrained oil is broken into droplets of varying sizes. Small droplets spread and diffuse into the water column, while larger ones rise rapidly back to the surface (Delvigne & Sweeney, 1988; Delvigne, 1991).

Dissolution is the process by which soluble hydrocarbons enter the water from a surface slick or from entrained droplets. The lower molecular weight hydrocarbons tend to be both more volatile and more soluble than those of higher molecular weight.

The formation of water-in-oil emulsions, or mousse, which is termed 'emulsification', depends on oil composition and sea state. Emulsified oil can contain as much as 80% water in the form of micrometre-sized droplets dispersed within a continuous phase of oil (Wheeler, 1978; Daling & Brandvik, 1991; Bobra, 1991; Daling et al., 1997; Fingas, 1995; Fingas, 1997).

Evaporation can result in the transfer of large proportions of spilled oil from the sea surface to the atmosphere, depending on the type of oil (Gundlach & Boehm, 1981).

Evaporation rates vary over space and time dependent on the prevailing sea temperatures, wind and current speeds, the surface area of the slick and entrained droplets that are exposed to the atmosphere as well as the state of weathering of the oil. Evaporation rates will decrease over time, depending on the calculated rate of loss of the more volatile compounds. By this process, the model can differentiate between the fates of different oil types.

Sedimentation of hydrocarbons occurs when the specific gravity increases over that of the surrounding seawater. Several processes may act on entrained oil and surface slicks to increase density: weathering (evaporation, dissolution and emulsification), adhesion or sorption onto suspended particles or detrital matter, and incorporation of sediment into oil during interaction with suspended particulates, bottom sediments, and shorelines.

Decay (degradation) of hydrocarbons may occur as the result of photolysis, which is a chemical process energised by ultraviolet light form the sun, and by biological breakdown, termed biodegradation. Many types of marine organisms ingest, metabolise and utilise oil as a carbon source, producing carbon dioxide and water as by-products.

Many types of marine organisms ingest, metabolise and utilise oil as a carbon source, producing carbon dioxide and water as by-products. The biodegradable portion of various crude oils range from 11 to 90% (NRC, 1985, 1989).

Entrainment, dissolution and emulsification rates are correlated to wave energy, which is accounted for by estimating wave heights from the sustained wind speed, direction and fetch (i.e. distance downwind from land barriers) at different locations in the domain. Dissolution rates are dependent upon the proportion of soluble, short-chained hydrocarbon compounds, and the surface area at the oil/water interface of slicks. Dissolution rates are also strongly affected by the level of turbulence. For example, dissolution rates will be relatively high at the site of the release for a deep-sea discharge at high pressure.

In contrast, the release of hydrocarbons onto the water surface will not generate high concentrations of soluble compounds. However, subsequent exposure of the surface slick to breaking waves will enhance entrainment of oil into the upper water column as oil droplets, which will enhance dissolution of the soluble components. Because the compounds that have high solubility also have high volatility, the processes of evaporation and dissolution will be in dynamic competition with the balance dictated by the nature of the release and the weather conditions that affect the oil after release. The SIMAP weathering algorithms include terms to represent these dynamic processes. Technical descriptions of the algorithms used in SIMAP and validations against real spill events are provided in French (1998), French et al. (1999) and French-McCay (2004).

Input specifications for oil types include the density, viscosity, pour-point, distillation curve (volume of oil distilled off versus temperature) and the aromatic/aliphatic component ratios within given boiling point ranges. The model calculates a distribution of the oil by mass into the following components:

- Surface-bound or floating oil;
- Oil stranded on shorelines;
- Entrained oil (non-dissolved oil droplets that are physically entrained by wave action);
- Dissolved hydrocarbons (principally the aromatic and short-chained aliphatic compounds);
- Evaporated hydrocarbons;
- Sedimented hydrocarbons;
- Decayed hydrocarbons;

SIMAP is a particle-based model that represents the mass of each oil component by populations of particles that move over time in response to physical forcing conditions. Each particle represents a proportion of the mass of a given component. Loss of particles occurs over time for some components and increase in the population of others occurs for others to represent weathering processes.

To convert distributions of particles into concentrations, the affected area is subdivided by a grid of rectangular cells and the mass is subdivided among these cells, at each time step, applying spatial interpolation. For this study a three-dimensional grid measuring 400 m x 400 m (0.16 km^2) in the horizontal and 1 m in the vertical was applied. Consequently, all concentrations were calculated as spatial averages over 0.16 km^2 for floating and stranded oil and volumetric averages over 0.16 km^3 for entrained and dissolved components.

2.2 Calculation of Stochastic Modelling Exposure Risks

The stochastic model within SIMAP performs many simulations for a given spill site, randomly varying the spill time for each simulation. The model uses the spill time to select sequences of current and wind data from a long time-series of wind and current data for the area. Hence, the transport and weathering of each slick will be subject to a different sequence of wind and current conditions.

This stochastic sampling approach provides an objective measure of the possible outcomes of a spill, because environmental conditions will be selected at a rate that is proportional to the frequency that these conditions occur over the study region. More simulations will tend to use the most commonly occurring conditions, while conditions that are more unusual will be represented less frequently.

During each simulation, the SIMAP model records the location (by latitude, longitude and depth) of each of the particles (representing a given mass of oil) on or in the water column, at regular time steps. For any particles that contact a shoreline, the model records the accumulation of oil mass that arrives on each section of shoreline over time, less any mass that is lost to evaporation and/or subsequent removal by current and wind forces.

The collective records from all simulations are then analysed by dividing the study region into a three-dimensional grid. For oil particles that are classified as being at the water surface (floating oil), the sum of the mass in all oil particles (including accounting for spreading and dispersion effects) located within a grid cell, divided by the area of the cell provides estimates of the concentration of oil in that grid cell, at each time step. For entrained and dissolved oil particles, concentrations are calculated at each time step by summing the mass of particles within a grid cell and dividing by the volume of the grid cell.

The concentrations of oil calculated for each grid cell, at each time step, are then analysed to determine whether concentration estimates exceed defined threshold concentrations over time.

Risks are then summarised as follows:

- The probability of exposure to a grid cell is calculated by dividing the number of spill simulations where contact was calculated (above a specified threshold) during at least one model time step (i.e. any instantaneous occurrence) by the total number of replicate spill simulations (i.e. 100). For example, if contact occurred at a location, above a specified threshold, during 21 out of 100 simulations, a probability of exposure of 21% is indicated for that threshold.
- The minimum potential time to a shoreline grid cell is calculated by the shortest time over which oil at a concentration above a threshold was calculated to travel from the source to the location in any of the replicate simulations.
- The maximum potential concentration of oil predicted for each shoreline section (composed of a collection of grid cells) is the greatest mass per m^2 of shoreline calculated to strand at any location within that section during any of the replicate simulations.
- The average of the maximum concentrations of oil predicted to potentially accumulate on each shoreline section is calculated by determining the greatest mass per m^2 of shoreline during each replicate simulation and calculating an average of these estimates across the simulations. Note that this statistic has been previously referred to as the “mean expected maximum” in earlier reports.
- Similar treatments are undertaken for entrained oil and dissolved aromatic hydrocarbons.

Thus, the minimum time to shoreline and the maximum potential concentration estimates indicate the worst potential outcome of the modelled spill scenario for each section of shoreline. However, the average over the replicates presents an average of the potential outcomes, in terms of oil that could strand.

Note also that results quoted for sections of shoreline or shoal are derived for any individual 400 m x 400 m grid cell representing that section or shoal. Consequently, grid cells will represent minimum shoreline lengths of the order of ~0.4 km, while sections or regions may represent shorelines spanning tens to hundreds of kilometres and we do not imply that the maximum potential concentrations quoted for a cell (as a worst case local concentration) will occur over the full extent of each section. We therefore warn against multiplying the maximum concentration estimates by the full area of the section because this will greatly overestimate the total volume expected on that section.

Noting the grid resolution of 0.4 km, for sensitive receptors with shorelines <400 m, it is not possible to resolve down to the smaller scale of these individual receptors. Clerke Reef (Rowley Shoals Marine Park) and Sandy Cay have shoreline areas above high tide that are smaller than the grid resolution and were represented by single cells (0.16 km^2). Hence, estimates for the oil onshore and shoreline length may be conservatively overestimated for these shorelines.

The maximum entrained hydrocarbon and maximum dissolved aromatic hydrocarbon concentration are calculated for areas surrounding each defined shoreline (see Section 2.2.1). These areas extend out from the coast to provide a buffer area enclosing shallow (< 10 m) habitats close to shore. If oil passes within this buffer distance from shore, calculation for shoreline exposure will be made. This is a conservative approach to estimating risks to shorelines to allow for spatial errors in model forecasts.

The greatest calculated value at any time step during any replicate simulation is listed. These values therefore represent worst-case localised estimates (within a grid cell). The averages over all replicate values represent a central tendency of these simulated worst-case estimates.

It is important to note that the stochastic modelling results presented in this document relate to the predicted outcomes once defined spill events have occurred. The probability of the spill scenarios occurring is not considered. The results should therefore be viewed as a guide to the likely outcomes, should the spill scenarios occur. Different locations within the potential zone of influence would be affected under different time-series of environmental forces. Consequently, these contours for the potential zone of influence will cover a larger area than the area that is likely to be affected during any one single spill event. The contours should therefore be judged as contours of probability and not representations of the area swept by individual spill slicks.

2.2.1 Sensitive Receptor Areas

Individual grid cells were grouped by geographic bounds to define sensitive receptor areas for special consideration. Sensitive receptor areas included sections of shorelines, islands, reefs, Australian and State marine and national parks, special management zones and key ecological features (Figure 2.1 to Figure 2.3). The bounds of the sensitive receptor areas were defined, with buffer zones defined with consideration of the bathymetry bordering each receptor, natural boundaries, or sensible legislative boundaries. Risks of exposure were separately calculated for each sensitive receptor area and have been tabulated.

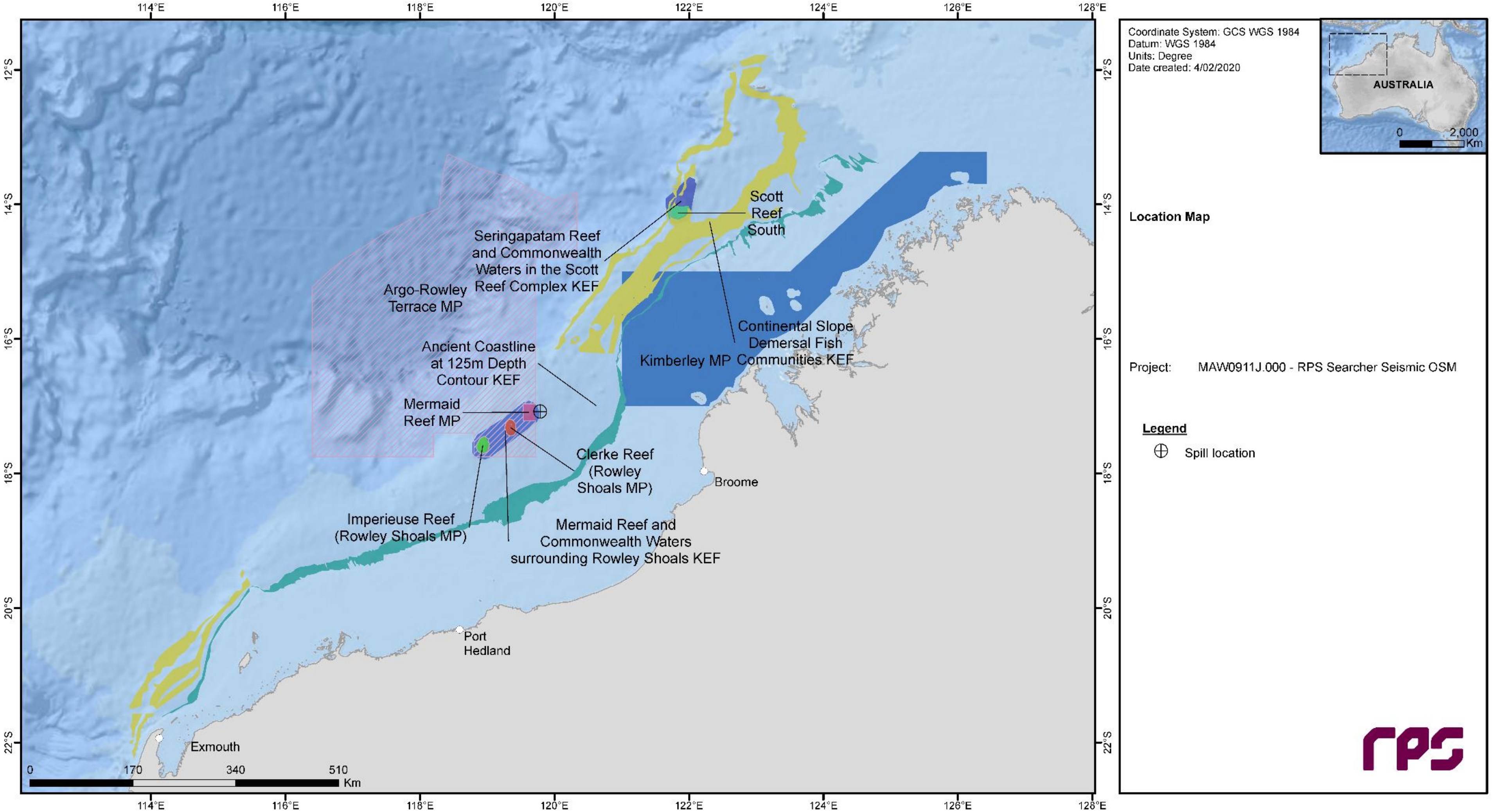

Figure 2.1 Locations of sensitive receptors near the release location.

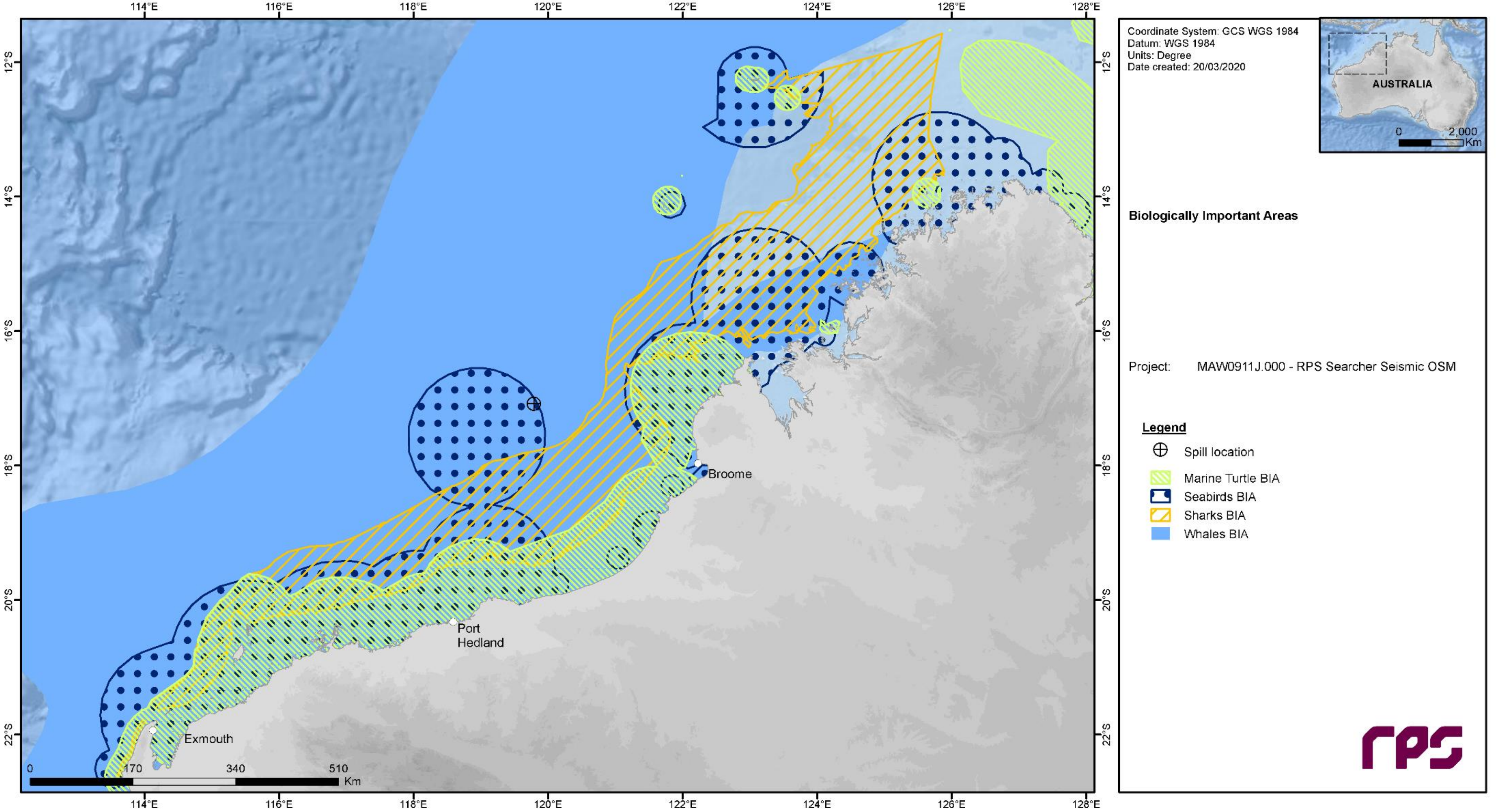

Figure 2.2 Locations of Biologically Important Areas (BIA) sensitive receptors near the release site. The release site considered in this study is marked by the circle enclosing a cross.

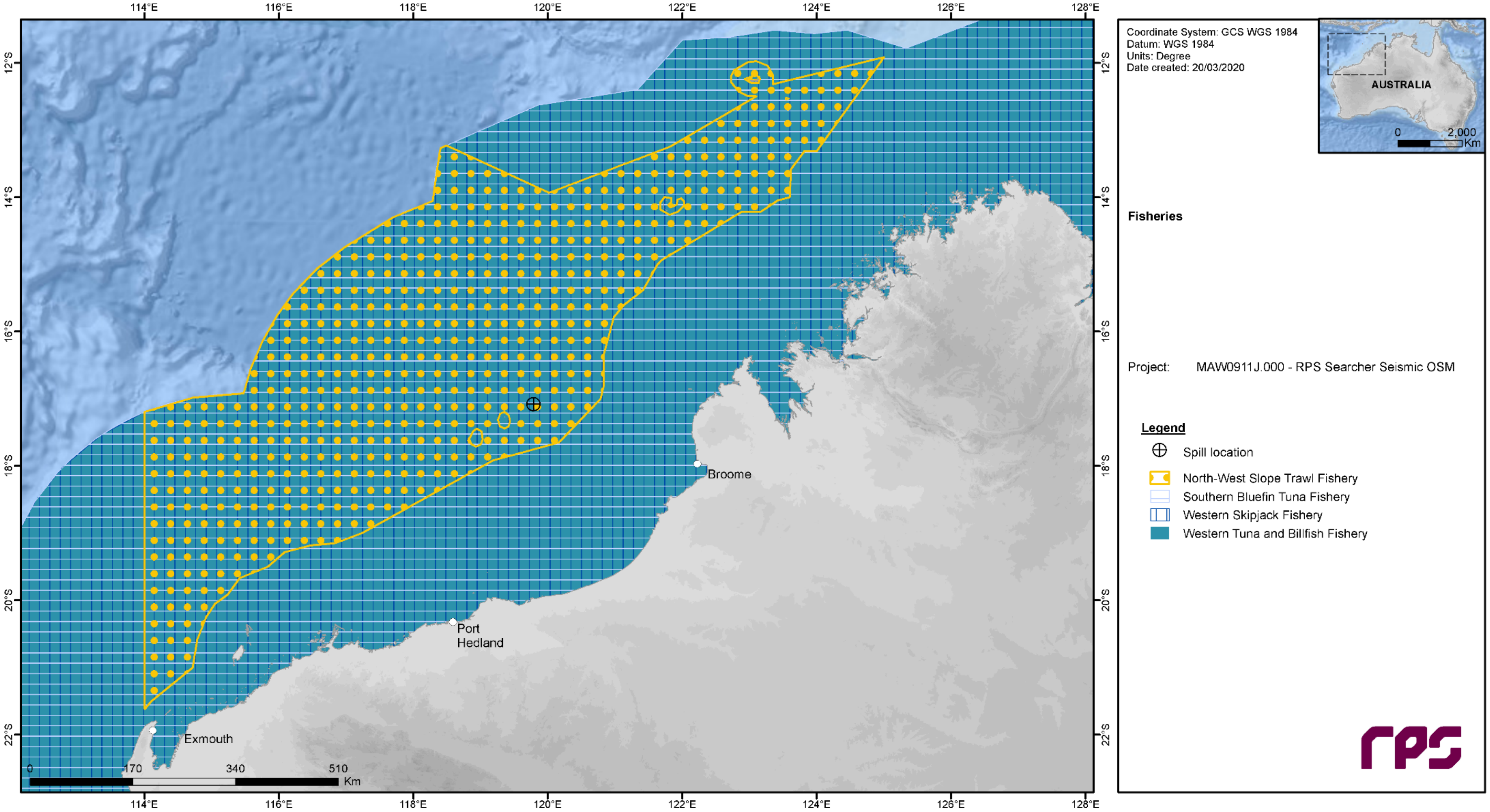

Figure 2.3 Locations of fishery sensitive receptors near the release site.

2.3 Inputs to the Risk Assessment

2.3.1 Current Data

2.3.1.1 Background

The area of interest for this study is located within the influence of the Indonesian Throughflow, a large-scale current system characterised as a series of migrating gyres and connecting jets that are steered by the continental shelf. While the mass flow is generally towards the south-west, year-round, the internal gyres generate local currents in all directions. As these gyres migrate through the area, large spatial variations in the speed and direction of currents will occur at a given location over time. Further south of the study area, the Leeuwin Current becomes the dominant large-scale current system, flowing poleward down the pressure gradient along the Western Australian coastline and past Cape Leeuwin.

Offshore regions with water depths exceeding 100-200 m experience significant large-scale drift currents. These drift currents can be relatively strong (1-2 knots) and complex, manifesting as a series of eddies, meandering currents and connecting flows. These offshore drift currents also tend to persist longer (days to weeks) than tidal current flows (hours between reversals) and thus will have greater influence upon the net trajectory of plumes over time scales exceeding a few hours.

On the continental shelf, in shallower waters around Scott Reef and closer to the inshore region of the Kimberley Coast, surface winds and tidal dynamics dominate over the large-scale current flows (Condie & Andrewartha, 2008). In comparison to drift currents, tidal currents generate only relatively short tidal migrations (distance travelled by a parcel of water over a tidal cycle) that follow an elliptical path with a period of about 12 hours in the study region. Hence, tidal currents add variability to the longer-term drift patterns of an entrained plume.

Wind shear on the water surface also generates local-scale currents that can persist for extended periods (hours to days) and result in long trajectories. Persistent winds along the mainland coast can induce Ekman transport, where surface waters move offshore and facilitate upwelling events in which cold nutrient-rich waters from the deep Indian Ocean are brought to the surface. However, due to the opposing transport of warm tropical waters by the Leeuwin Current, large-scale persistent upwelling along the Western Australian coast is suppressed. Therefore, upwelling events are sporadic, short-term and localised to areas of the coastline where the continental shelf narrows, including the area around the Capes and the Ningaloo coast (IMOS, 2015). This process is seasonal/transient and affected by the strength of the Leeuwin Current, with minimal upwelling in times with strong Leeuwin Current flow.

The current-induced transport of plumes can be variably affected by combinations of tidal, wind-induced and density-induced drift currents. Depending on their local influence, it is critical to consider all these potential advective mechanisms to rigorously understand patterns of potential transport from a given discharge location.

To appropriately allow for temporal and spatial variation in the current field, dispersion modelling requires the current speed and direction over a spatial grid covering the potential migration trajectories of plumes. As long-term measured current data is not available for simultaneous periods over a network of locations covering the offshore areas relevant to this study, the analysis relied upon hindcasts of the circulation generated through numerical modelling by internationally recognised organisations.

A composite modelled ocean current data product was derived by combining predictions of mesoscale circulation currents, available at daily resolution from global ocean models, with predictions of the hourly tidal currents generated by the RPS HYDROMAP model. By combining a drift current model with a tidal model, the influences of inter-annual and seasonal drift patterns, and the more regular variations in tide, were depicted, ensuring nearshore and offshore hydrodynamic processes were represented.

2.3.1.2 Mesoscale Circulation Model

2.3.1.2.1 Description of Mesoscale Model: BRAN

Two mesoscale ocean current data sets were considered for the study: the CSIRO (Commonwealth Scientific and Industrial Research Organisation) global ocean model, BRAN (Bluelink ReANalysis); and the HYCOM (Hybrid Coordinate Ocean Model) Consortium's global ocean model, HYCOM. Based on a hydrodynamic model validation conducted by RPS, the output of the BRAN (Oke *et al.*, 2008, 2009; Schiller *et al.*, 2008) ocean model, which is sponsored by the Australian Government through the Commonwealth Bureau of

Meteorology (BoM), Royal Australian Navy and CSIRO, was chosen for representation of the drift currents that affect the area. BRAN is a data-assimilative, three-dimensional ocean model that has been run as a hindcast for many periods and is now used for ocean forecasting (Schiller *et al.*, 2008).

BRAN routinely assimilates sea level anomaly data, tide gauge data, sea surface temperature and in situ temperature and salinity measurements (Oke *et al.*, 2009). Comparisons of BRAN hindcast outputs to satellite and independent in situ observations found that BRAN was reliably representing the broad-scale ocean circulation, the mesoscale surface eddy field, and shelf circulation around Australia (Oke *et al.*, 2008; Schiller *et al.*, 2008). Additionally, reanalysis of past periods using the BRAN model has been shown to realistically represent upwelling events, in particular along the Bonney Coast of South Australia, a region of frequent wind-driven upwellings (Oke *et al.*, 2009).

The BRAN predictions for drift currents are produced at a horizontal spatial resolution of approximately 0.1° over the region, at a frequency of once per day, averaged over the 24-hour period. Hence, the BRAN model data provides estimates of mesoscale circulation with horizontal resolution suitable to resolve eddies of a few tens of kilometres' diameter, as well as connecting stream currents of similar spatial scale. Drift currents that are represented over the inner shelf waters in the BRAN data are principally attributable to wind induced drift.

There are several versions of the BRAN database available. The latest BRAN simulation spans the period of January 1994 to August 2016. From this database, three-dimensional data representing horizontal water movement at discrete depths was extracted for all points in the model domain for the years 2006-2015 (inclusive). The data was assumed to be a suitably representative sample of the current conditions over the study area for future years.

Although this data should represent effects of upwelling and downwelling processes on horizontal transport at a given depth, the data does not explicitly represent vertical currents between horizontal layers. This was considered reasonable because vertical currents associated with episodic upwelling and downwelling events are relatively small in magnitude (3-30 cm/s; Kampf *et al.*, 2004) compared to horizontal currents represented in the tidal and non-tidal current data (0.5-2 m/s), and considering allowances for dispersion rates in the horizontal (0.1-50 m/s) and vertical (1-10 cm/s) planes.

2.3.1.2.2 Mesoscale currents at the release location

Figure 2.4 show the monthly distributions of current speeds and directions for the BRAN data points closest to the spill location. Note that the convention for defining current direction is the direction *towards* which the current flows.

The data indicates that higher average current speeds are characteristic of February and March months, with average speeds varying between 0.13-0.14 m/s. Lower average current speeds are more common during the May to July period, with the lowest average speeds (0.09 m/s) occurring in June. Peak current speeds across all months are approximately 0.50 m/s.

The prevailing current direction at the spill site varies throughout the year, with north-easterly currents dominant in November and January and between April and August, while southerly currents dominate in March. Current directions during the September, October and February periods are variable.

The extracted current data near the spill location provides an insight into the expected initial behaviour of any released oil due to the drift currents alone. Oil moving beyond the release site, particularly towards the coast, would be subject to considerable variation in the drift current regime.

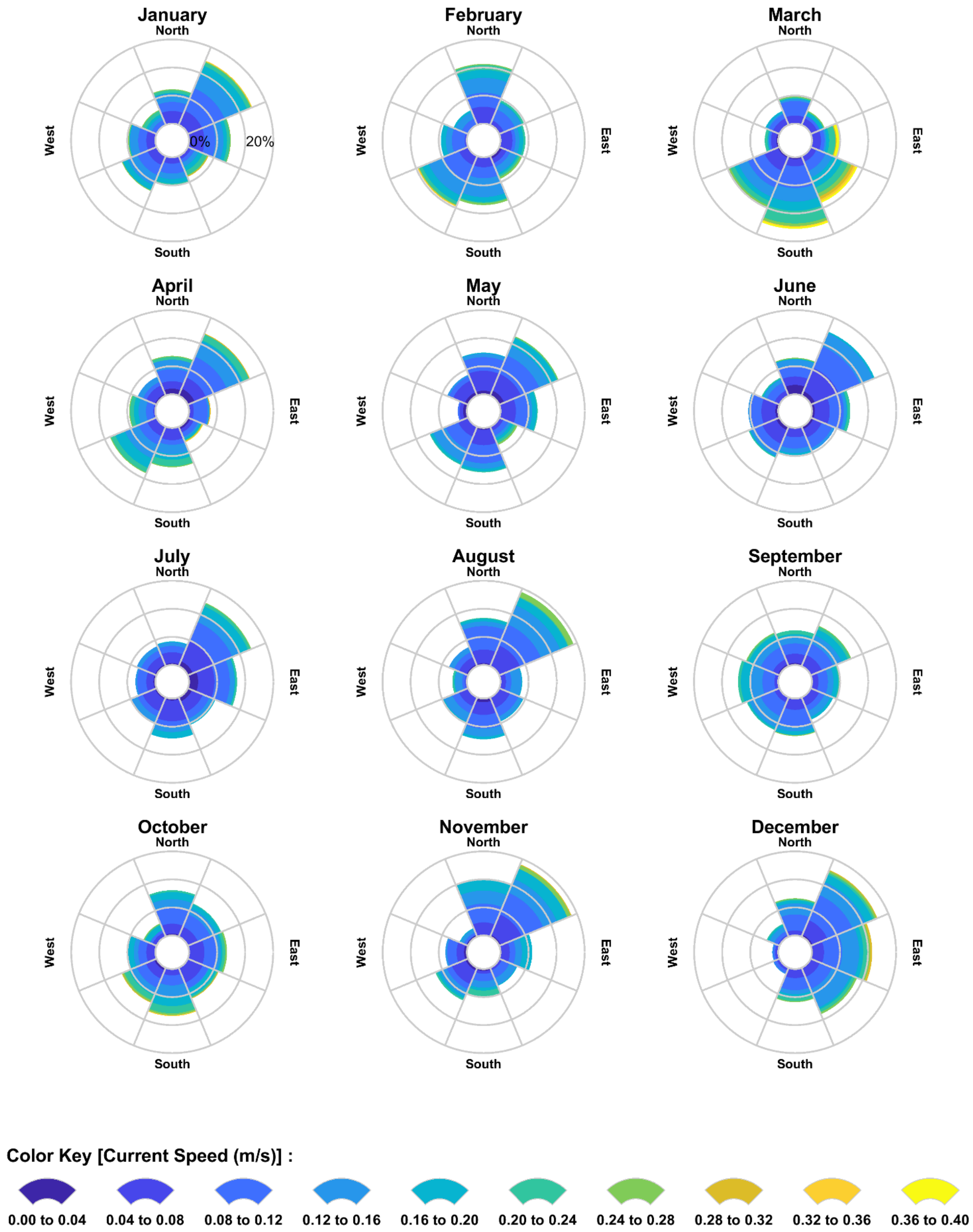

Figure 2.4 Monthly mesoscale current distributions (2006-2015, inclusive) derived from metocean modelling (source: BRAN model, CSIRO) for a site near the release location. The colour key indicates the current magnitude. The compass sector indicates the direction the current was flowing towards. The thickness of the wedge indicates the frequency of a speed and direction combination.

2.3.1.3 Tidal Circulation

2.3.1.3.1 Description of Tidal Model: HYDROMAP

As the BRAN model does not include tidal forcing, and because the data is only available at a daily frequency, a tidal model was developed for the study region using RPS' three-dimensional hydrodynamic model, HYDROMAP.

The model formulations and output (current speed, direction and sea level) of this model have been validated through field measurements around the world for more than 30 years (Isaji & Spaulding, 1984, 1986; Isaji *et al.*, 2001; Zigic *et al.*, 2003). HYDROMAP current data has also been widely used as input to forecasts and hindcasts of oil spill migrations in Australian waters. This modelling system forms part of the National Marine Oil Spill Contingency Plan for the Australian Maritime Safety Authority (AMSA, 2002).

HYDROMAP simulates the flow of ocean currents within a model region due to forcing by astronomical tides, wind stress and bottom friction. The model employs a sophisticated dynamically nested-gridding strategy, supporting up to six levels of spatial resolution within a single domain. This allows for higher resolution of currents within areas of greater bathymetric and coastline complexity, or of particular interest to a study.

The numerical solution methodology of HYDROMAP follows that of Davies (1977a, 1977b) with further developments for model efficiency by Owen (1980) and Gordon (1982). A more detailed presentation of the model can be found in Isaji & Spaulding (1984).

2.3.1.3.2 Tidal Domain Setup

A HYDROMAP model was established over a domain that extended approximately 3,300 km east-west by 3,100 km north-south over the eastern Indian Ocean. The grid extends beyond Eucla in the south and beyond Bathurst Island in the north (Figure 2.5). Approximately 98,600 cells were used to define the region, with four layers of sub-gridding applied to provide variable resolution throughout the domain. The resolution at the primary level was 15 km. The finer levels were defined by subdividing these cells into 4, 16 and 64 cells, resulting in resolutions of 7.5 km, 3.75 km and 1.88 km.

The finer grids were allocated in a stepwise fashion to areas where higher resolution of circulation patterns was required to resolve flows through channels, around shorelines or over more complex bathymetry.

Bathymetric data used to define the three-dimensional shape of the study domain was extracted from the Geoscience Australia 250 m resolution bathymetry database (GA, 2009) and the CMAP electronic chart database, supplemented where necessary with manual digitisation of chart data supplied by the Australian Hydrographic Office. Depths in the domain ranged from shallow intertidal areas through to approximately 7,200 m.

2.3.1.3.3 Tidal Boundary Conditions

Ocean boundary data for the HYDROMAP model was obtained from the TOPEX/Poseidon global tidal database (TPXO7.2) of satellite-measured altimetry data, which provided estimates of tidal amplitudes and phases for the eight dominant tidal constituents (designated as K_2, S_2, M_2, N_2, K_1, P_1, O_1 and Q_1) at a horizontal scale of approximately 0.25°. Using the tidal data, sea surface heights are firstly calculated along the open boundaries at each time step in the model.

The TOPEX/Poseidon satellite data is produced, and quality controlled by the US National Atmospheric and Space Agency (NASA). The satellites, equipped with two highly accurate altimeters capable of taking sea level measurements accurate to less than ±5 cm, measured oceanic surface elevations (and the resultant tides) for over 13 years (1992-2005). In total, these satellites carried out more than 62,000 orbits of the planet. The TOPEX/Poseidon tidal data has been widely used amongst the oceanographic community, being the subject of more than 2,100 research publications (e.g. Andersen, 1995; Ludicone *et al.*, 1998; Matsumoto *et al.*, 2000; Kostianoy *et al.*, 2003; Yaremchuk & Tangdong, 2004; Qiu & Chen, 2010). As such, the TOPEX/Poseidon tidal data is considered suitably accurate for this study.

2.3.1.3.4 Tidal Elevation Validation

For the purpose of verification of the tidal predictions, the model output was compared against independent predictions of tides using the XTide database (Flater, 1998). The XTide database contains harmonic tidal constituents derived from measured water level data at locations around the world. Overall, there are more than 120 tidal stations within the HYDROMAP model domain; however, some of these are located in areas that are not sufficiently resolved by this large-scale ocean model. More than 80 stations along the coastline were suitable for comparisons of the model performance with the observed data. These stations covered the mid-to-northwest regions of the Western Australian coastline, encompassing the locales of the marine discharges considered in this study (Figure 2.5). For the purposes of brevity and clarity, a selected representative subset of the available tidal station validation data is presented here.

Water level time series for the selected subset of ten stations are shown in Figure 2.6 and Figure 2.7 for a one-month period (January 2018). All comparisons show that the model produces a very good match to the known tidal behaviour for a wide range of tidal amplitudes and clearly represents the varying diurnal and semi-diurnal nature of the tidal signal.

The model skill was further evaluated through a comparison of the predicted and observed tidal constituents, derived from an analysis of model-predicted time series at each of the tidal station locations. Scatter plots of the observed and modelled amplitude (top) and phase (bottom) of the five dominant tidal constituents (S_2, M_2, N_2, K_1 and O_1) for all relevant stations within the model domain (>80) are presented in Figure 2.8. The red line on each plot shows the 1:1 line, which would indicate a perfect match between the modelled and observed data. Note that the data is generally closely aligned to the 1:1 line demonstrating the high quality of the model performance.

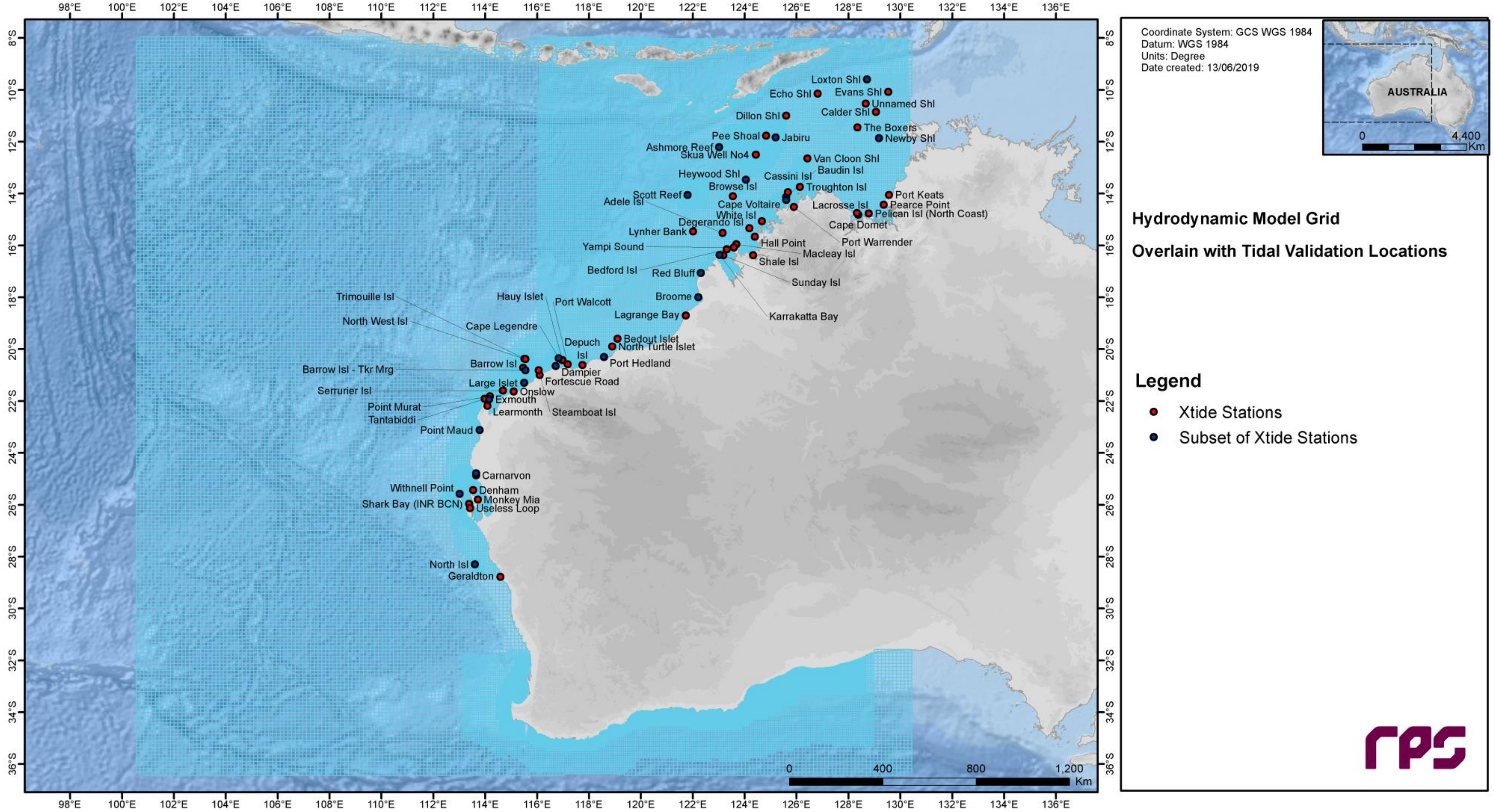

Figure 2.5 Hydrodynamic model grid (blue wire mesh) used to generate the tidal currents, showing the full domain in context with the continental land mass and the locations available for tidal comparisons (red and blue labelled dots). Higher-resolution areas are indicated by the denser mesh zones.

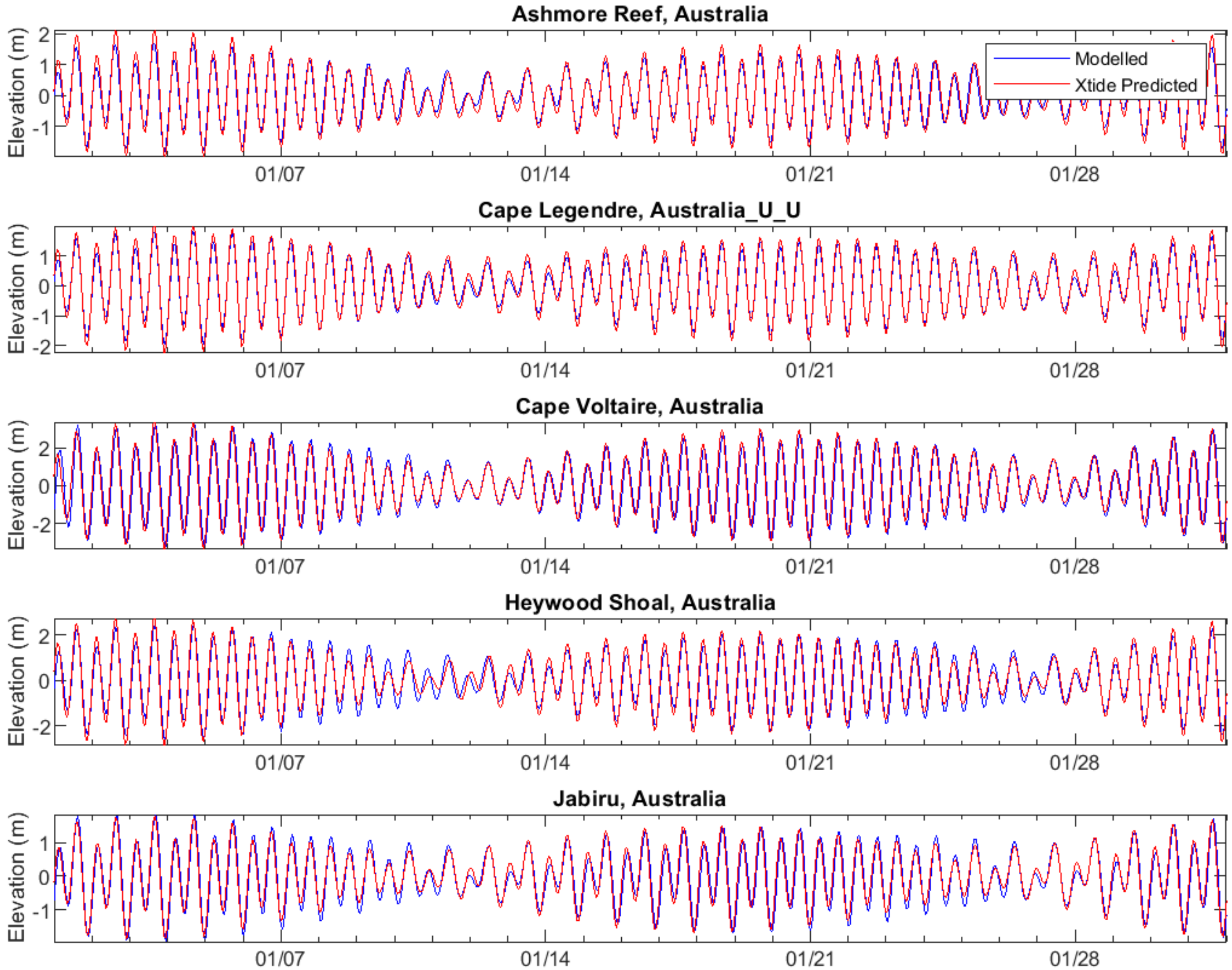

Figure 2.6 Comparisons between the predicted (blue line) and observed (red line) surface elevation variations at five locations in the north-east of the tidal model domain for January 2018.

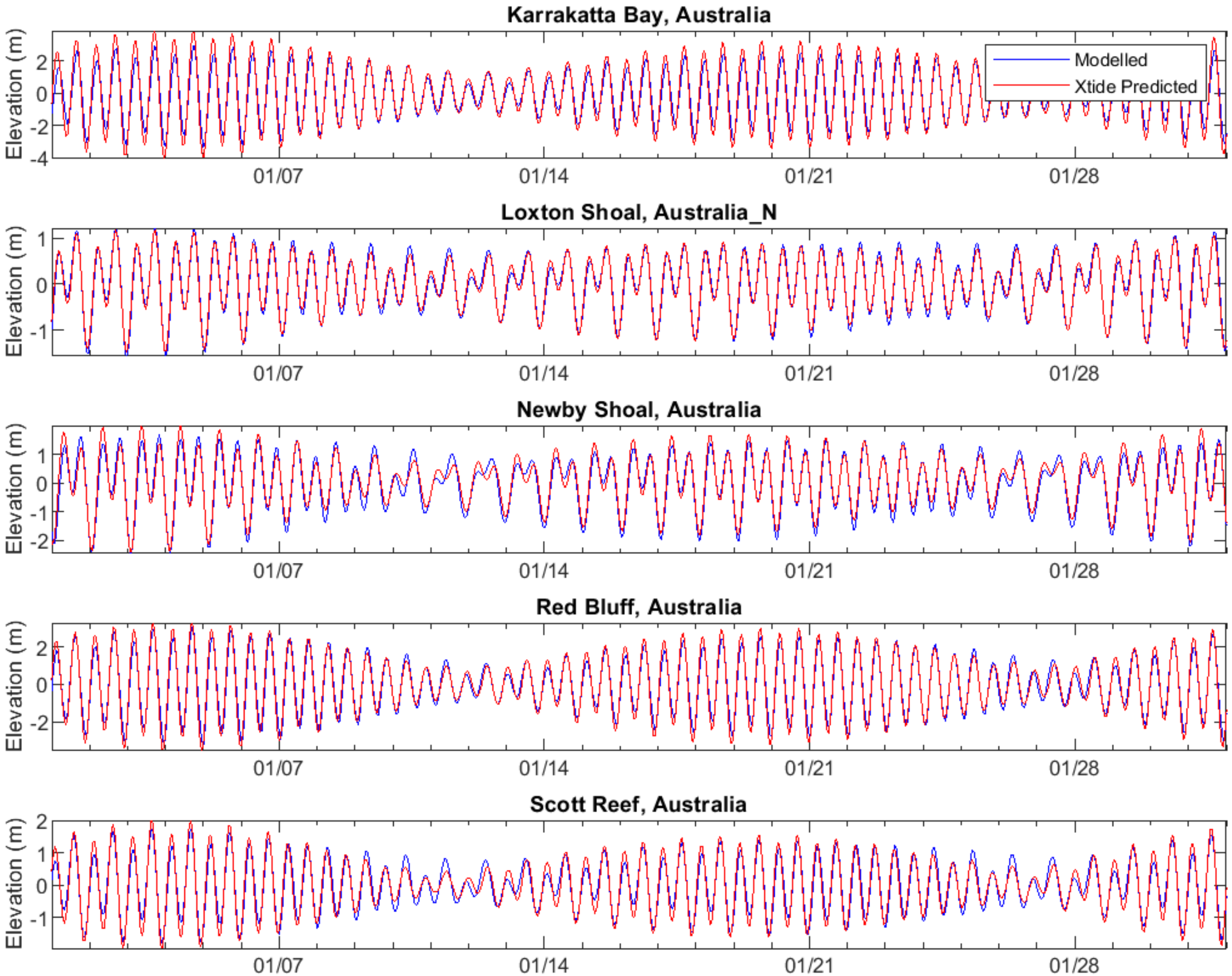

Figure 2.7 Comparisons between the predicted (blue line) and observed (red line) surface elevation variations at five locations in the north-east of the tidal model domain for January 2018.

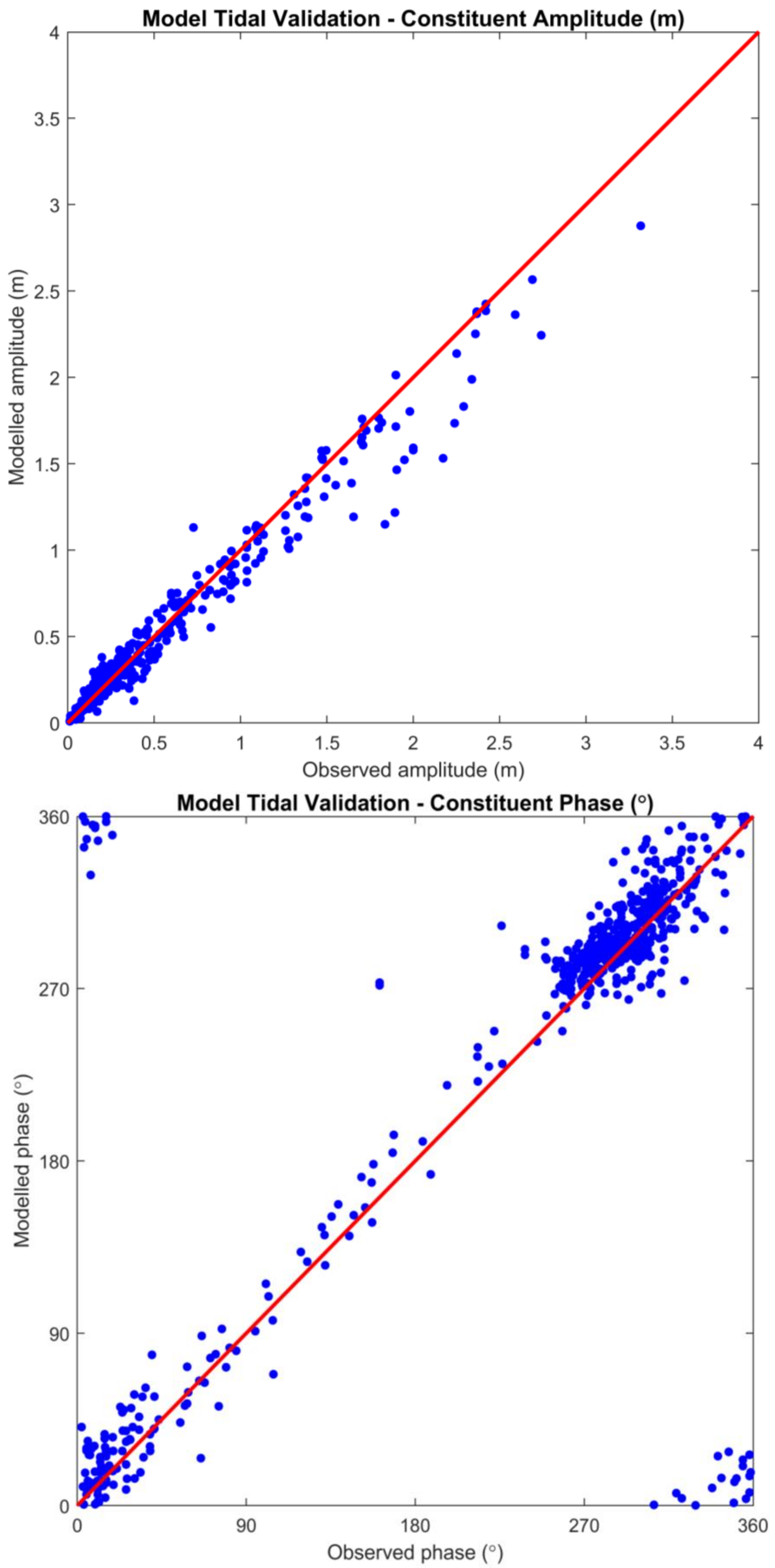

Figure 2.8 Comparisons between modelled and observed tidal constituent amplitudes (top) and phases (bottom) at all relevant stations (>80) in the HYDROMAP model domain. The red line indicates a 1:1 correlation between the modelled and observed data.

2.3.1.3.5 Tidal currents at the release location

Figure 2.9 show the monthly distributions of current speeds and directions for the HYDROMAP data point closest to the spill location. Note that the convention for defining current direction is the direction *towards* which the current flows.

The data indicates cyclical tidal flow directions along a northwest-southeast axis near the release location, with maximum average speeds of approximately 0.16 m/s and peak speeds of around 0.43 m/s.

The extracted current data near the spill location provides an insight into the expected initial behaviour of any released oil due to the tidal currents alone. Oil moving beyond the release sites, particularly towards the coast, would be subject to considerable variation in the tidal current regime.

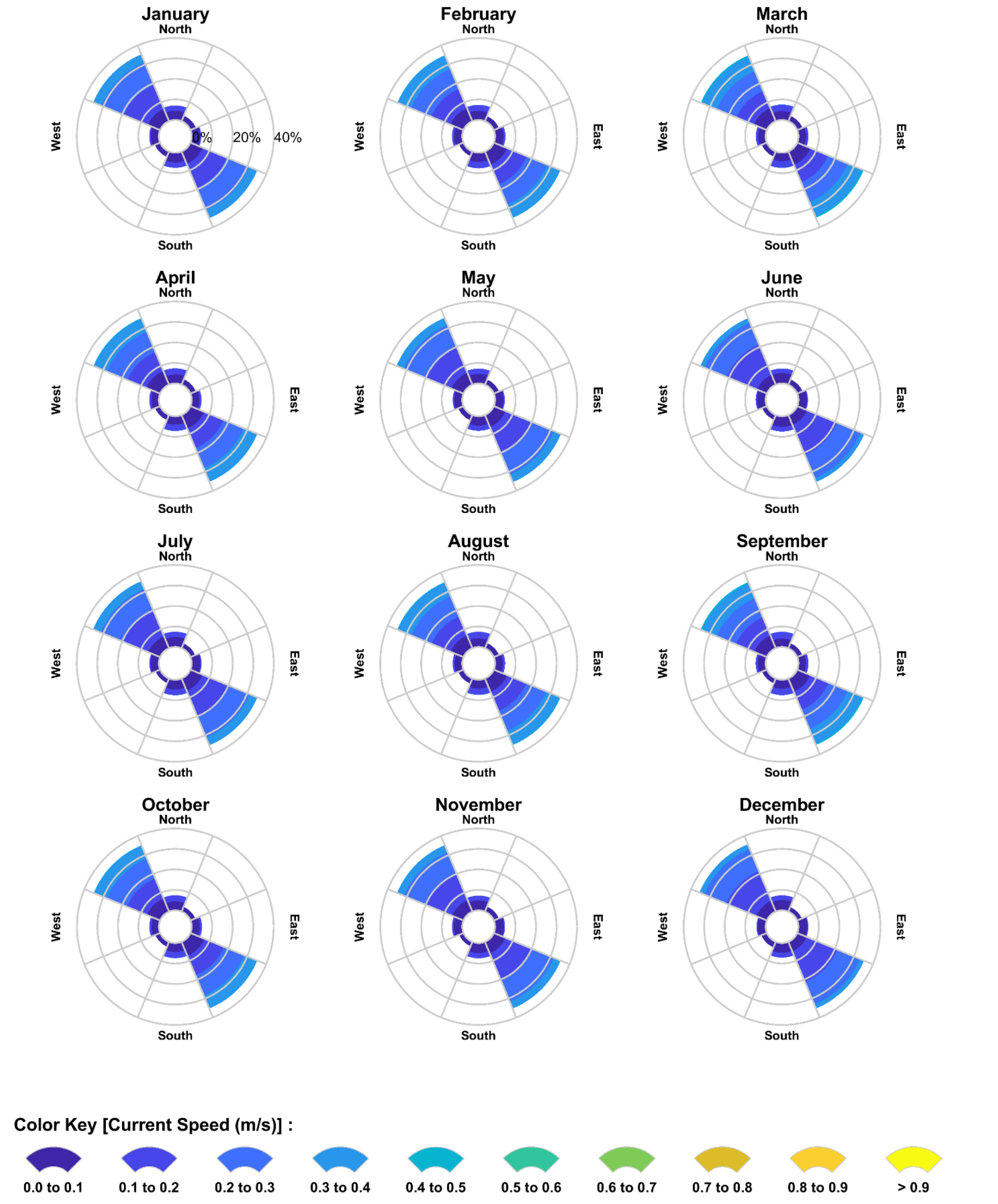

Figure 2.9 Monthly tidal current distributions (2006-2015, inclusive) derived from the HYDROMAP database near to the spill location. The colour key shows the current magnitude, the compass direction provides the direction towards which the current is flowing, and the size of the wedge gives the percentage of the record.

2.3.2 Wind Data

To account for the influence of the wind on surface-bound hydrocarbons, representation of the wind conditions was provided by spatial wind fields sourced from the National Center for Environmental Prediction (NCEP), National Oceanic and Atmospheric Administration (NOAA) Cooperative Institute for Research in Environmental Sciences (CIRES) Climate Diagnostics Center in Boulder, Colorado, United States of America (USA). The NCEP Climate Forecast System Reanalysis (CFSR; Saha *et al.*, 2010) is a fully-coupled, data-assimilative hindcast model representing the interaction between the Earth's oceans, land and atmosphere. The gridded data output, including surface winds, is available at 0.25° resolution and 1-hourly time intervals.

Time series of wind speed and direction were extracted from the CFSR database for all nodes in the model domain for the same temporal coverage as the current data (2006 - 2015, inclusive). The data was assumed to be a suitably representative sample of the wind conditions over the study area for future years. Note that the convention for defining wind direction is the direction the wind blows *from* (as opposed to ocean currents where the convention is the direction the current is flowing *towards*).

Figure 2.10 show the monthly distribution of wind speed and direction for the CFSR data point closest to the release location. The wind data indicates higher average wind speeds are characteristic of June and July months (averages between 6.2 m/s and 6.6 m/s). and January (6.1 m/s). Lower average wind speeds near the release location are most common during May and April months (averages between 4.2 m/s and 4.6 m/s). Peak wind speeds across all months are around 33.2 m/s.

The extracted wind data near the release location suggests that, in the absence of any current effects, the wind acting on hydrocarbons on the sea surface will tend to result in initial trajectories that will most frequently be towards the east/northeast during November to March, and towards the west/northwest during May to August months. Note that the actual trajectories of the hydrocarbons on the sea surface will be the net result of a combination of the prevailing wind and current vectors acting at a given time and location. For long duration spills which may span multiple "periods" of the year, the net outcomes may be a blend between the major seasonal outcomes.

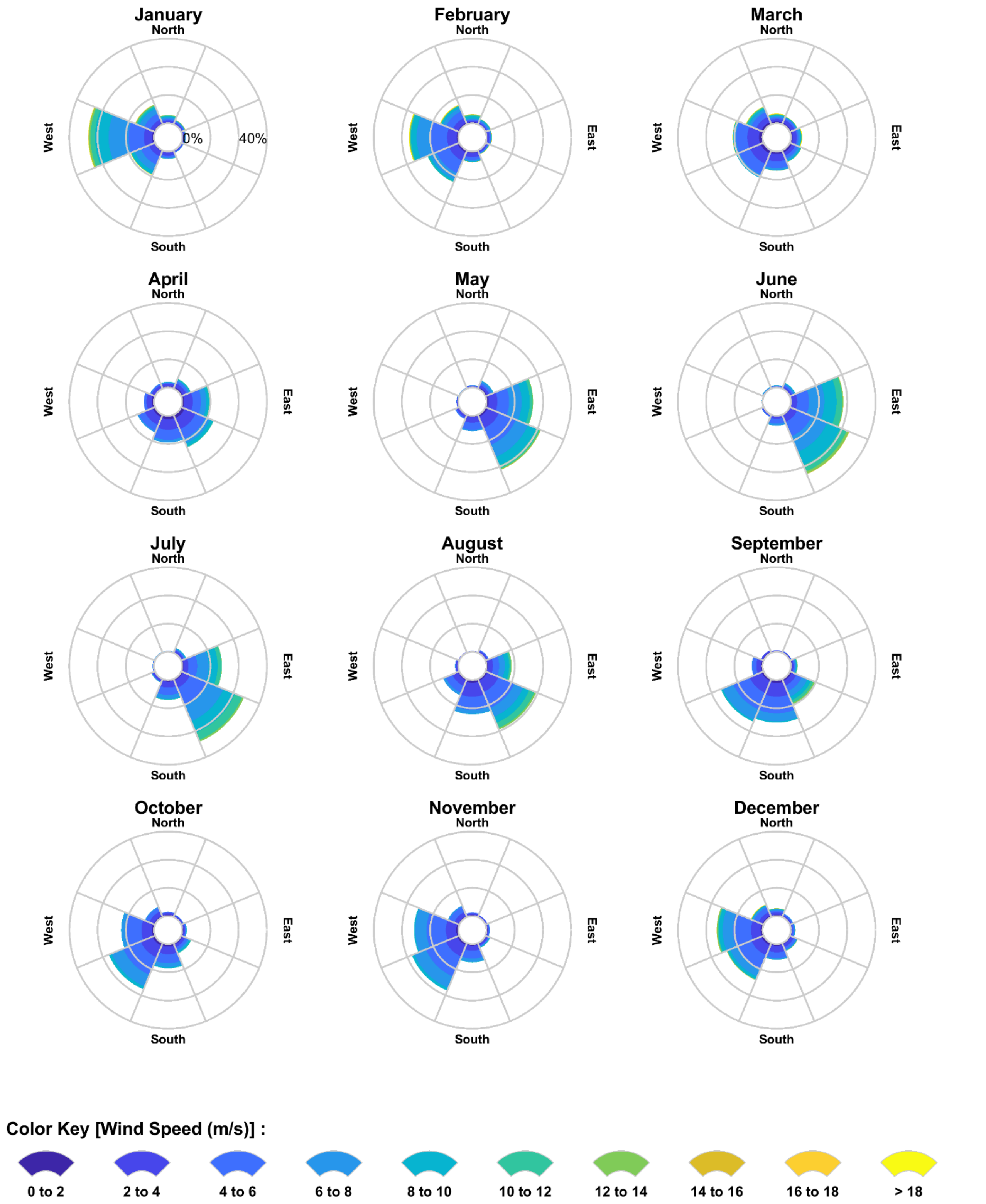

Figure 2.10 Seasonal wind distribution (2006-2015, inclusive) derived from the CFSR database nearest the spill location. The colour key shows the wind magnitude, the compass direction provides the direction from which the wind is blowing, and the size of the wedge gives the percentage of the record.

2.3.3 Water Temperature and Salinity Data

The World Ocean Atlas 2013 (WOA13) is provided by NOAA and is a hindcast model of the climatological fields of in situ temperature, salinity, and several additional variables (NOAA, 2013a). WOA13 has a 0.25° resolution and has standard depth levels ranging from the water surface to 5,500 m (Locarnini *et al.*, 2013; Zweng *et al.*, 2013). Vertical profiles of sea temperature and salinity were retrieved from a data point in the WOA13 database close to the spill location, with monthly averages used as input to SIMAP.

Figure 2.11 shows the variation in water temperature and salinity both monthly and over depth. During the period from April to August, surface mixing is evident over the upper 50-100 m of the water column. In contrast, during the period from November to March, the surface mixing layer is shallower, indicating stronger thermal stratification. The average temperature varies between approximately 10-30 °C across the year, while the average salinity over this depth range varies between approximately 34.2-35 PSU year-round.

2.3.4 Dispersion

A horizontal dispersion coefficient of 10 m^2/s was used to account for dispersive processes acting at the surface that are below the scale of resolution of the input current field, based on typical values for open waters (Okubo, 1971). Dispersion rates within the water column (applicable for entrained and dissolved plumes of hydrocarbons) were specified at 1 m^2/s, based on empirical data for the dispersion of hydrocarbon plumes over the North West Shelf (King & McAllister, 1998).

2.3.5 Replication

Multiple replicate simulations were completed for the defined scenario to account for trends and variations in the trajectory and weathering of spilled oil, with an even number of replicates completed using samples of metocean data that commenced within each month. For Scenario 1, a total of 100 replicate simulations were run over an annual period.

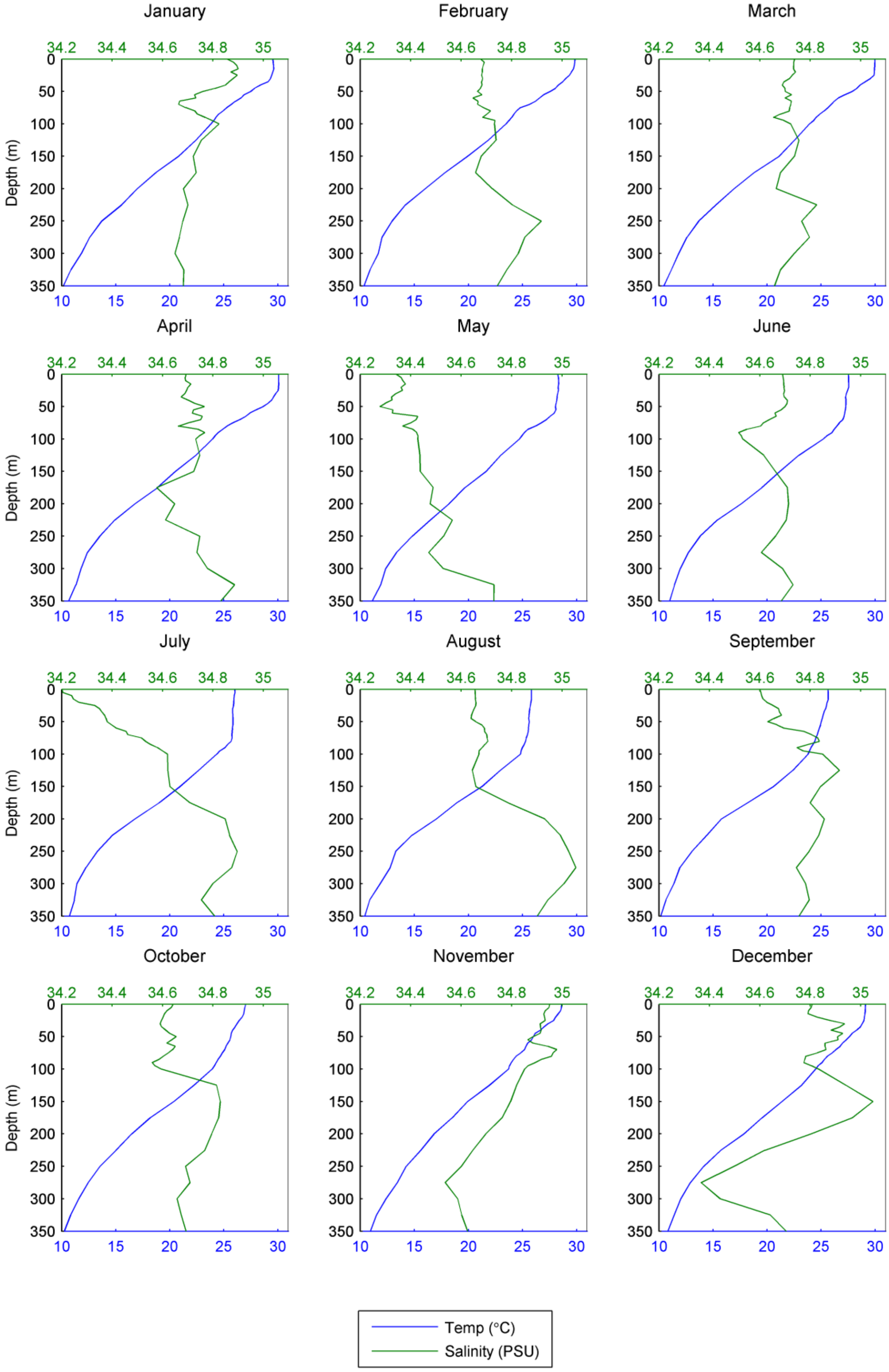

Figure 2.11 Temperature (blue line) and salinity (green line) profiles derived from the WOA13 database, nearest the spill location. Depth of 0 m is the water surface.

2.3.6 Contact Thresholds

2.3.6.1 Overview

The SIMAP model will track oil concentrations to very low levels. Hence, it is useful to define meaningful threshold concentrations for the recording of contact by oil components and determining the probability of exposure at a location (calculated from the number of replicate simulations in which this contact occurred).

The judgement of meaningful levels is complicated and will depend upon the mode of action, sensitivity of the biota contacted, the duration of the contact and the particular toxicity of the compounds that are represented in the oil. The latter factor is further complicated by the change in the composition of an oil type over time due to weathering processes. Without specific testing of the oil types, at different states of weathering against a wide range of the potential local receptors, such considerations are beyond the scope of this investigation.

For this case, thresholds for floating, entrained and dissolved aromatic hydrocarbons were specified by Searcher for use in defining the potential zone of influence of the spill event. These thresholds are summarised in Table 2.1 and discussed afterwards.

Table 2.1 Summary of the thresholds applied in this study.

Floating Oil Concentration (g/m^2)	Shoreline Oil Concentration (g/m^2)	Entrained Oil Concentration (ppb)	Dissolved Aromatic Hydrocarbon Concentration (ppb)
1 10 50 100	10 100 250 1,000	10 100 500	10 50 400 500

2.3.6.2 Floating Oil

Floating oil concentrations are relevant to describing the risks of oil coating emergent reefs, vegetation in the littoral zone and shoreline habitats, as well as the risk to wildlife found on the water surface, such as marine mammals, reptiles and birds. Floating oil is also visible at relatively low concentrations (> ~0.05 g/m^2). Hence, the area affected by visible oil, which might trigger social or economic impacts, will be larger than the area where biological impacts might be expected.

The 1 g/m^2 threshold represents the practical limit of observing hydrocarbon sheens in the marine environment, this threshold is likely to be below levels which would cause significant environmental harm but indicative of the areas perceived to be affected due to visibility of oil sheens on the sea-surface.

Estimates for the minimal thickness of floating oil that might result in harm to seabirds through ingestion from preening of contaminated feathers, or the loss of the thermal protection of their feathers, has been estimated by different researchers at approximately 10 g/m^2 (French-McCay, 2009) to 25 g/m^2 (Koops *et al.*, 2004). Hence, the 10 g/m^2 threshold is likely to be moderately conservative in terms of environmental harm for effects on seabirds, for example. The 50 g/m^2 and 100 g/m^2 threshold are above the minimum threshold observed to cause ecological impact therefore would be considered higher exposure thresholds.

It is important to note that real spill events generate surface slicks that break up into multiple patches separated by areas of open water. Concentrations calculated and presented in this study represent necessary areal averaging of floating oil concentrations over discrete model cells.

2.3.6.3 Shoreline Oil

Shoreline oil concentrations are relevant to describing the risks of oil contacting or stranding on shorelines and beaches. Analysis for this component was carried out in two ways. Firstly, by calculating if contact might occur at concentrations equal to or exceeding defined thresholds, at any one point in time (i.e. instantaneous contact). Secondly, through calculation of accumulation on shorelines over time, which might occur through a sequence of contacts at lower concentrations.

French *et al.* (1996) and French-McCay (2009) defined an oil exposure threshold of 100 g/m^2 for potential impact on shorebirds and wildlife (furbearing aquatic mammals and marine reptiles) on or along the shore, based on studies for sub-lethal and lethal impacts. The 100 g/m^2 threshold has also been used in previous environmental risk assessment studies (French-McCay *et al.*, 2004, 2011, 2012; French-McCay, 2003; NOAA, 2013b). This threshold is also recommended in the Australian Maritime Safety Authority's foreshore assessment guide as the acceptable minimum thickness that does not inhibit the potential for recovery and is best remediated by natural coastal processes alone (AMSA, 2015).

A threshold of 10 g/m^2 has been defined by NOPSEMA as the zone of potential 'low' exposure. This exposure zone represents the area visibly contacted by the spill and defines the outer boundary of the area of influence from a hydrocarbon spill. Thresholds of 250 g/m^2 and 1,000 g/m^2 will define the zones of potential 'high' exposure on shorelines, respectively. Accumulation of concentrations of these orders would be more likely to result in impacts to the marine environment.

2.3.6.4 Entrained Oil

Calculations for this component consider the distributions of oil that occurs as droplets suspended in the water column due to physical mixing. Oil droplets can be entrained into the water column from surface slicks due to wind and wave-induced turbulence or may be generated subsea by a pressurised discharge at depth.

The chemical components within these droplets will vary depending on the oil type (the initial mixture) and the state of weathering. Oil droplets that entrain before evaporation of the more soluble components has occurred through weathering may contain soluble compounds and hence there is the potential for soluble hydrocarbons to dissolve from the oil droplets into the water column. However, we provide specific calculations for the distributions of these soluble components (see section 2.3.6.5) as a more direct indication for the potential for impacts through this mechanism.

Some physical and chemical effects have been attributed to direct contact by entrained oil droplets with organisms; for example, through physical coating of gills and body surfaces, or through accidental ingestion (NRC, 2005). However, clear definitions of impact thresholds have not been well defined for direct contact by entrained oil.

The lowest threshold applied (10 ppb) corresponds approximately with the lowest trigger levels for chronic exposure for entrained hydrocarbons in the Australian and New Zealand Environment and Conservation Council (ANZECC) and Agricultural and Resource Management Council of Australia and New Zealand (ARMCANZ) (ANZECC & ARMCANZ, 2000) water quality guidelines.

The higher thresholds (100 ppb and 500 ppb) are 10 and 50 times higher, respectively and are more likely to result in some form of impact.

2.3.6.5 Dissolved Aromatic Hydrocarbons

The mode of action of soluble hydrocarbons is a narcotic effect resulting from uptake into the tissues of organisms. This effect is additive, increasing with exposure concentration or with time of exposure (French, 2000; NRC, 2005) For many oil mixtures, the concentration of aromatic hydrocarbons, and specifically the polynuclear aromatic hydrocarbons (PAHs), in the water-soluble fraction is the best predictor of the toxicity of the oil.

French-McCay (2002) reviewed toxicity data published for a wide range of oil types and identified that the incipient LC50 concentration (concentration lethal to 50% of a test population given exposure times of 24 to 96 hrs) calculated for exposure to soluble aromatic hydrocarbons generated from the more toxic oil blends ranged from 6 ppb for the more sensitive species (2.5th-percentile species) to 410 ppb for insensitive species (97.5th-percentile species). Pace *et al.* (1995) and French-McCay (2002) demonstrated that the concentration of soluble aromatic hydrocarbons required for lethal effect on marine species increased exponentially for shorter durations. The lowest threshold adopted in this study, applied to any instantaneous occurrence, is of the same order of magnitude as the incipient concentration calculated by French-McCay (2002) for the more sensitive species, given longer term (24-96 hrs) exposure, indicating that the threshold will be conservative for lethal effect, but could be indicative of the potential for sublethal effects on sensitive species.

The higher thresholds (50, 400, 500 ppb), also applied to any instantaneous occurrence, would be indicative of increasing potential for environmental effect on more tolerant species.

2.3.7 Oil Characteristics

Characteristics of marine gas oil are summarised in Table 2.2.

Table 2.2 Characteristics of the oil type used in the modelling of Scenario 1.

Oil Type	Density (g/cm^3)	Viscosity (cP)	Component	Volatile (%)	Semi-Volatile (%)	Low Volatility (%)	Residual (%)	Aromatics (%)
			Boiling point (°C)	<180 C4 to C10	180-265 C11 to C15	265-380 C16 to C20	>380 >C20	Of whole oil <380 BP
Marine gas oil	0.829 at 25 °C	4.00 at 25 °C	% of total	6.0	34.6	54.4	5.0	3.0
			% aromatics	1.8	1.0	0.2	-	-

The boiling points are dictated by the length of the carbon chains, with the longer and more complex compounds having a higher boiling point, and therefore lower volatility and evaporation rate.

The aromatic components within the volatile to low-volatility range are also soluble (with decreasing solubility following decreasing volatility) and will dissolve across the oil-water interface. The rate of dissolution will increase with increase in surface area. Hence, dissolution rates will be higher under discharge conditions that generate smaller oil droplets.

Atmospheric weathering will commence if and when oil droplets float to the water surface. Typical evaporation times once the hydrocarbons reach the surface and are exposed to the atmosphere are:

- Up to 12 hours for the C4 to C10 compounds (or less than 180 °C BP);
- Up to 24 hours for the C11 to C15 compounds (180-265 °C BP);
- Several days to a few weeks for the C16 to C20 compounds (265-380 °C BP); and
- Not applicable for the residual compounds (BP > 380 °C), which will resist evaporation, persist in the marine environment for longer periods, and be subject to relatively slow degradation.

The fate of oil in the marine environment will depend greatly on the proportion of oil that reaches the surface after rising through the water column. Oil at surface will be subject to atmospheric weathering and will be transported by prevailing currents and wind. Oil that entrains or dissolves in the water column will be transported by prevailing current and, hence, will follow a different path. Oil in the water column will also be subject to different weathering processes in comparison to floating oil.

Marine gas oil is a mixture of volatile and more persistent hydrocarbons derived from distillation. MGO blends have low proportions of both highly volatile and residual (non-volatile) components. In general, about 6% of the oil mass should evaporate within the first 12 hours (BP < 180 °C). Approximately 35% should evaporate within the first 24 hours (180 °C < BP < 265 °C). A further 54% by mass is composed of compounds with boiling points ranging from 265 °C to 380 °C and these compounds will evaporate at progressively slower rates with increasingly higher boiling points. Individual compounds in this group would evaporate over several days to a few weeks. Approximately 5% of the oil is composed of compounds with boiling points exceeding 380 C, and these will not evaporate. Consequently, if the oil is constantly exposed to atmospheric weathering, the mixture will change over time, becoming progressively denser and more resistant to evaporation until only the residual remains. Degradation will also occur through biological and photochemical processes, but at a relatively slow rate compared to the initial evaporation rate.

The fate of a spill of MGO onto the water surface will vary markedly with the sea conditions. If released onto the water surface under calm sea conditions and the fuel remains floating at the surface exposed to the atmosphere under sea and air temperatures that occur at the Possum survey area, approximately 41% by mass of this oil should evaporate over the first couple of days depending upon the prevailing conditions, with the further evaporation slowing over time. However, marine gas oil has relatively low viscosity (4.00 cP at 25 °C) and would tend to entrain into the upper water column as oil droplets due to the shear forces generated by wind-generated waves. Entrainment of a proportion of the oil would result in slower evaporation of the mixture. Entrained oil droplets could therefore travel as sub-sea plumes for longer, and over greater distances, than surface slicks. The oil droplets will be present in suspension (not dissolved) and could subsequently resurface if wind-waves abate.

The proportion of soluble aromatic hydrocarbons within the fresh oil is approximately 3% and this component will be subject to both evaporation and dissolution. These are competing processes with higher evaporation from the surface of oil films, especially of the more volatile aromatics (e.g. the BTEX compounds) and higher rates of dissolution from entrained oil droplets.

2.3.8 Weathering Characteristics

A series of model weather tests were conducted to illustrate the potential behaviour of marine gas oil when exposed to idealised and representative environmental conditions:

- Instantaneous release onto the water surface at a discharge rate of 50 m^3/hr under calm wind conditions (constant 5 knots), assuming low seasonal water temperature (27 °C) and average air temperature (25 °C). Slick also subject to ambient tidal and drift currents.

- Instantaneous release onto the water surface at a discharge rate of 50 m^3/hr under variable wind conditions (4-19 knots, drawn from representative data files), assuming low seasonal water temperature (27 °C) and average air temperature (25 °C). Slick also subject to ambient tidal and drift currents.

The first case is indicative of cumulative weathering rates under calm conditions that would not generate entrainment, while the second case may represent conditions that could cause a minor degree of entrainment. Both scenarios provide examples of potential behaviour during periods of a spill event, once the oil reaches the surface.

2.3.8.1 Marine Gas Oil

Change in the mass balance calculated for marine gas oil weathering under low (5 knots) and constant wind (Figure 2.12) indicates that approximately 41% of the oil volume would evaporate within 12 hours, with most of this component evaporating within several hours. The remaining oil would weather at increasingly slower rate as the mixture becomes proportionally enriched by compounds with longer carbons chains, hence higher boiling points. Once all volatile compounds have evaporated, only the residual compounds will remain and weathering rates would slow significantly, with further reduction reliant upon slower biological and photochemical processes.

Under the variable-wind case (Figure 2.13), where the winds are of greater strength in general, significant entrainment of marine gas oil into the water column is indicated. Approximately 24 hours after the spill, around 72% of the oil mass is forecast to have entrained and only 24% is forecast to have evaporated. Only a small proportion of the oil (<1%). is forecasted to be floating on the water surface after the first few hours.

Higher rates of entrainment of oil into the water column is forecasted to increase the proportion that undergoes decay. For the higher, variable, wind case, degradation was calculated at the approximate rate of 2.4% per day with an accumulated total of ~16% after 7 days, in comparison to a rate of ~0.2% per day and an accumulated total of 1.3% after 7 days in the low-wind case. This indicates that the remaining hydrocarbons would decay over time scales of several weeks. Dispersion of oil droplets will be a further significant process that reduces concentrations of entrained marine gas oil.

Based on the weathering calculations, simulations were set to calculate the distributions of oil for 28 days.

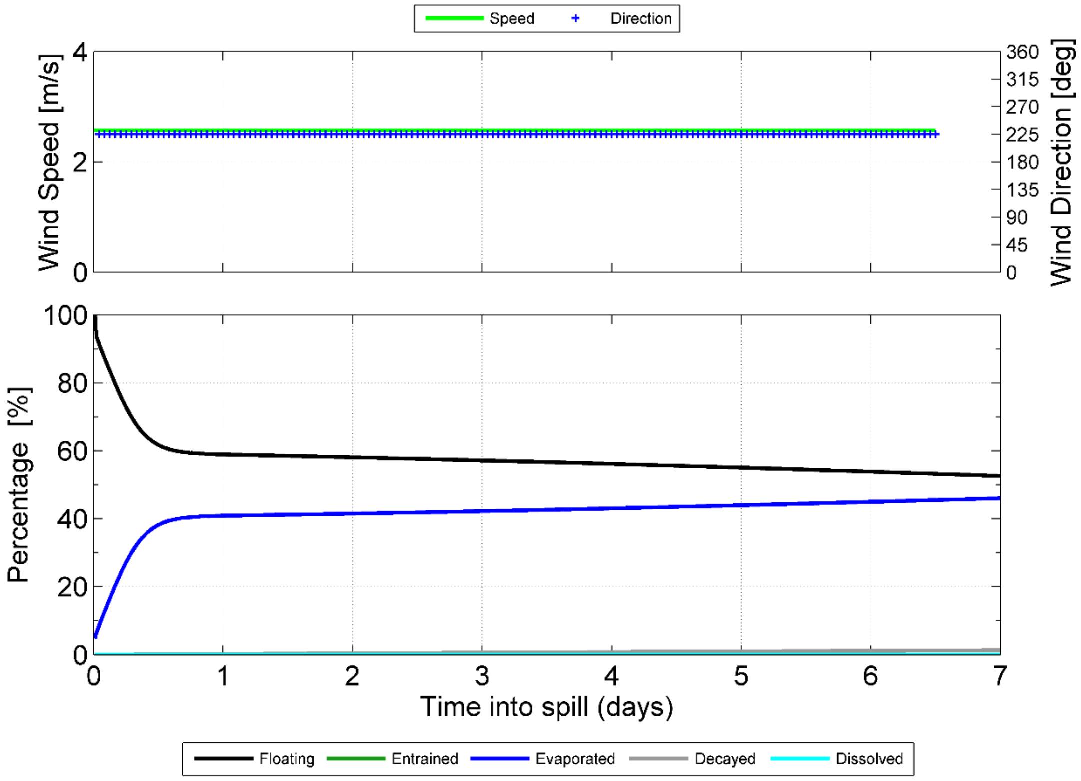

Figure 2.12 Proportional mass balance plot representing the weathering of marine gas oil spilled onto the water surface as a one-off instantaneous release and subject to a constant 5 kn (2.6 m/s) wind at 27 °C water temperature and 25 °C air temperature.

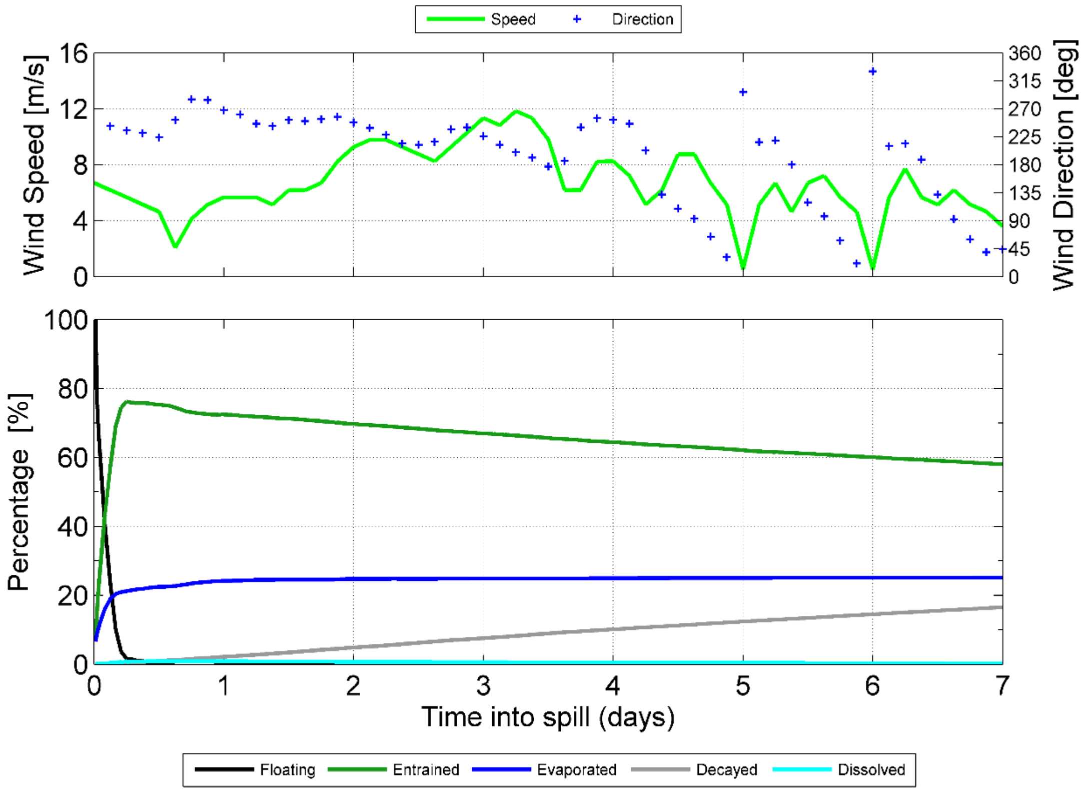

Figure 2.13 Proportional mass balance plot representing the weathering of marine gas oil spilled onto the water surface as a one-off instantaneous release and subject to variable wind at 27 °C water temperature and 25 °C air temperature.

3 STOCHASTIC ASSESSMENT RESULTS

3.1 Overview

Predictions for the probability of contact and time to contact by oil concentrations equalling or exceeding defined thresholds for floating oil, entrained oil and dissolved aromatic hydrocarbons are provided in the following sections to summarise the results of the annualised stochastic modelling.

Contour maps present estimates for the annualised probability of contact by instantaneous concentrations of at least the defined minimum threshold concentrations (1 g/m^2, 10 g/m^2, 50 g/m^2 and 100 g/m^2 for floating oil; 10 g/m^2, 100 g/m^2, 250 g/m^2 and 1,000 g/m^2 for shoreline oil; 10 ppb, 100 ppb and 500 ppb for entrained oil and 10 ppb, 50 ppb, 400 ppb and 500 ppb for dissolved aromatic hydrocarbons) for at least one time step. These contours summarise the outcomes for all replicate simulations commencing across the annual period – a total of 100 replicate simulations.

Readers should note that the contour maps presented in this report do not represent the predicted coverage of any one hydrocarbon spill or a depiction of a slick or plume at any particular instant in time. Rather, the contours are a composite of a large number of theoretical slick paths, integrated over the full duration of the simulations relevant to the assessed scenario. The contour maps should be treated as indications of the probability of exposure at defined concentrations, for individual locations, at some point in time after the defined spill commences, given the trends and variations in metocean conditions that occur around the study area.

Locations with higher probability ratings were exposed during a greater number of spill simulations, indicating that the combination of the prevailing wind and current conditions are more likely to result in contact to these locations if the spill scenario were to occur in the future. The areas outside of the lowest-percentage contour indicate that contact will be less likely under the range of prevailing conditions for this region than areas falling within higher probability contours. It is important to note that the probabilities are derived from the samples of data used in the modelling. Therefore, locations that are not calculated to receive exposure at threshold concentrations or greater in any of the replicate simulations might possibly be contacted if very unusual conditions were to occur. Hence, we do not attribute a probability of nil to areas beyond the lowest probability contour.

Tables are presented to summarise estimates of contact risk for locations within potentially sensitive receptors. The probability estimates for contact by floating oil that are presented in the tables summarise the probability that oil will arrive at shorelines as floating films at the specified threshold concentration or greater for at least one time-step (1 hour).

The minimum time estimates shown in the tables present the shortest time for any oil to drift from the source to any part of the sensitive receptor, relative to the commencement of the spill. These times indicate the shortest time that might be available to intercept floating oil.

The mean and maximum shoreline concentrations indicate the concentrations forecast to potentially accumulate over time on any discrete part of a shoreline (calculated for individual portions of 0.4 km length). Accumulated concentrations are calculated by summing the mass of oil that arrives at any concentration (including < threshold) over time at a model cell and subtracting any mass lost through evaporation and washing off, where relevant.

The maximum local accumulated concentration in the worst replicate spill is the greatest accumulation predicted for any point on the shoreline during any replicate simulation, and thus represents an extreme estimate. The maximum local accumulated concentration averaged over all replicate spills is the greatest concentration calculated for any point on the shoreline after averaging over all replicate simulations.

Note that it is possible that oil films arriving at concentrations that are less than the threshold may accumulate over the course of a spill event to result in concentrations that apparently exceed the threshold. Hence, the mean expected, and maximum concentrations of accumulated oil can exceed the threshold applied to the probability calculations for the arrival of floating oil even where no instantaneous exceedances above threshold are predicted. It is important to understand that the two parameters (floating concentration and shoreline concentration) are quite distinct, calculated in different ways and representative of alternative outcomes. The floating probability estimates and the shoreline accumulative estimates should therefore be treated as independent estimators of different exposure outcomes, and not directly compared.

For the entrained and dissolved components, the tabulated results summarise interrogations of cells representing the water surrounding the sensitive receptor shorelines (or submerged features), with individual buffer zones as illustrated in Figure 2.1 to Figure 2.3. Buffer zones were defined with consideration of the bathymetry bordering each receptor, natural boundaries, or sensible legislative boundaries.

Modelling assumed no mitigation efforts are undertaken to collect or otherwise affect the natural transport and weathering of the oil.

The predicted outcomes based on the modelling results are discussed in the following sections in terms of floating, entrained and dissolved aromatic hydrocarbons. Discussion is based around the outcomes of stochastic risk contours calculated for each component. Probabilities of contact are indicated at 10% increments from 1% (the lowest probability that can be defined: i.e. 1 out of 100 simulations) to 100% (100 out of 100 simulations). The minimum time to contact is graduated by single days initially, then weeks.

Plots are also provided to define the Environment that May Be Affected (EMBA) for each component. These plots show the 1% probability contours, with spatial smoothing as a conservative treatment.

Vertical cross-section plots are also provided to indicate the depth to which oil may penetrate given the spill scenario and environmental conditions.

3.2 Short-term (instantaneous) surface release of marine gas oil from a vessel collision during marine seismic survey operations near Rowley Shoals

3.2.1 Discussion of Results

3.2.1.1 Overview

This scenario investigated the probability of exposure to surrounding regions by oil resulting from a short-term (instantaneous) release of 321 m^3 of marine gas oil, onto the water surface, after a vessel fuel tank rupture from a vessel collision near the Rowley Shoals. The trajectory and fate of released oil was simulated for 28 days following the commencement of release. The calculations are made for the spill occurring at any time of year, with no mitigation measures applied.

3.2.1.2 Floating and Shoreline Oil

Probability contours generated from stochastic modelling (100 replicate spills) indicate that floating oil concentrations ≥ 1 g/m^2 could potentially occur up to 148 km, from the spill site. The potential effect distance was calculated to decrease for higher concentration thresholds, reducing to 84 km for ≥ 10 g/m^2, 32 km for ≥ 50 g/m^2 and 19 km for ≥ 100 g/m^2 (Figure 3.1 to Figure 3.4).

Highest probabilities of floating oil contact at ≥ 10 g/m^2 were calculated for Mermaid Reef Marine Park (MP; 5%) and Mermaid Reef and Commonwealth waters surrounding Rowley Shoals Key Ecological Feature (KEF; 13%). Note that both features have no emergent land, hence this is the probability that such oil concentrations would contact the water surface over those receptor areas. Floating oil at the 10 g/m^2 threshold is predicted to arrive at these receptors within 1 hour after a spill commencement (Table 3.1).

Floating oil concentrations at ≥ 10 g/m^2 might pass over several other submerged receptors (Table 3.1). Highest probabilities were forecast for North-West Slope Trawl Fishery, Southern Bluefin Tuna Fishery, Western Skipjack Fishery, Western Tuna and Billfish Fishery, Seabirds Biologically Important Area (BIA) and Whales BIA at 100%.

The forecast annualised minimum times to contact, Zone of Consequence (ZoC) and Smoothed Environment that May Be Affected (EMBA) for floating oil at or above the 1 g/m^2, 10 g/m^2, 50 g/m^2 and 100 g/m^2 threshold concentrations are depicted in Figure 3.5 to Figure 3.16.

3.2.1.3 Oil on Shorelines

A low probability of contact (< 1%) with any shoreline is indicated for floating oil at ≥ 1 g/m^2. However, the potential for accumulation of oil that arrives at lower concentrations indicated on some shorelines. The worst-case is indicated for emergent land within the Mermaid Reef and Commonwealth waters surrounding Rowley Shoals KEF and the Seabirds BIA (Table 3.1).

3.2.1.4 Entrained Oil

Entrained oil at concentrations equal to or greater than the 10 ppb, 100 ppb and 500 ppb thresholds are predicted to be found up to around 441 km, 280 km and 120 km from the spill site, respectively (Figure 3.18 to Figure 3.20).

The probability of contact by entrained oil concentrations at or greater than 100 ppb is predicted to be greatest at North-West Slope Trawl Fishery, Southern Bluefin Tuna Fishery, Western Skipjack Fishery, Western Tuna and Billfish Fishery, Seabirds and Whales BIAs with a probability of 49% (Table 3.2).

The worst-case instantaneous entrained oil concentration at any receptor is predicted at North-West Slope Trawl Fishery, Southern Bluefin Tuna Fishery, Western Skipjack Fishery, Western Tuna and Billfish Fishery, Seabirds and Whales BIAs as 58,739 ppb (Table 3.2). Mermaid Reef Marine Park (MP) is predicted to have a worst-case entrained oil concentration of 4,922 ppb.

The forecast annualised minimum times to contact, ZoC and smoothed EMBA for entrained oil at or above the 10 ppb, 100 ppb and 500 ppb threshold concentrations are depicted in Figure 3.21 to Figure 3.29.

Cross-sectional transects of maximum entrained oil concentrations in the vicinity of the release site indicate that entrained oil concentrations at or greater than 100 ppb are not likely to occur at depths greater than ~20 m BMSL (Figure 3.30 and Figure 3.31).

Note that the distributions depicted in the cross-sections show the highest concentration ever calculated, in any of the replicate simulations, for each location and depth combination. The results are not derived from a single worst-case but from 100 simulations and should not be interpreted as the outcome of a single release.

3.2.1.5 Dissolved Aromatic Hydrocarbons

Dissolved aromatic hydrocarbons at concentrations at ≥ 10 ppb are calculated to occur up to 215 km from the spill site. The potential contact zone is calculated to decrease exponentially as the threshold concentration is raised (122 km at 50 ppb, 11 km at 400 ppb and 1 km at 500 ppb; Figure 3.32 to Figure 3.35).

Highest probability of contact by dissolved aromatic hydrocarbon concentrations at ≥ 50 ppb is calculated for North-West Slope Trawl Fishery, Southern Bluefin Tuna Fishery, Western Skipjack Fishery, Western Tuna and Billfish Fishery, Seabirds and Whales BIAs, each with a probability of 22% (Table 3.3).

The worst-case dissolved aromatic hydrocarbon concentration at any receptor (671 ppb) is calculated for North-West Slope Trawl Fishery, Southern Bluefin Tuna Fishery, Western Skipjack Fishery, Western Tuna and Billfish Fishery, Seabirds and Whales BIAs (Table 3.3). Mermaid Reef MP is predicted to have a worst-case dissolved aromatic hydrocarbon concentration of 258 ppb.

The forecast annualised minimum times to contact, ZoC and smoothed EMBA for dissolved aromatic hydrocarbons at or above the 500 ppb threshold concentration are depicted in Figure 3.36 to Figure 3.47.

Cross-sectional transects of maximum dissolved aromatic hydrocarbon concentrations in the vicinity of the release site indicate that dissolved aromatic hydrocarbon concentrations greater than 50 ppb should not reach depths greater than ~40 m BMSL (Figure 3.48 and Figure 3.49).

As for the entrained oil, these plots show the highest concentration calculated in any replicate simulation for each location and depth and do not illustrate outcomes of any single release simulation.

3.2.2 Results – Tables and Figures

3.2.2.1 Floating and Shoreline Oil

Table 3.1 Expected annualised floating and shoreline oil outcomes at sensitive receptors resulting from a short-term (instantaneous) surface release of marine gas oil during marine seismic survey operations near Rowley Shoals.

Receptors		Probability (%) of films arriving at receptors at ≥				Minimum time to receptor (hours) for films at ≥				Probability (%) of shoreline oil on receptors at ≥				Minimum time to receptor (hours) for shoreline oil at ≥				Maximum local accumulated concentration (g/m^2)		Maximum accumulated volume (m^3) along this shoreline		Maximum length of shoreline (km) with concentrations exceeding 10 g/m^2		Maximum length of shoreline (km) with concentrations exceeding 100 g/m^2		Maximum length of shoreline (km) with concentrations exceeding 250 g/m^2		Maximum length of shoreline (km) with concentrations exceeding 1,000 g/m^2	
		1 g/m^2	10 g/m^2	50 g/m^2	100 g/m^2	1 g/m^2	10 g/m^2	50 g/m^2	100 g/m^2	10 g/m^2	100 g/m^2	250 g/m^2	1,000 g/m^2	10 g/m^2	100 g/m^2	250 g/m^2	1,000 g/m^2	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill
Australian Marine Parks	Argo-Rowley Terrace MP*	3	2	1	<1	19	19	20	NC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Kimberley MP*	<1	<1	<1	<1	NC	NC	NC	NC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Mermaid Reef MP*	12	5	2	1	5	5	5	5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
State Marine Parks	Clerke Reef (Rowley Shoals MP)	<1	<1	<1	<1	NC	NC	NC	NC	1	<1	<1	<1	92	NC	NC	NC	0.3	22	<1	<1	<1	<1	NC	NC	NC	NC	NC	NC
	Imperieuse Reef (Rowley Shoals MP)	<1	<1	<1	<1	NC	NC	NC	NC	<1	<1	<1	<1	NC	NC	NC	NC	<0.1	1.9	<1	<1	NC	NC	NC	NC	NC	NC	NC	NC
Key Ecological Features	Ancient Coastline at 125m Depth Contour KEF*	<1	<1	<1	<1	NC	NC	NC	NC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Continental Slope Demersal Fish Communities KEF*	<1	<1	<1	<1	NC	NC	NC	NC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Mermaid Reef and Commonwealth Waters surrounding Rowley Shoals KEF	20	13	7	4	1	1	1	1	4	1	1	<1	15	15	16	NC	6.6	496	<1	3	<1	<1	<1	<1	<1	<1	NC	NC
	Seringapatam Reef and Commonwealth Waters in the Scott Reef Complex KEF	<1	<1	<1	<1	NC	NC	NC	NC	<1	<1	<1	<1	NC	NC	NC	NC	<0.1	0.3	<1	<1	NC	NC	NC	NC	NC	NC	NC	NC
Fisheries	North-West Slope Trawl Fishery*	100	100	100	100	1	1	1	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Southern Bluefin Tuna Fishery*	100	100	100	100	1	1	1	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Western Skipjack Fishery*	100	100	100	100	1	1	1	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Western Tuna and Billfish Fishery*	100	100	100	100	1	1	1	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Biologically Important Areas	Marine Turtle BIA	<1	<1	<1	<1	NC	NC	NC	NC	<1	<1	<1	<1	NC	NC	NC	NC	<0.1	0.3	<1	<1	NC	NC	NC	NC	NC	NC	NC	NC
	Seabirds BIA	100	100	100	100	1	1	1	1	4	1	1	<1	15	15	16	NC	6.6	496	<1	3	<1	<1	<1	<1	<1	<1	NC	NC
	Sharks BIA*	<1	<1	<1	<1	NC	NC	NC	NC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Whales BIA*	100	100	100	100	1	1	1	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Reefs	Scott Reef South	<1	<1	<1	<1	NC	NC	NC	NC	<1	<1	<1	<1	NC	NC	NC	NC	<0.1	0.3	<1	<1	NC	NC	NC	NC	NC	NC	NC	NC

NC: No contact to receptor predicted for specified threshold. NA: Not applicable.

* Floating oil will not accumulate on submerged features and at open ocean locations.

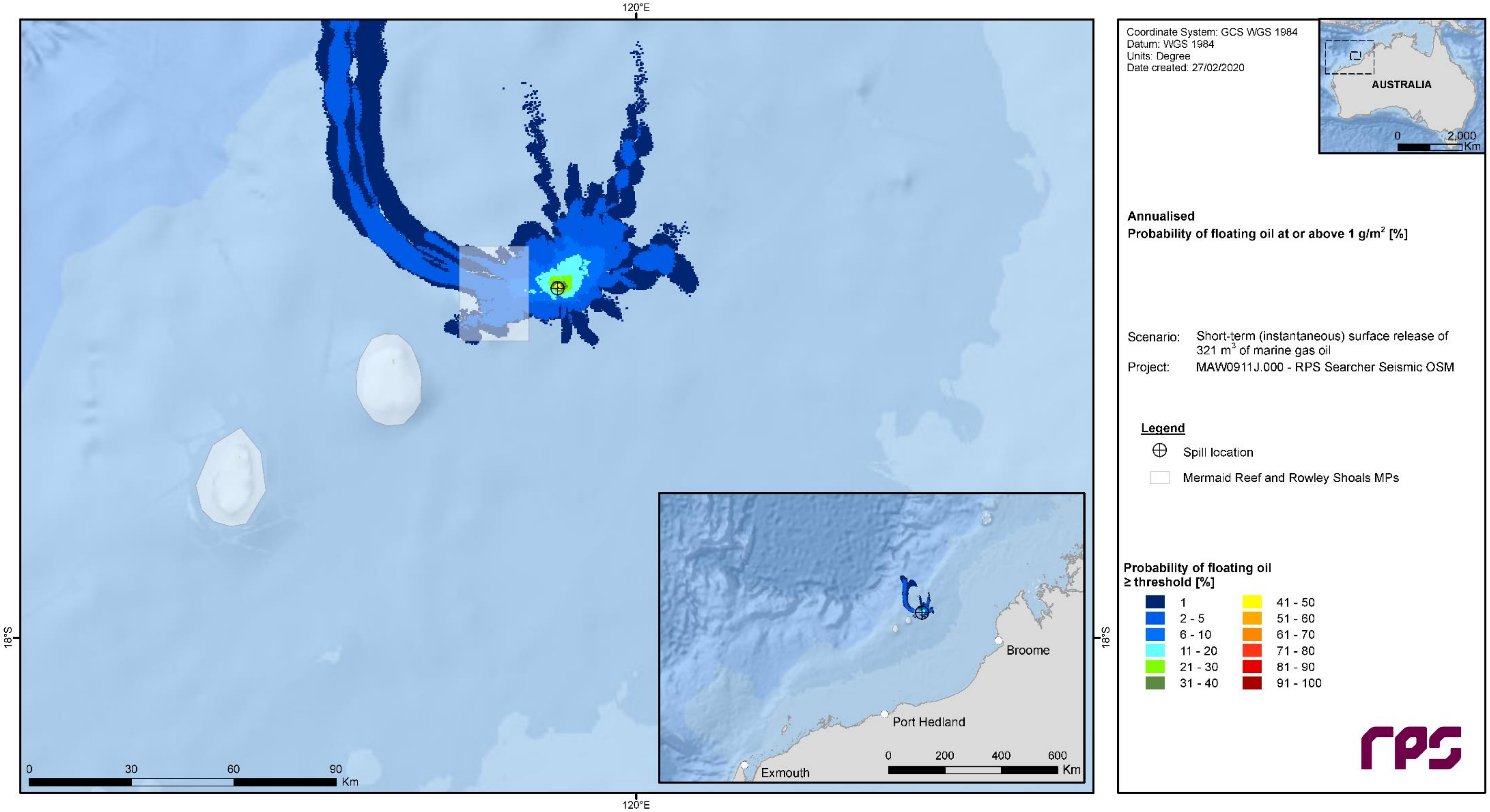

Figure 3.1 Predicted annualised probability of floating oil concentrations at or above 1 g/m^2 resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

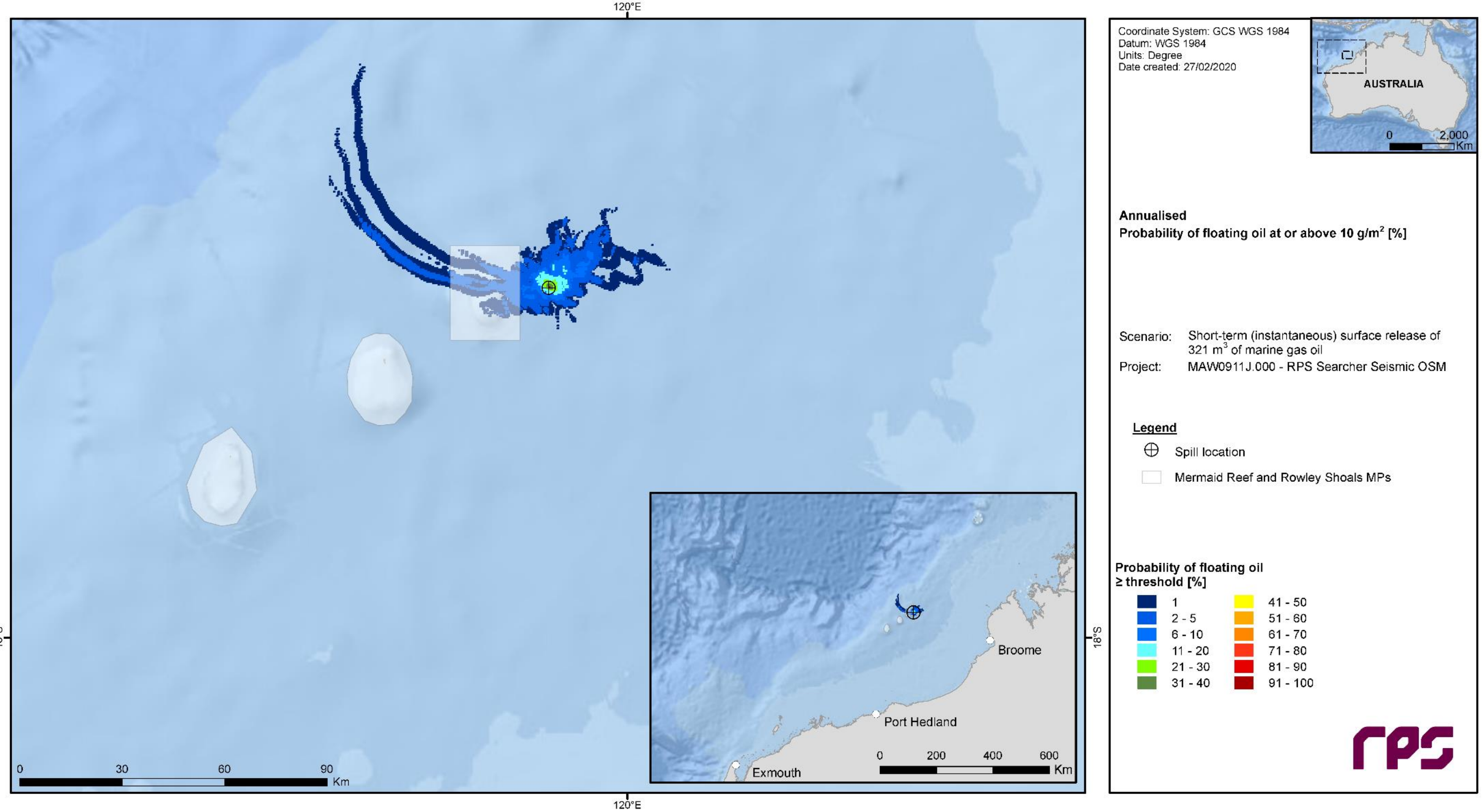

Figure 3.2 Predicted annualised probability of floating oil concentrations at or above 10 g/m² resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

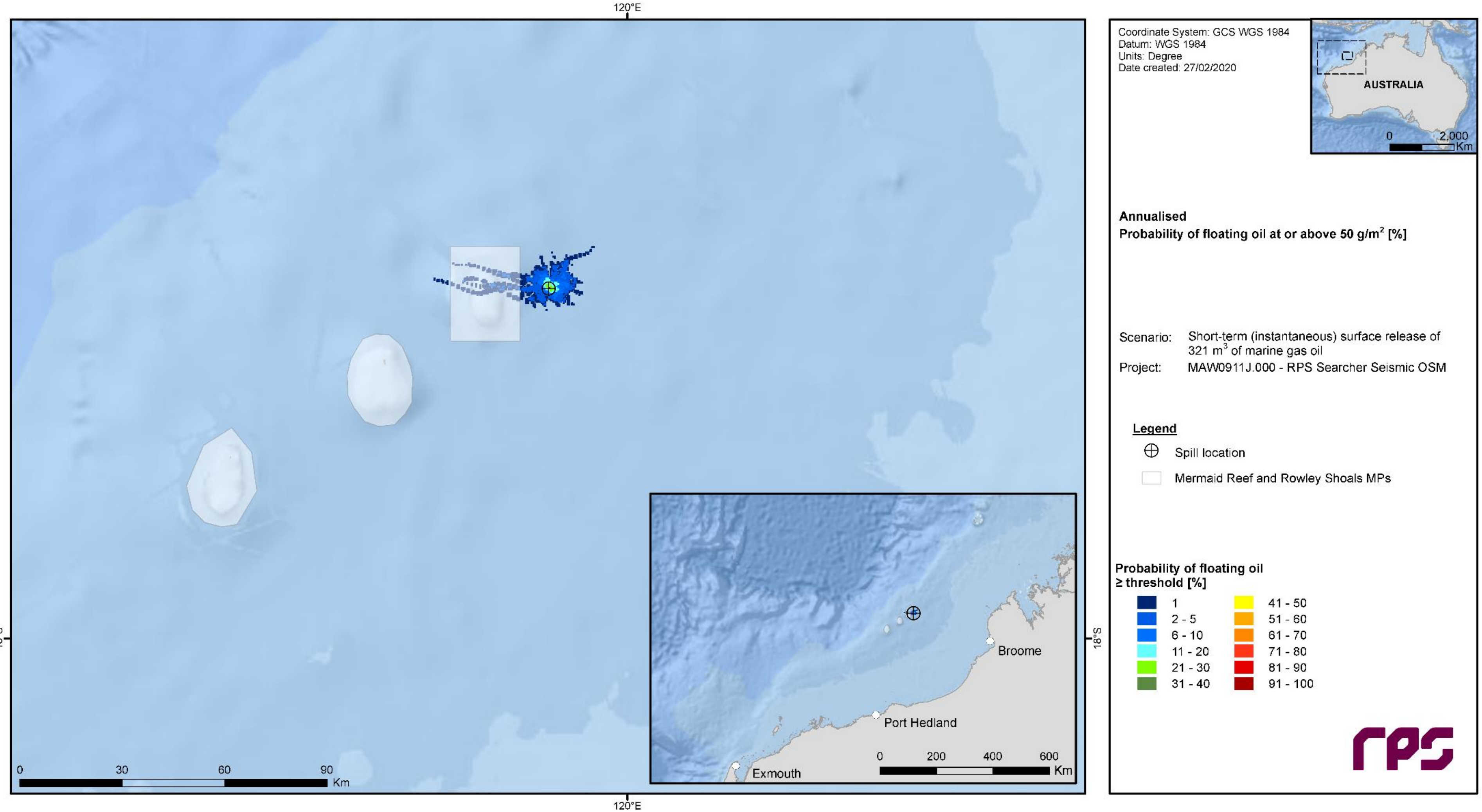

Figure 3.3 Predicted annualised probability of floating oil concentrations at or above 50 g/m² resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

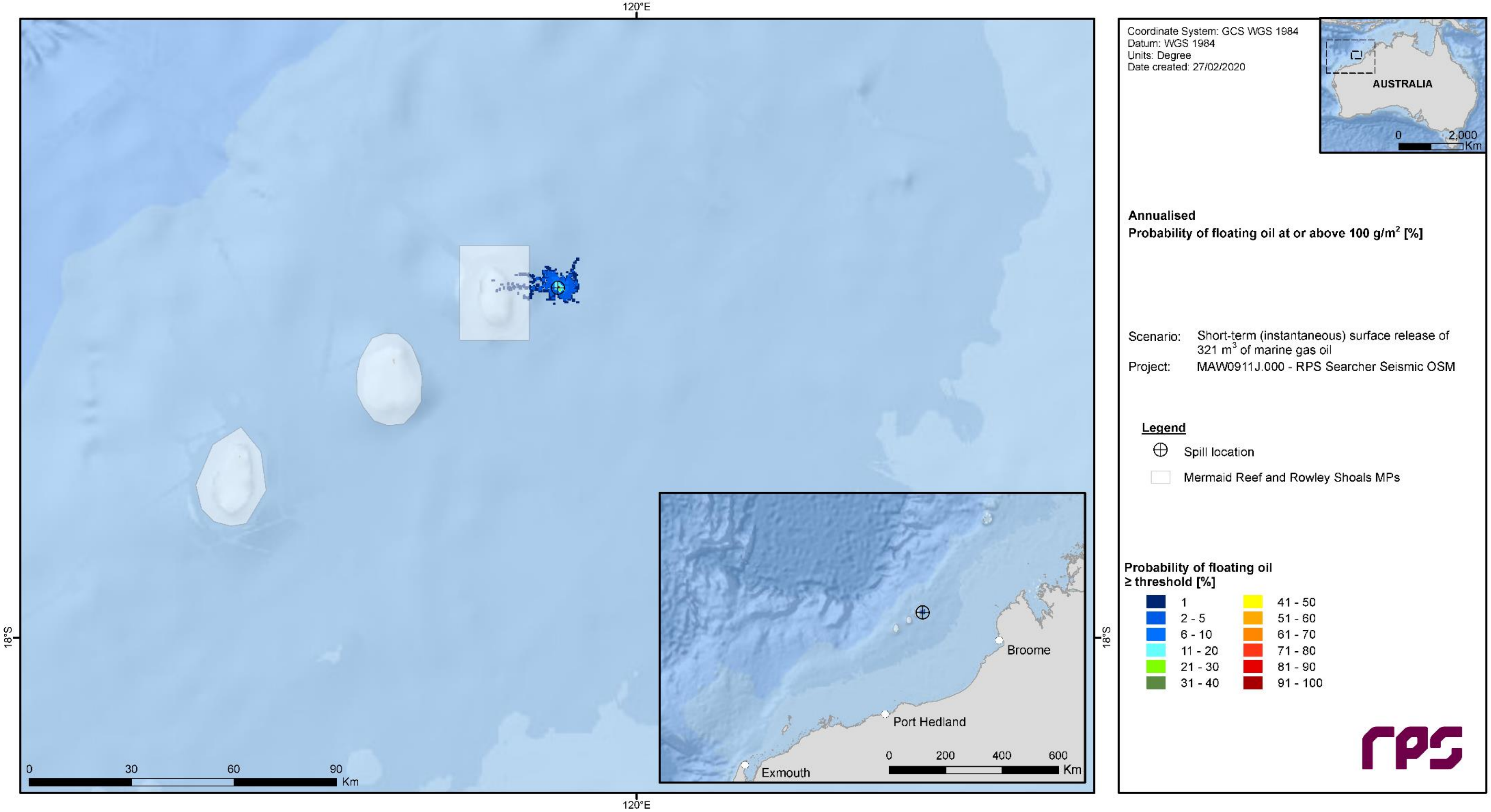

Figure 3.4 Predicted annualised probability of floating oil concentrations at or above 100 g/m² resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

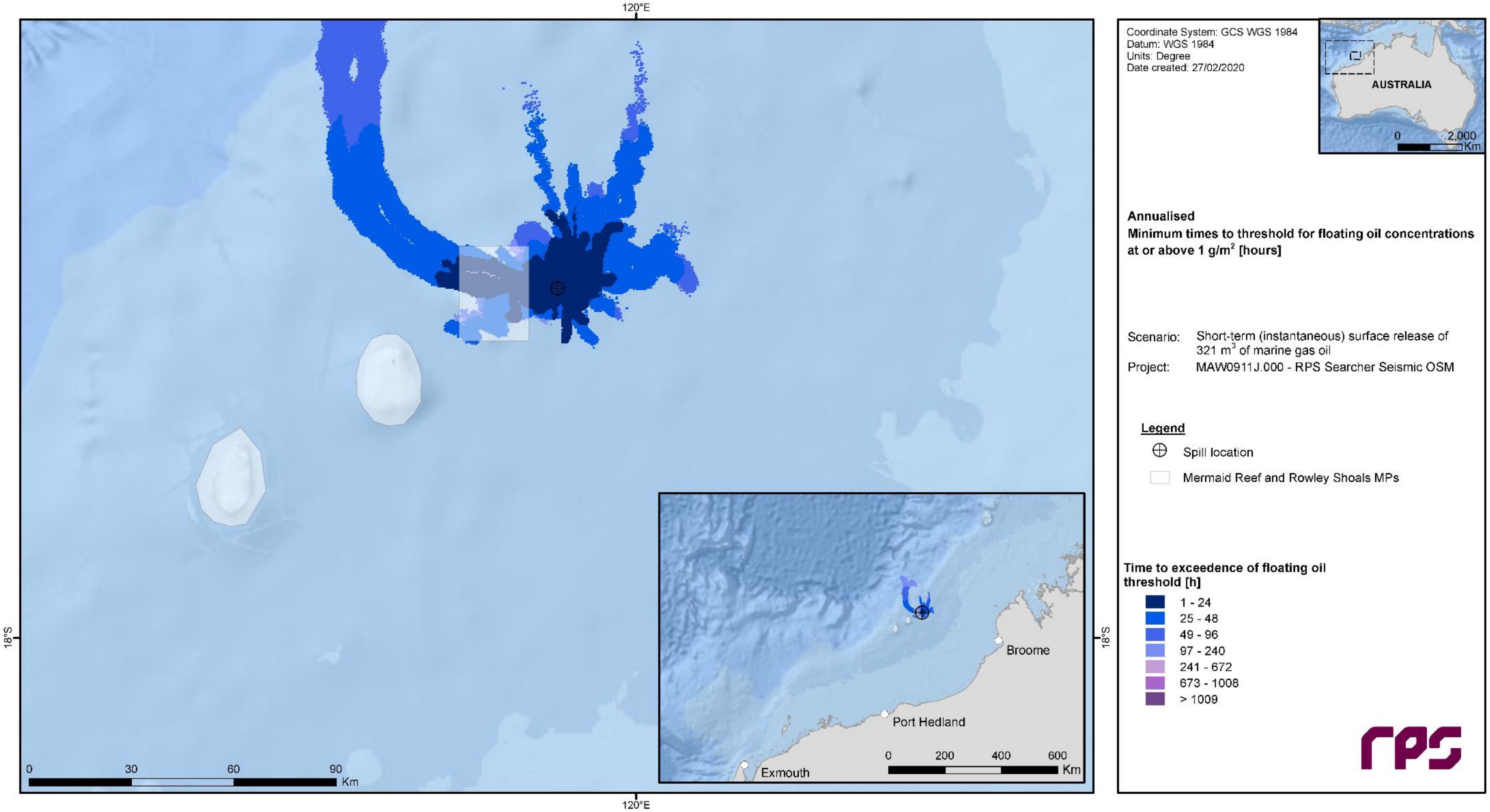

Figure 3.5 **Predicted annualised minimum times to contact by floating oil concentrations at or above 1 g/m^2 resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.**

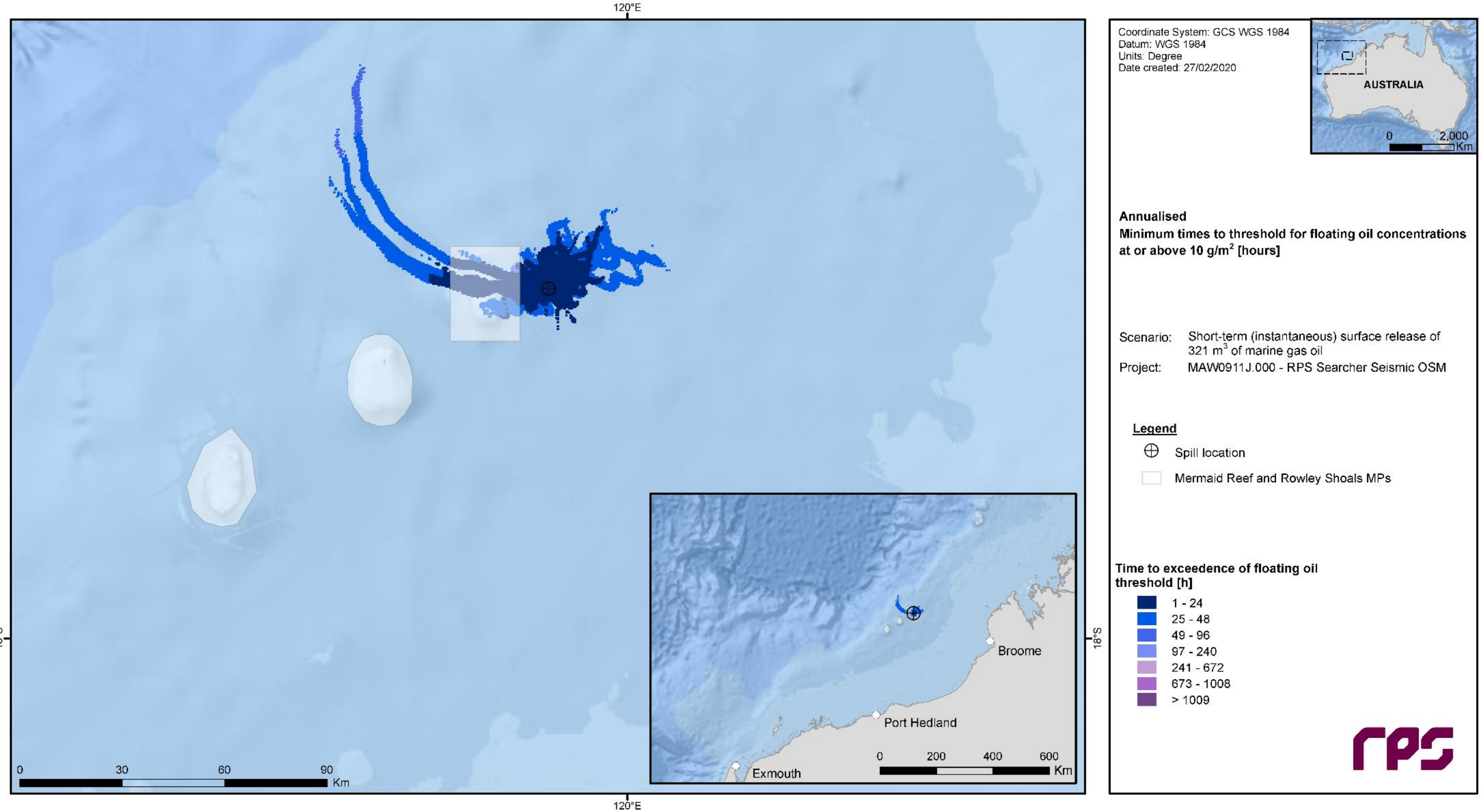

Figure 3.6 **Predicted annualised minimum times to contact by floating oil concentrations at or above 10 g/m^2 resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.**

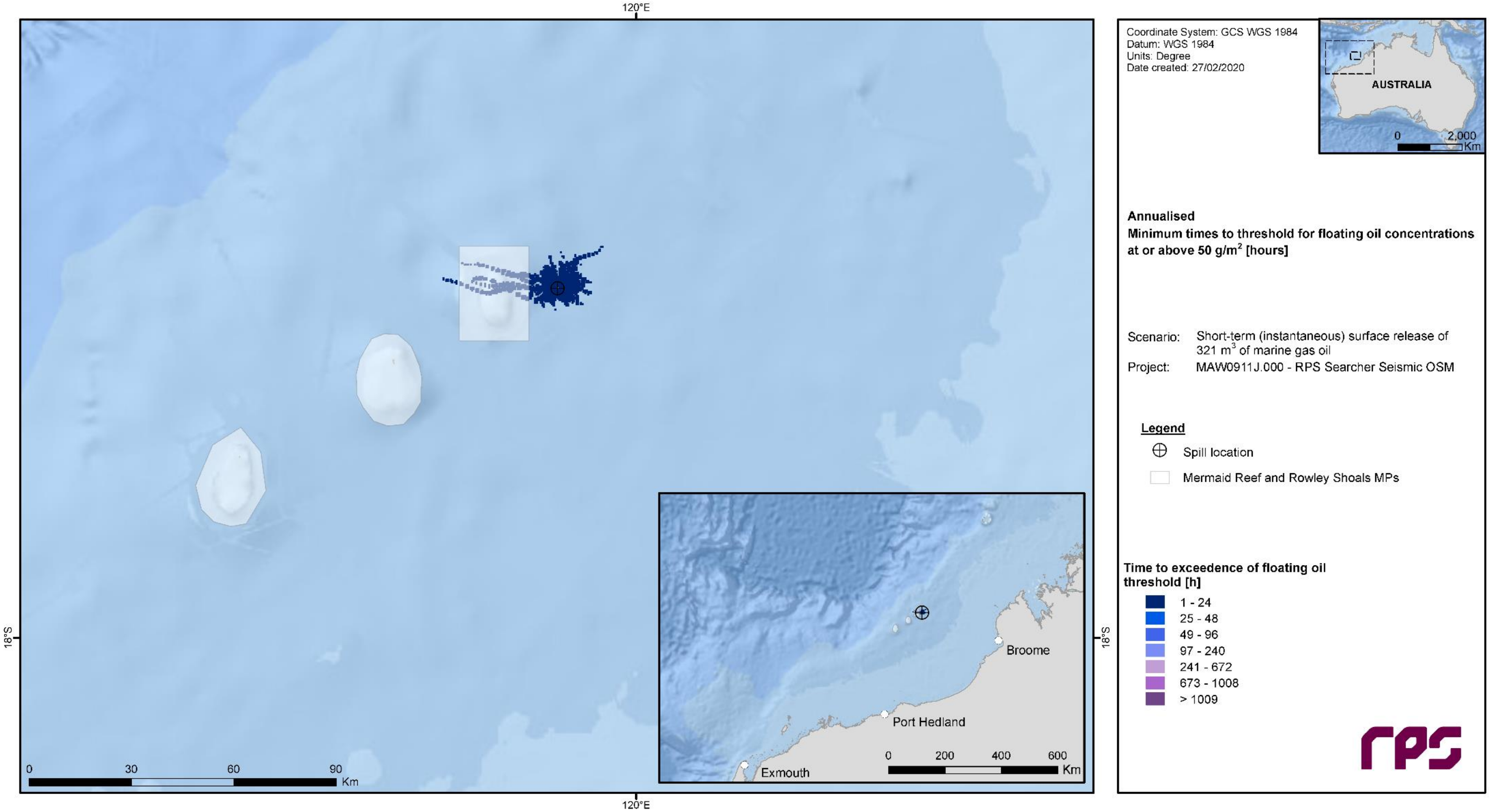

Figure 3.7 Predicted annualised minimum times to contact by floating oil concentrations at or above 50 g/m^2 resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

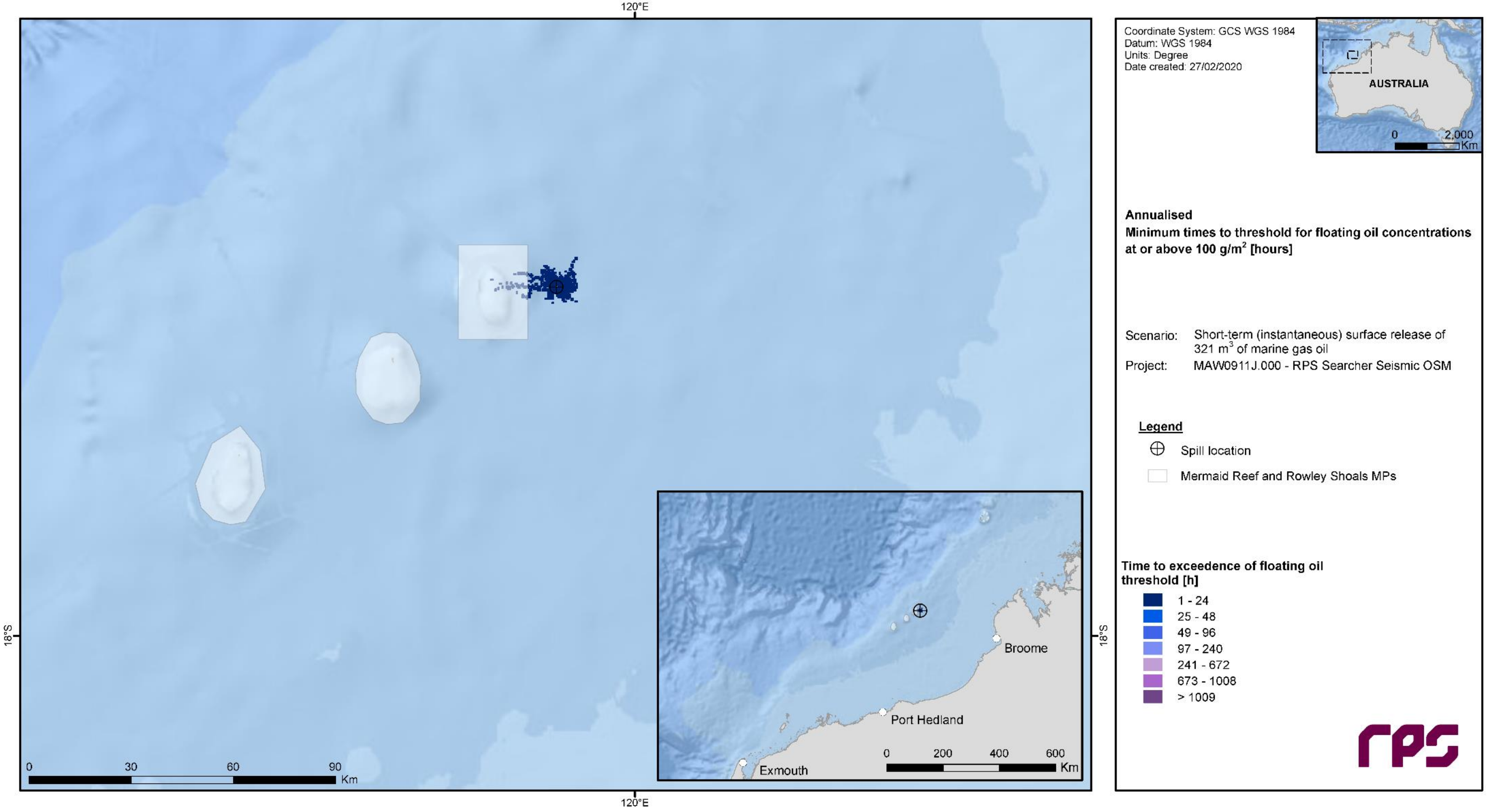

Figure 3.8 Predicted annualised minimum times to contact by floating oil concentrations at or above 100 g/m^2 resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

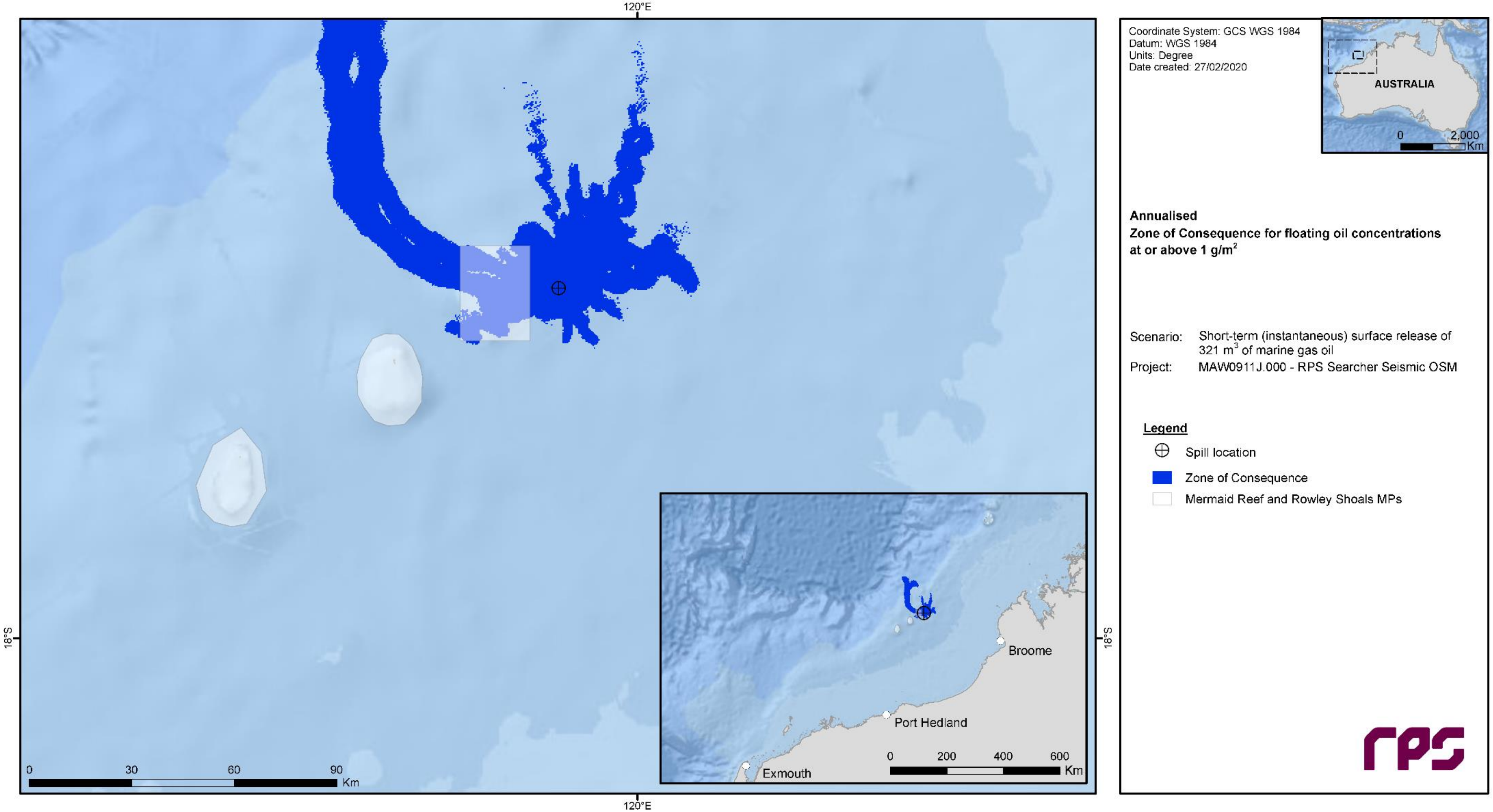

Figure 3.9 Predicted annualised zone of consequence of floating oil concentrations at or above 1 g/m^2 resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

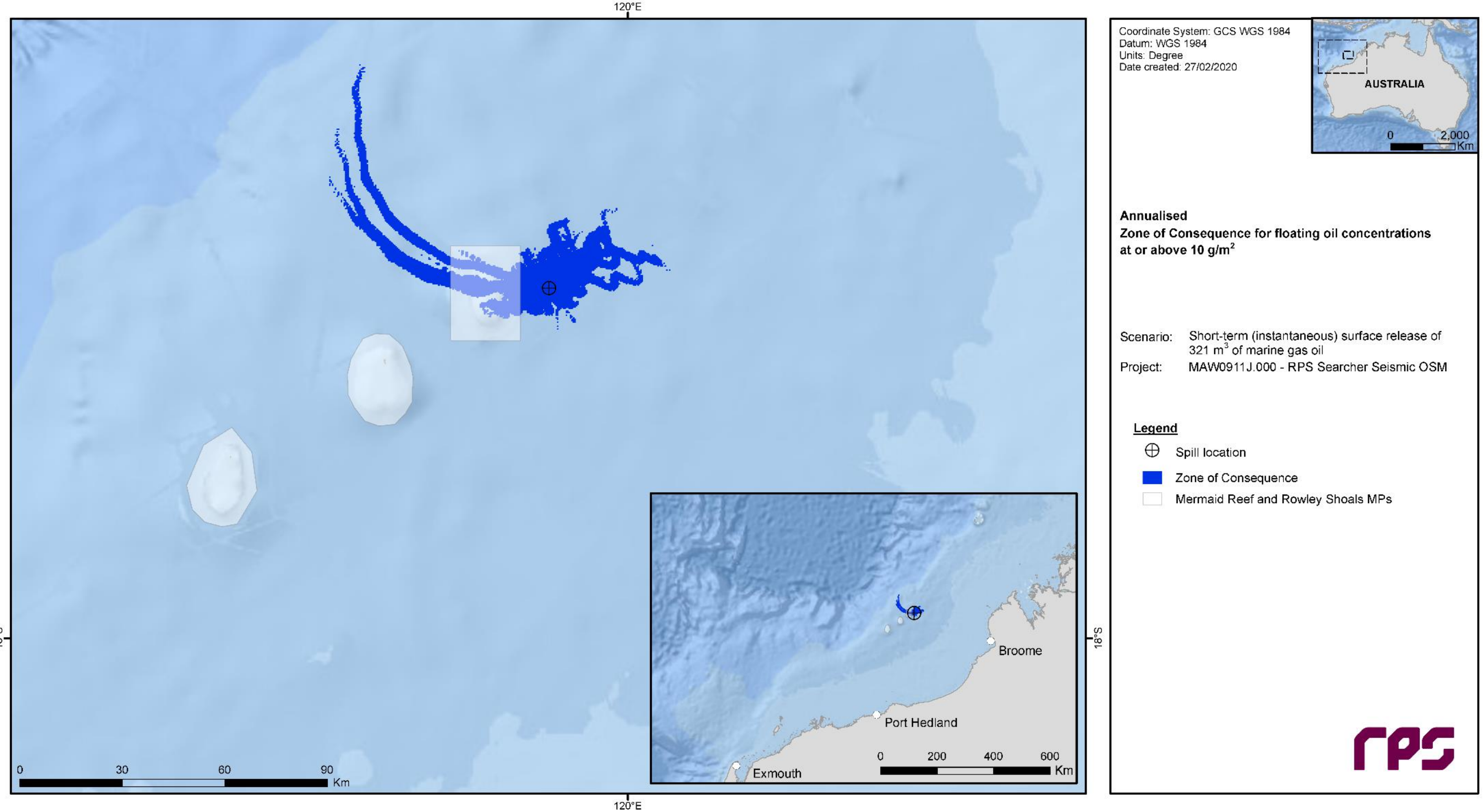

Figure 3.10 **Predicted annualised zone of consequence of floating oil concentrations at or above 10 g/m^2 resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.**

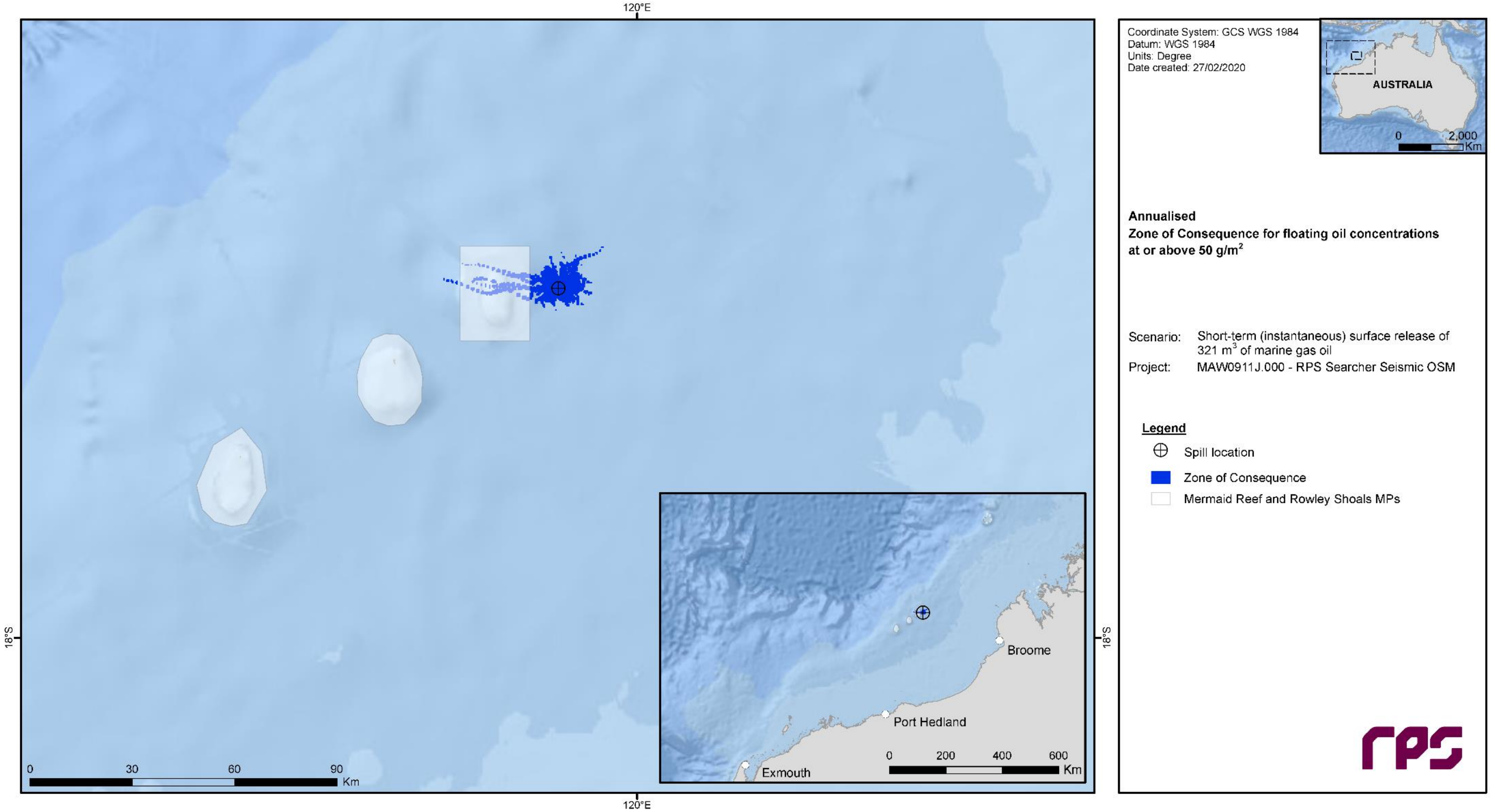

Figure 3.11 Predicted annualised zone of consequence of floating oil concentrations at or above 50 g/m^2 resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

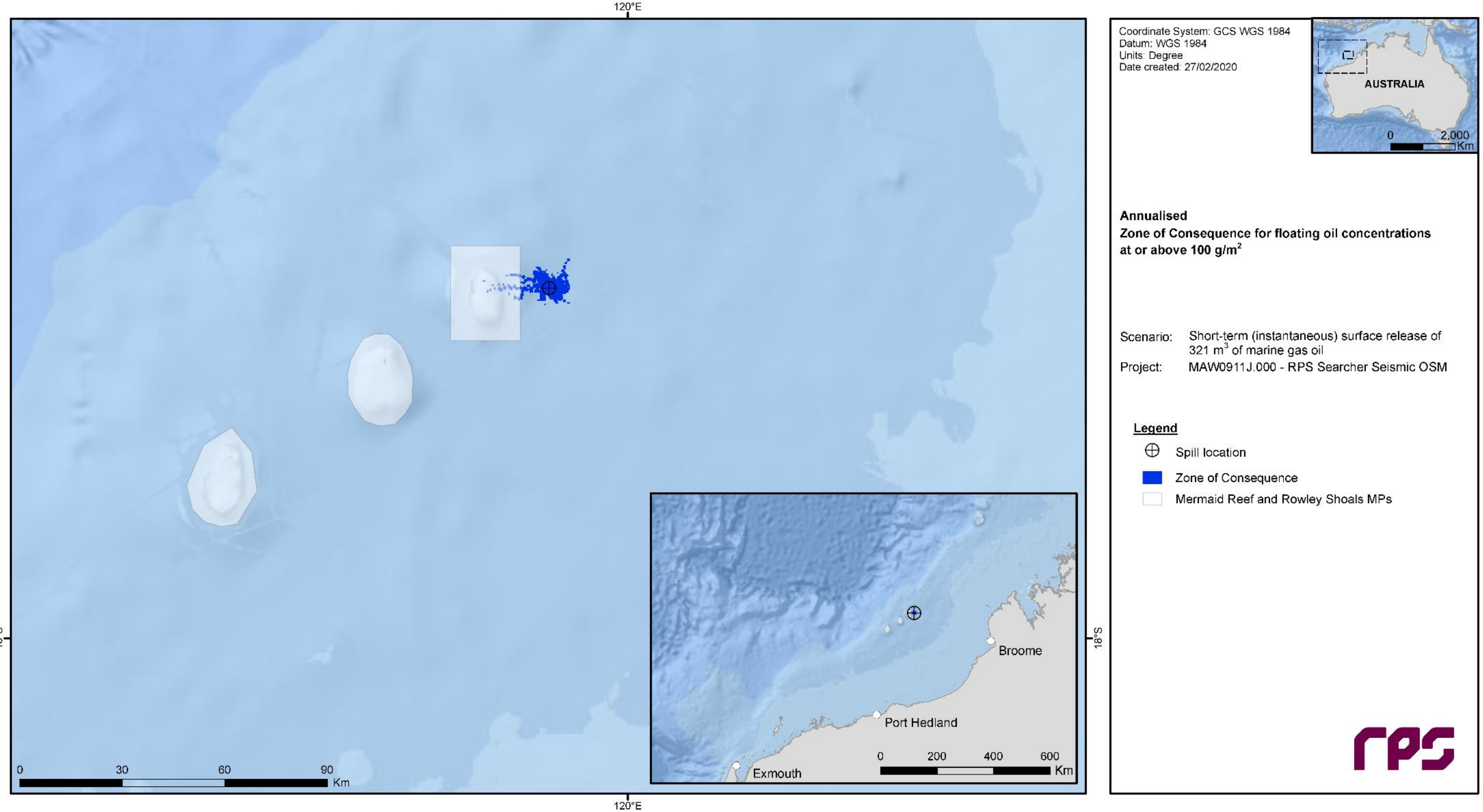

Figure 3.12 Predicted annualised zone of consequence of floating oil concentrations at or above 100 g/m^2 resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

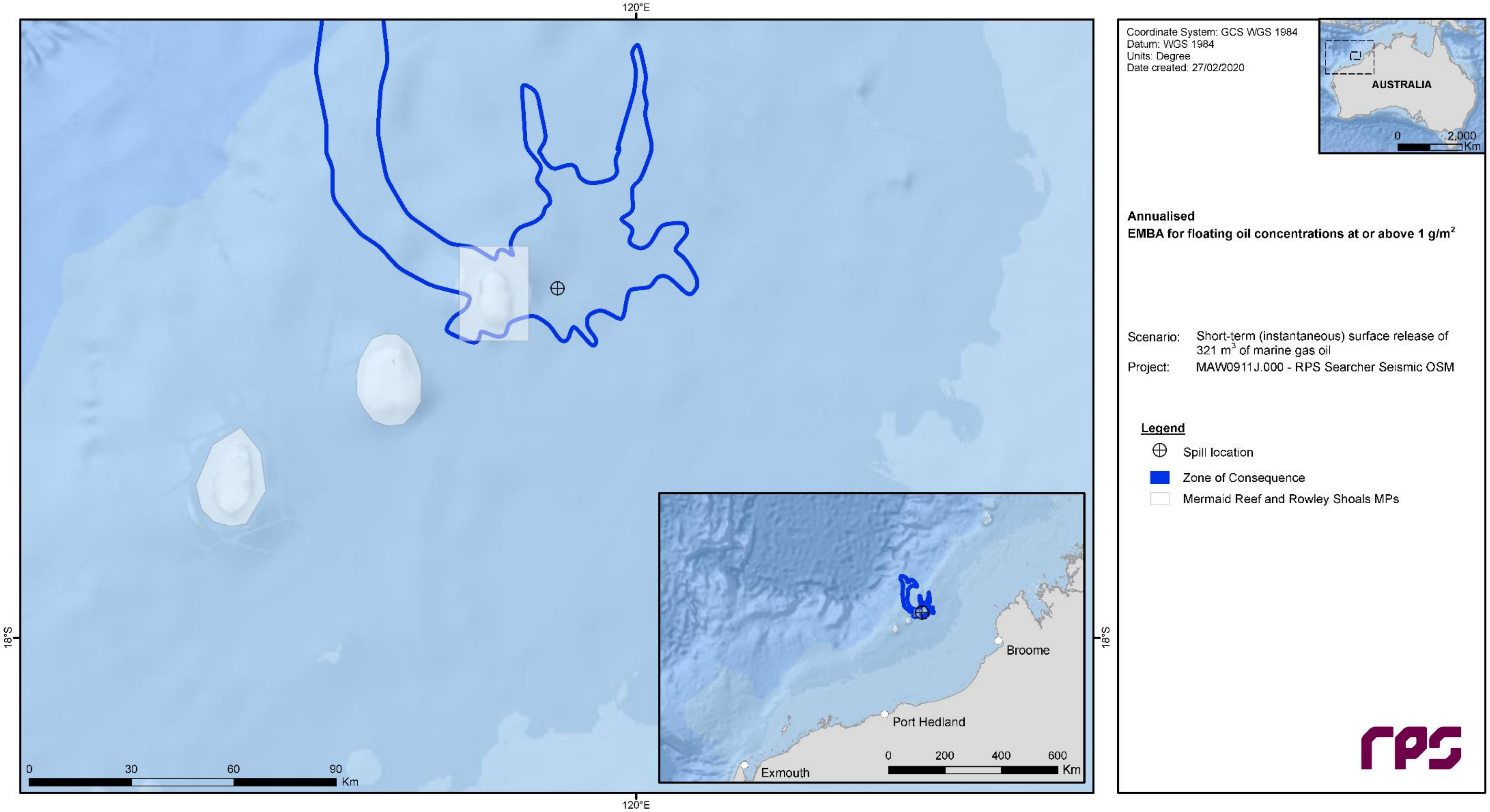

Figure 3.13 Predicted annualised smoothed EMBA of floating oil concentrations at or above 1 g/m^2 resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

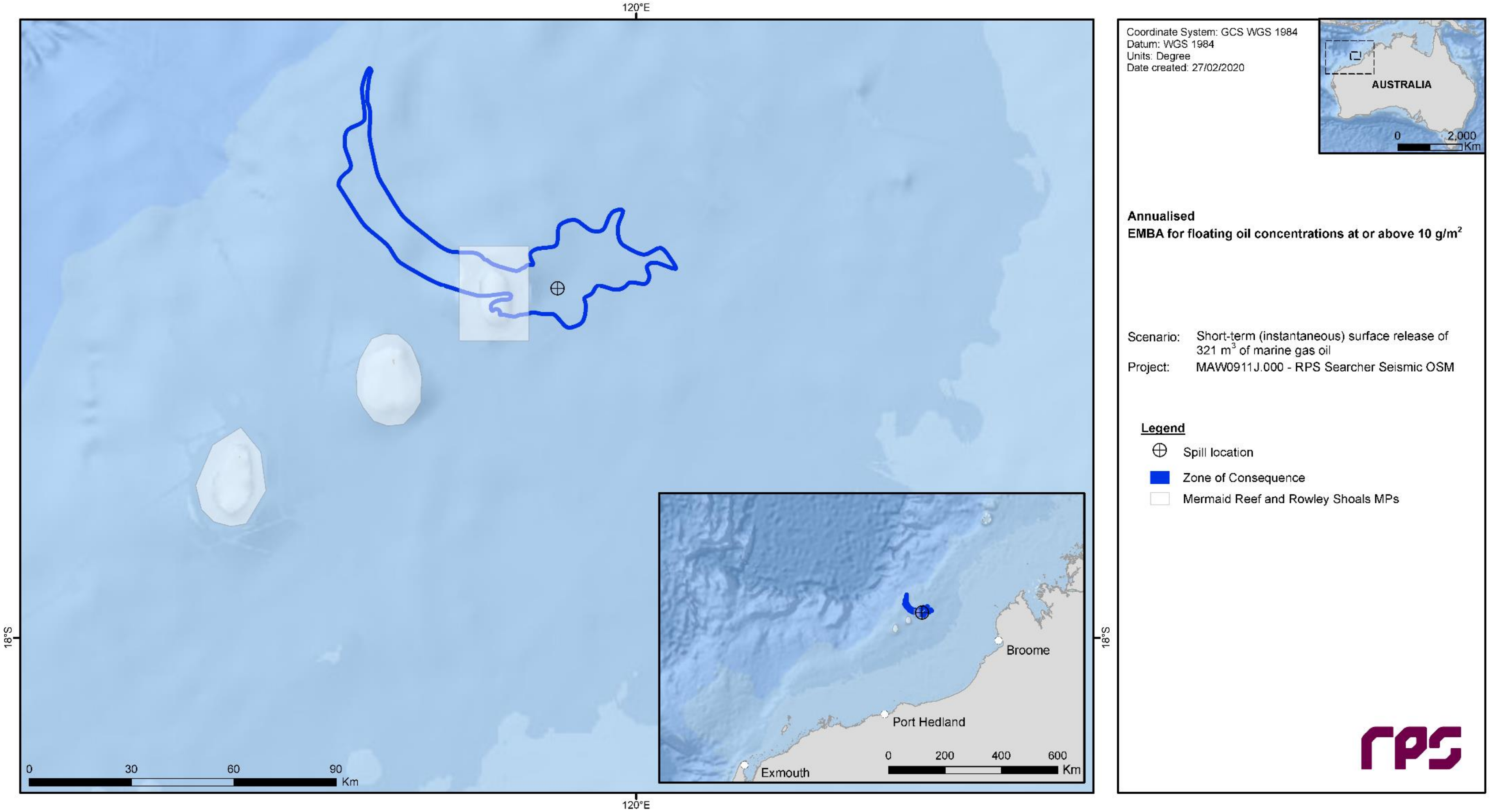

Figure 3.14 Predicted annualised smoothed EMBA of floating oil concentrations at or above 10 g/m^2 resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

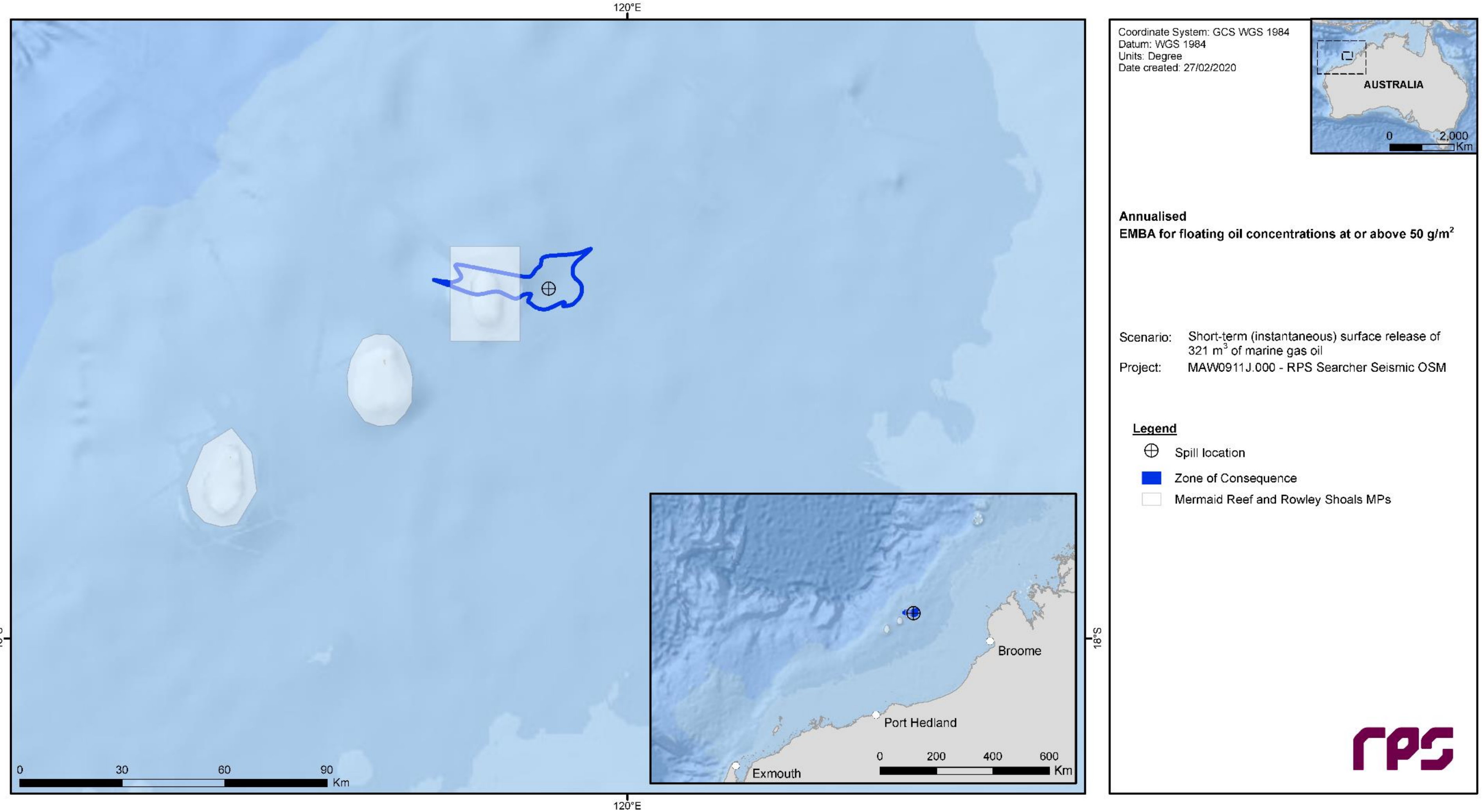

Figure 3.15 Predicted annualised smoothed EMBA of floating oil concentrations at or above 50 g/m^2 resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

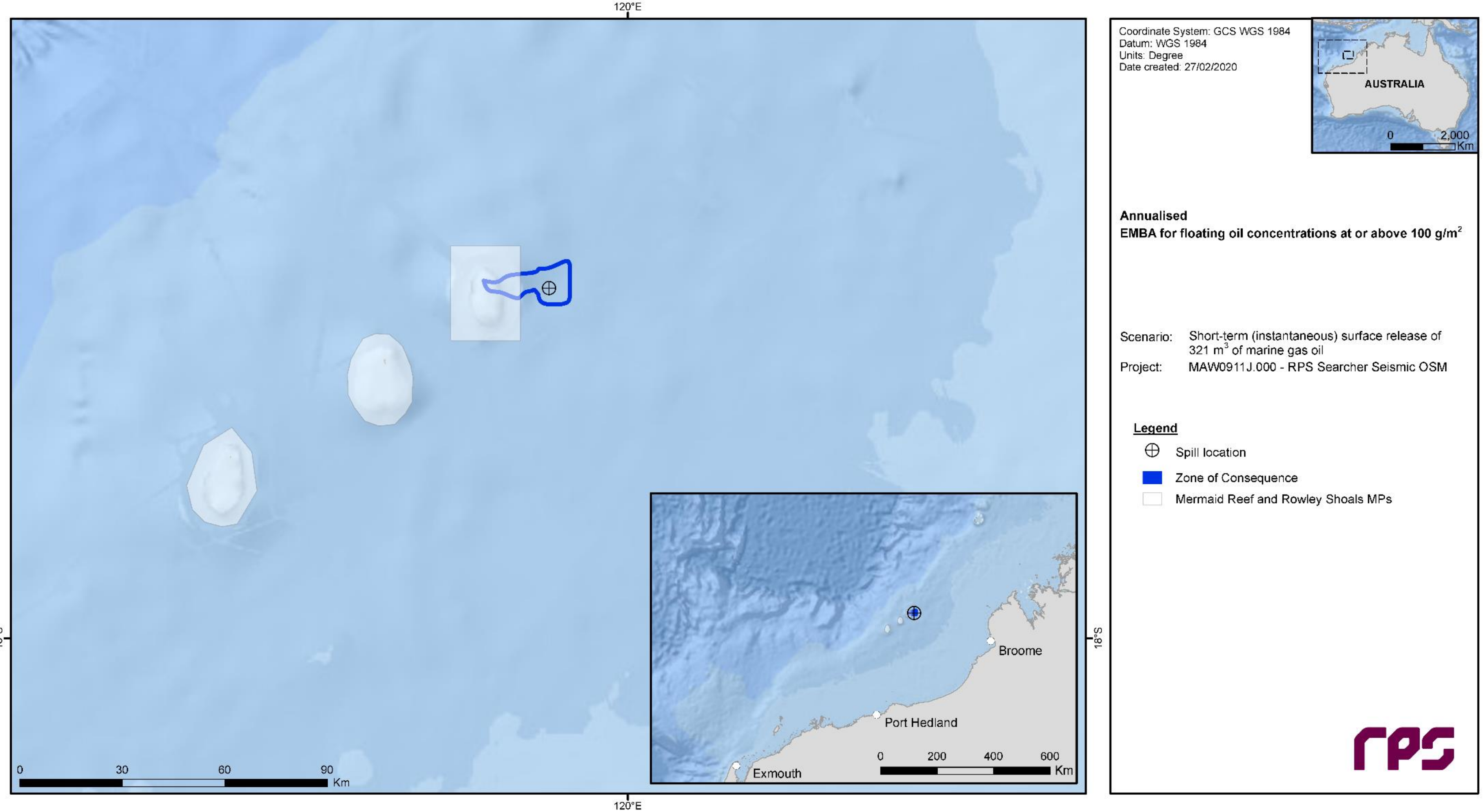

Figure 3.16 Predicted annualised smoothed EMBA of floating oil concentrations at or above 100 g/m^2 resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

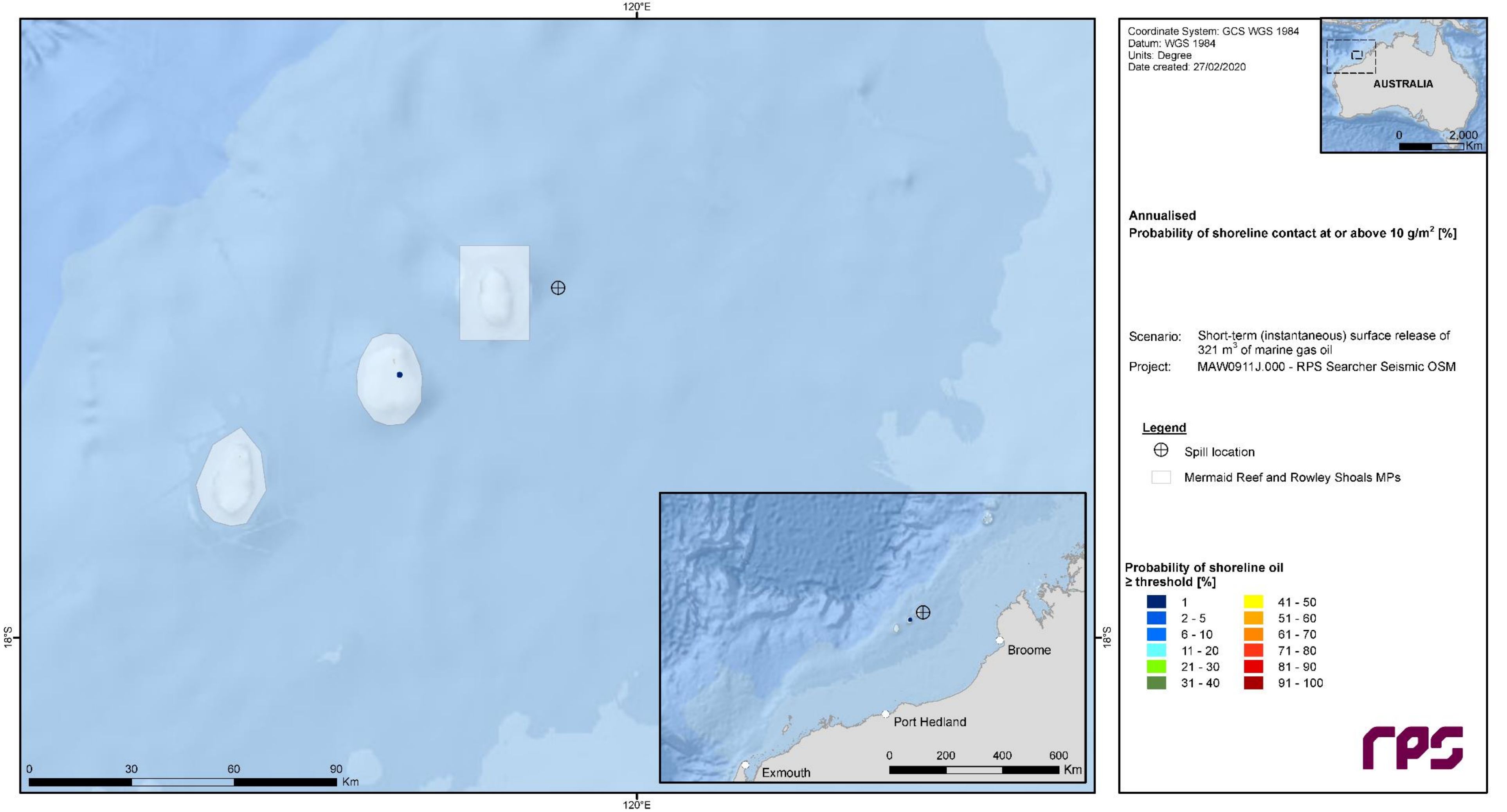

Figure 3.17 Predicted annualised probability of shoreline oil concentrations at or above 10 g/m^2 resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

3.2.2.2 Entrained Oil

Table 3.2 Expected annualised entrained oil outcomes at sensitive receptors resulting from a short-term (instantaneous) surface release of marine gas oil during marine seismic survey operations near Rowley Shoals.

Receptors		Probability (%) of entrained hydrocarbon concentration contact at ≥			Minimum time to receptor waters (hours) at ≥			Maximum entrained hydrocarbon concentration (ppb)	
		10 ppb	100 ppb	500 ppb	10 ppb	100 ppb	500 ppb	averaged over all replicate spills	at any depth, in the worst replicate
Australian Marine Parks	Argo-Rowley Terrace MP	25	12	7	19	21	22	106	3,342
	Kimberley MP	3	<1	<1	353	NC	NC	2	91
	Mermaid Reef MP	37	24	13	5	6	12	219	4,922
State Marine Parks	Clerke Reef (Rowley Shoals MP)	15	8	2	72	75	84	23	742
	Imperieuse Reef (Rowley Shoals MP)	8	1	1	136	137	147	7	573
Key Ecological Features	Ancient Coastline at 125m Depth Contour KEF	4	1	<1	255	268	NC	3	199
	Continental Slope Demersal Fish Communities KEF	7	2	<1	146	150	NC	6	351
	Mermaid Reef and Commonwealth Waters surrounding Rowley Shoals KEF	51	41	29	2	2	2	1,085	25,616
	Seringapatam Reef and Commonwealth Waters in the Scott Reef Complex KEF	1	<1	<1	645	NC	NC	<1	22
Fisheries	North-West Slope Trawl Fishery	69	49	39	1	1	1	3,228	58,739
	Southern Bluefin Tuna Fishery	69	49	39	1	1	1	3,228	58,739
	Western Skipjack Fishery	69	49	39	1	1	1	3,228	58,739
	Western Tuna and Billfish Fishery	69	49	39	1	1	1	3,228	58,739
Biologically Important Areas	Marine Turtle BIA	1	<1	<1	452	NC	NC	<1	30
	Seabirds BIA	69	49	39	1	1	1	3,228	58,739
	Sharks BIA	8	3	<1	156	166	NC	8	426
	Whales BIA	69	49	39	1	1	1	3,228	58,739
Reefs	Scott Reef South	1	<1	<1	648	NC	NC	<1	20

NC: No contact to receptor predicted for specified threshold.

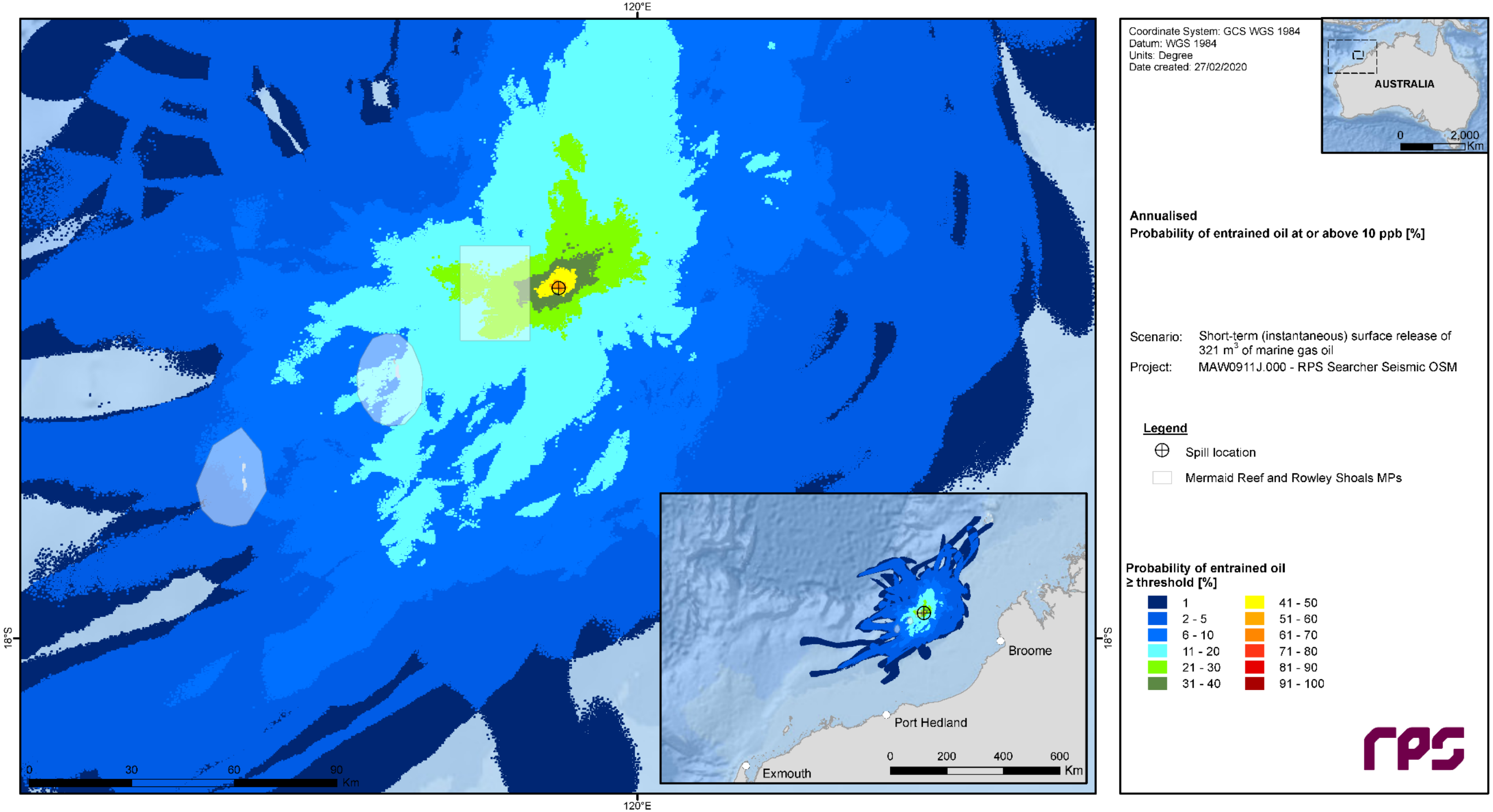

Figure 3.18 Predicted annualised probability of entrained oil concentrations at or above 10 ppb resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

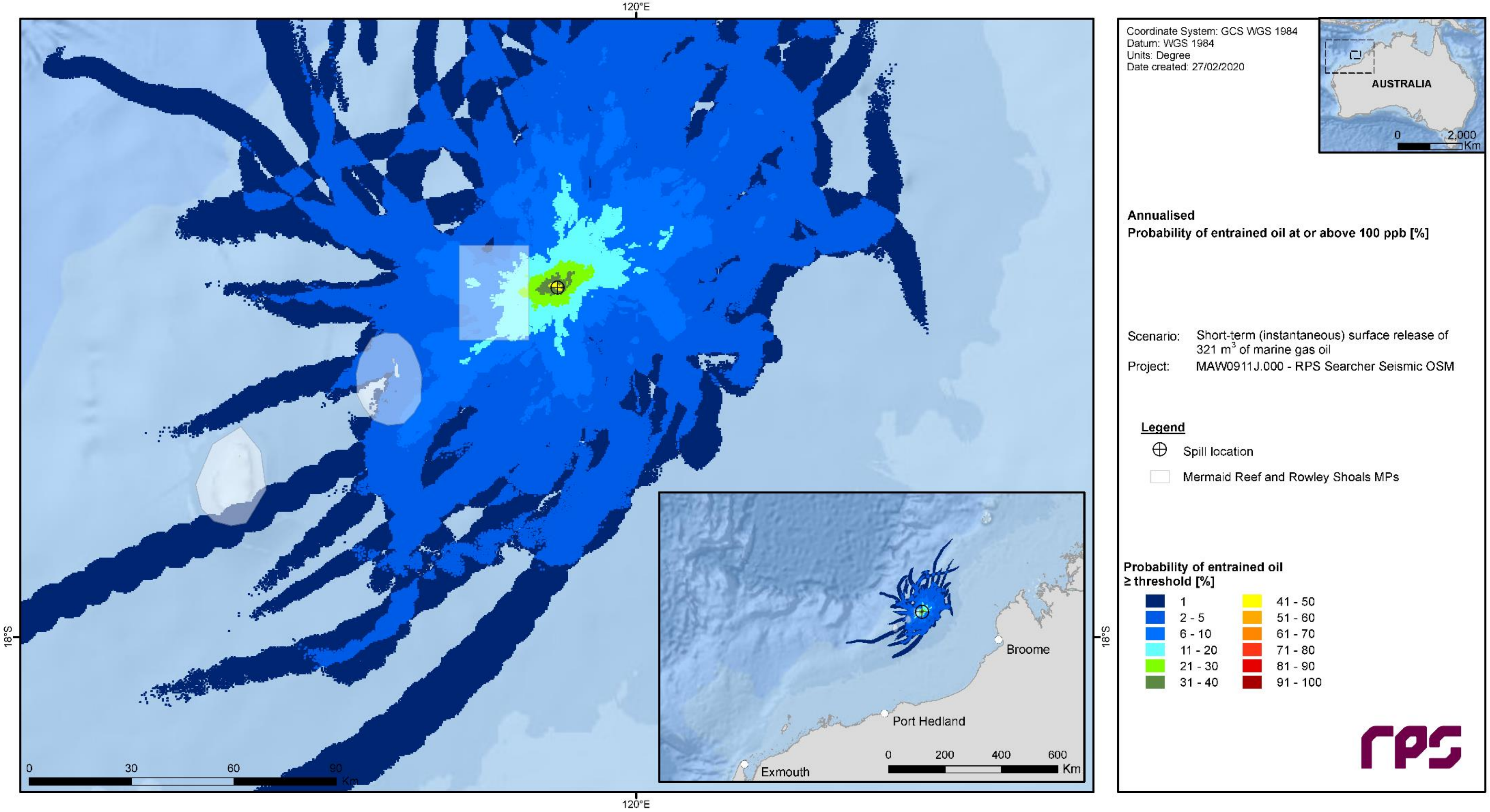

Figure 3.19 Predicted annualised probability of entrained oil concentrations at or above 100 ppb resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

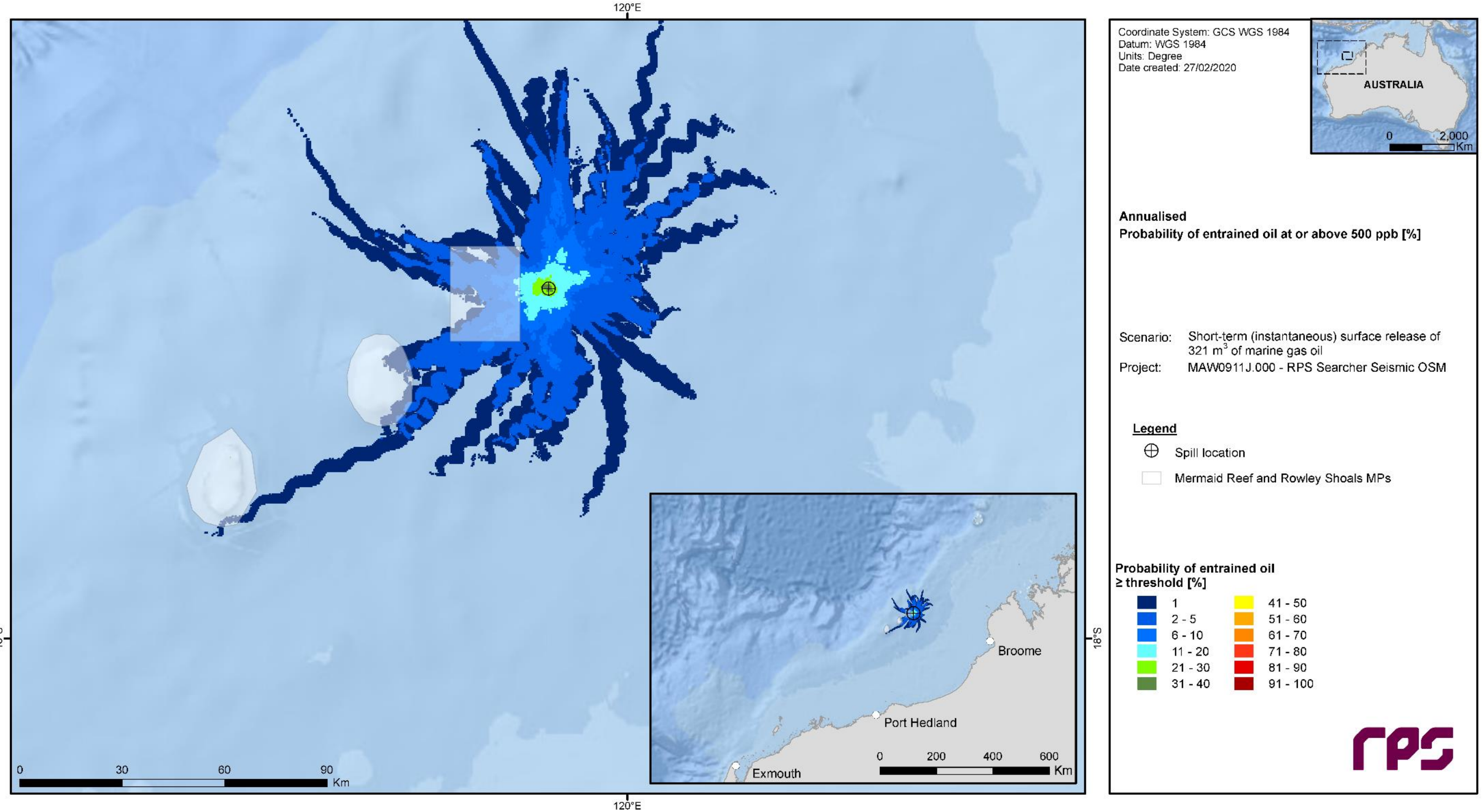

Figure 3.20 Predicted annualised probability of entrained oil concentrations at or above 500 ppb resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

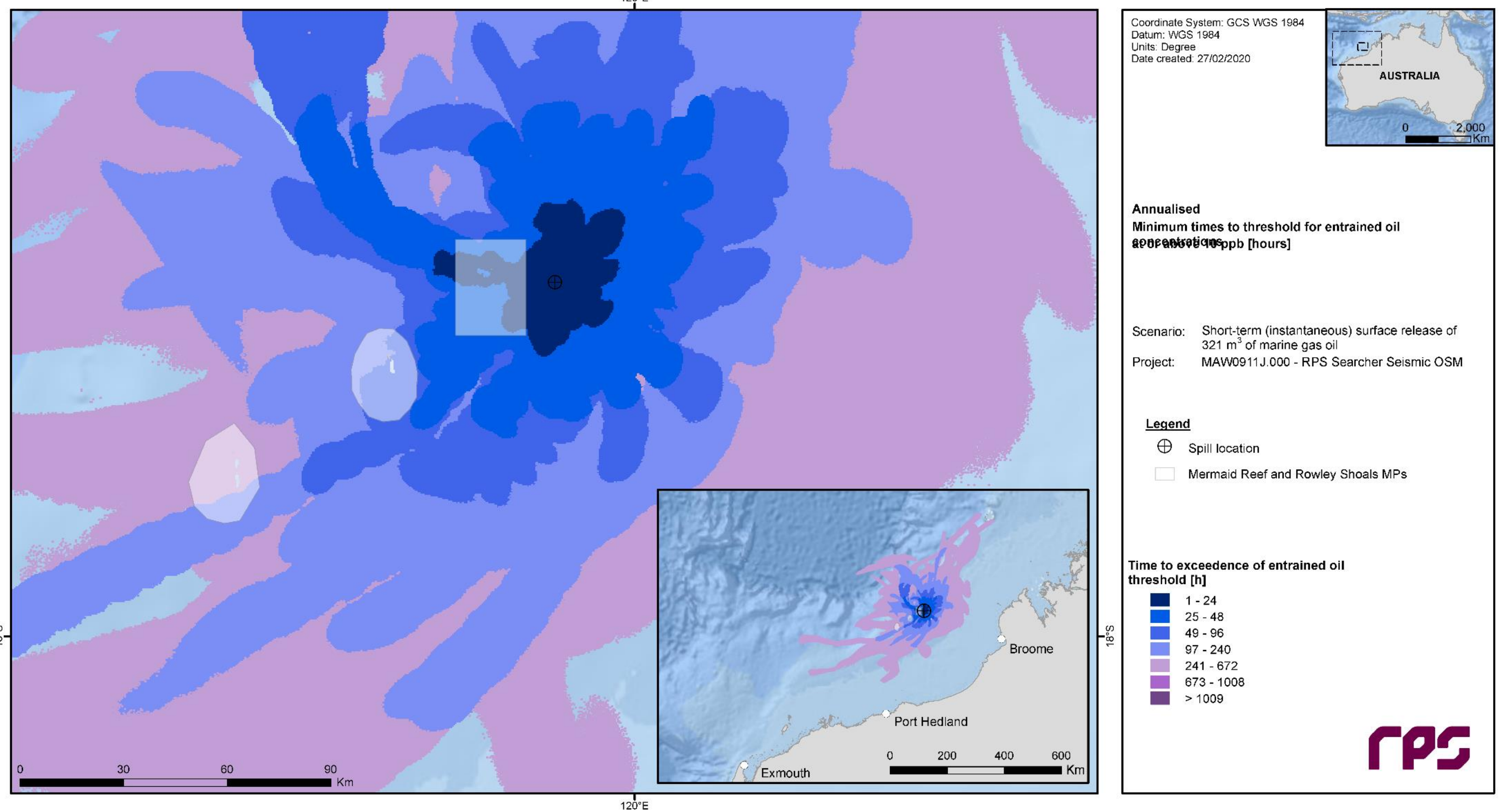

Figure 3.21 Predicted annualised minimum times to contact by entrained oil concentrations at or above 10 ppb resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

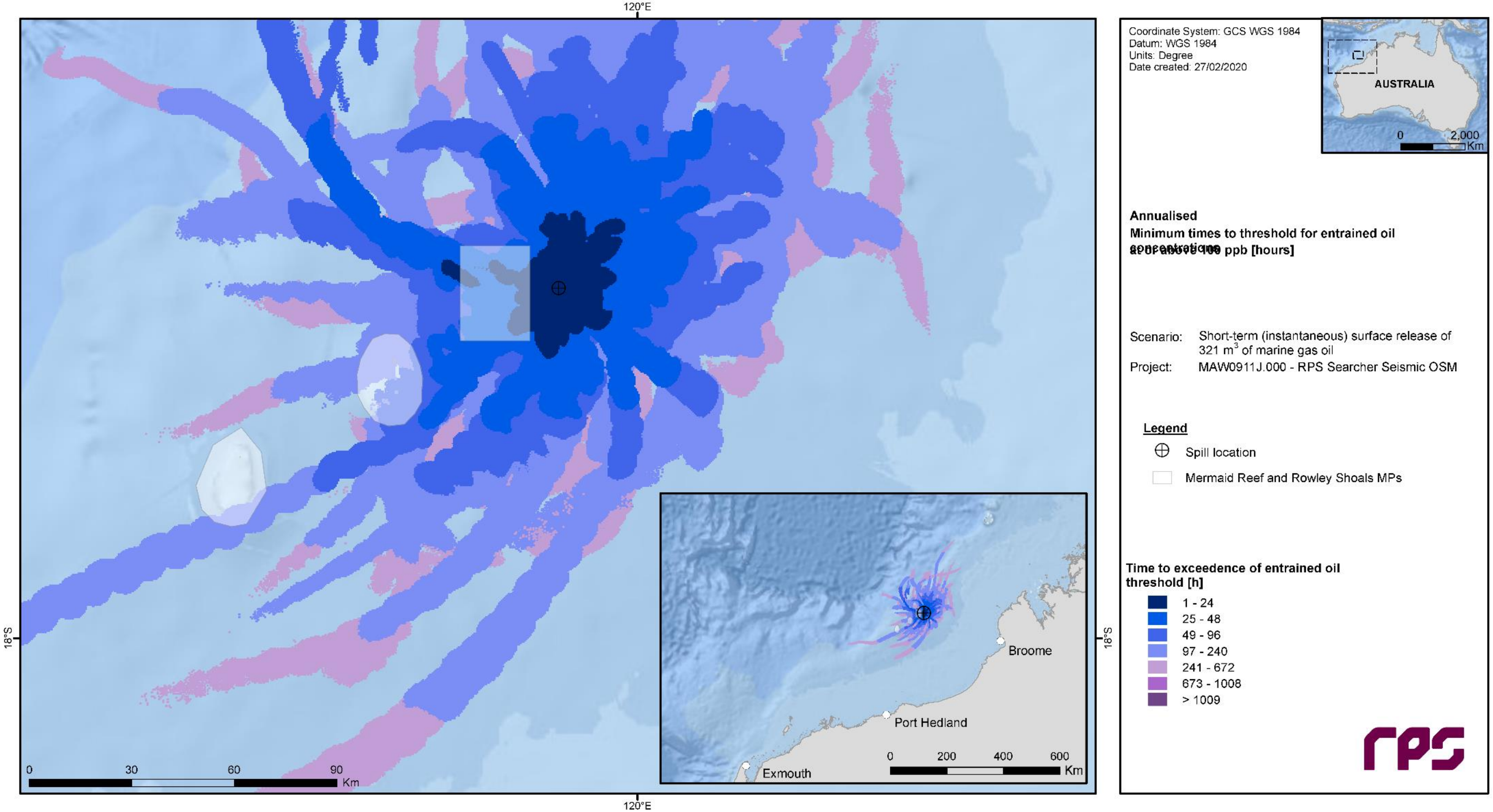

Figure 3.22 Predicted annualised minimum times to contact by entrained oil concentrations at or above 100 ppb resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

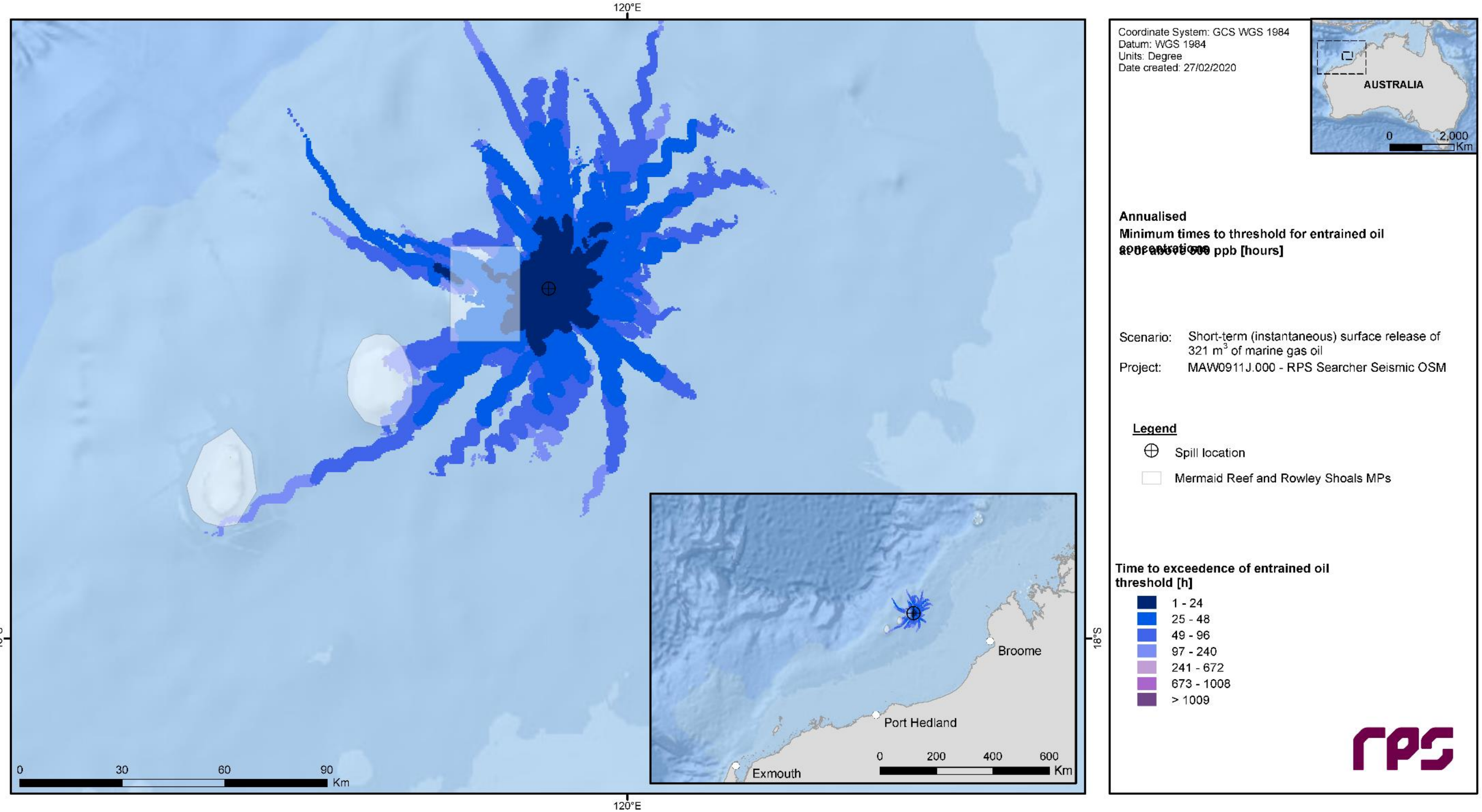

Figure 3.23 Predicted annualised minimum times to contact by entrained oil concentrations at or above 500 ppb resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

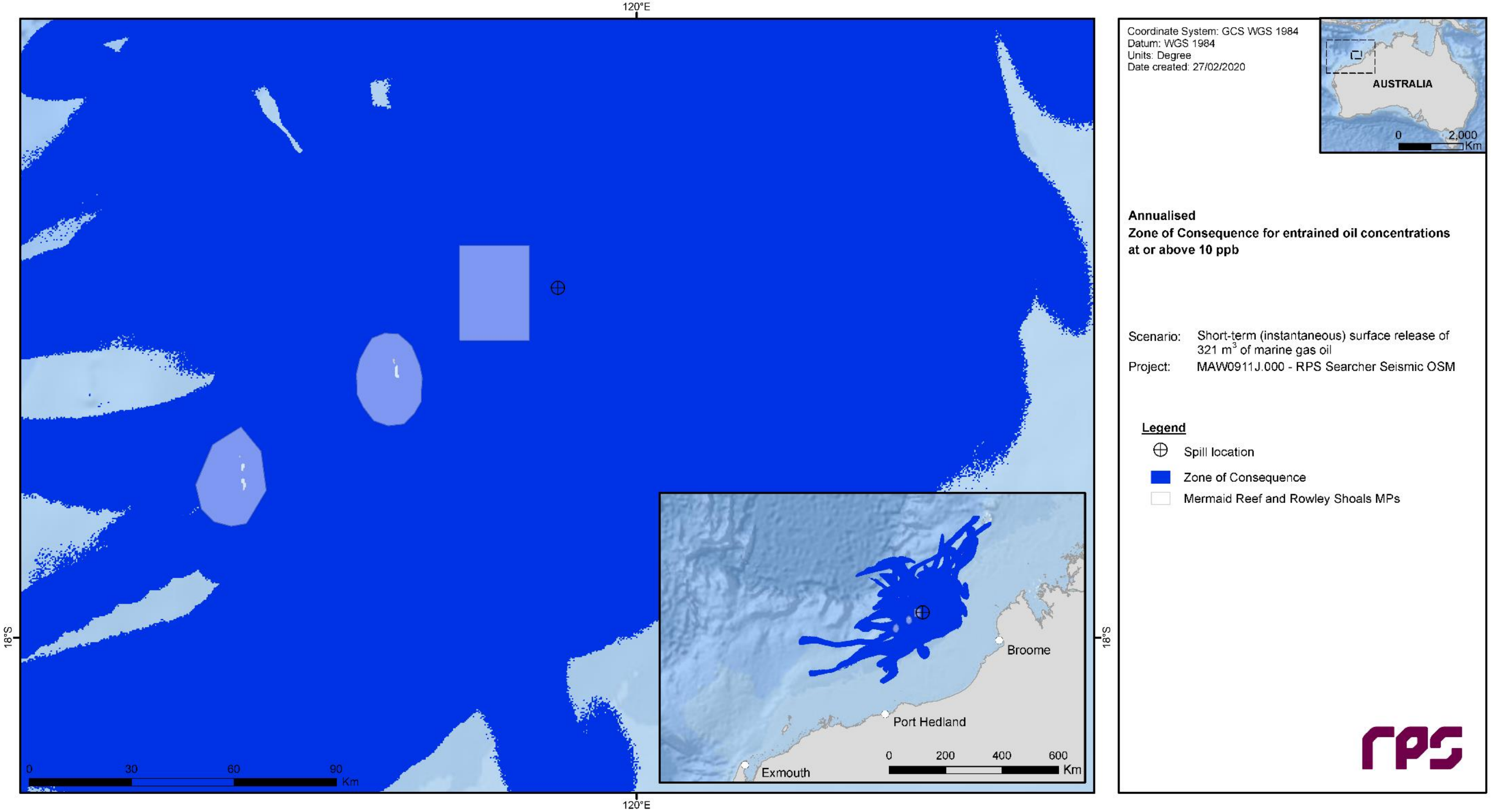

Figure 3.24 Predicted annualised zone of consequence of entrained oil concentrations at or above 10 ppb resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

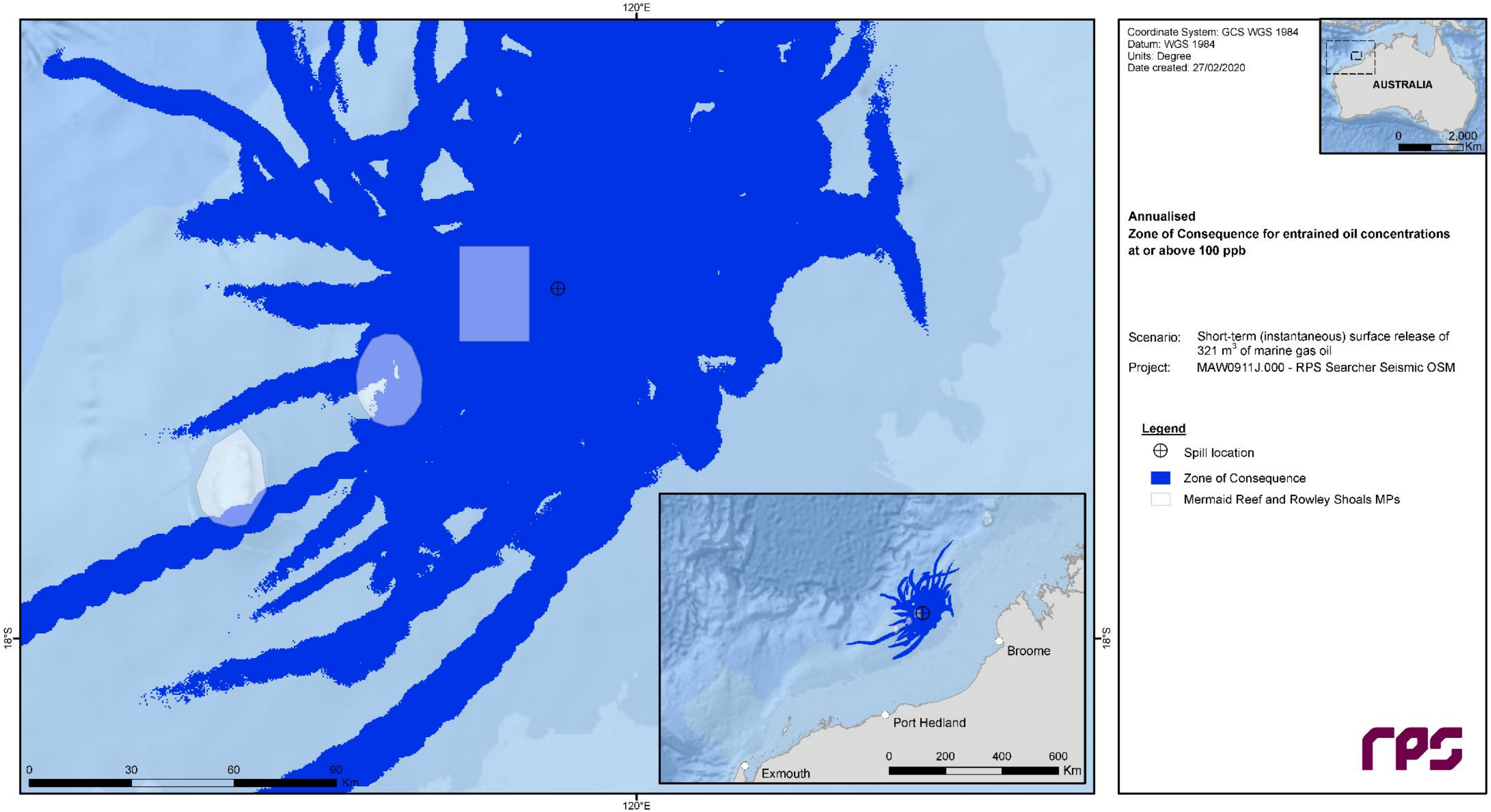

Figure 3.25 Predicted annualised zone of consequence of entrained oil concentrations at or above 100 ppb resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

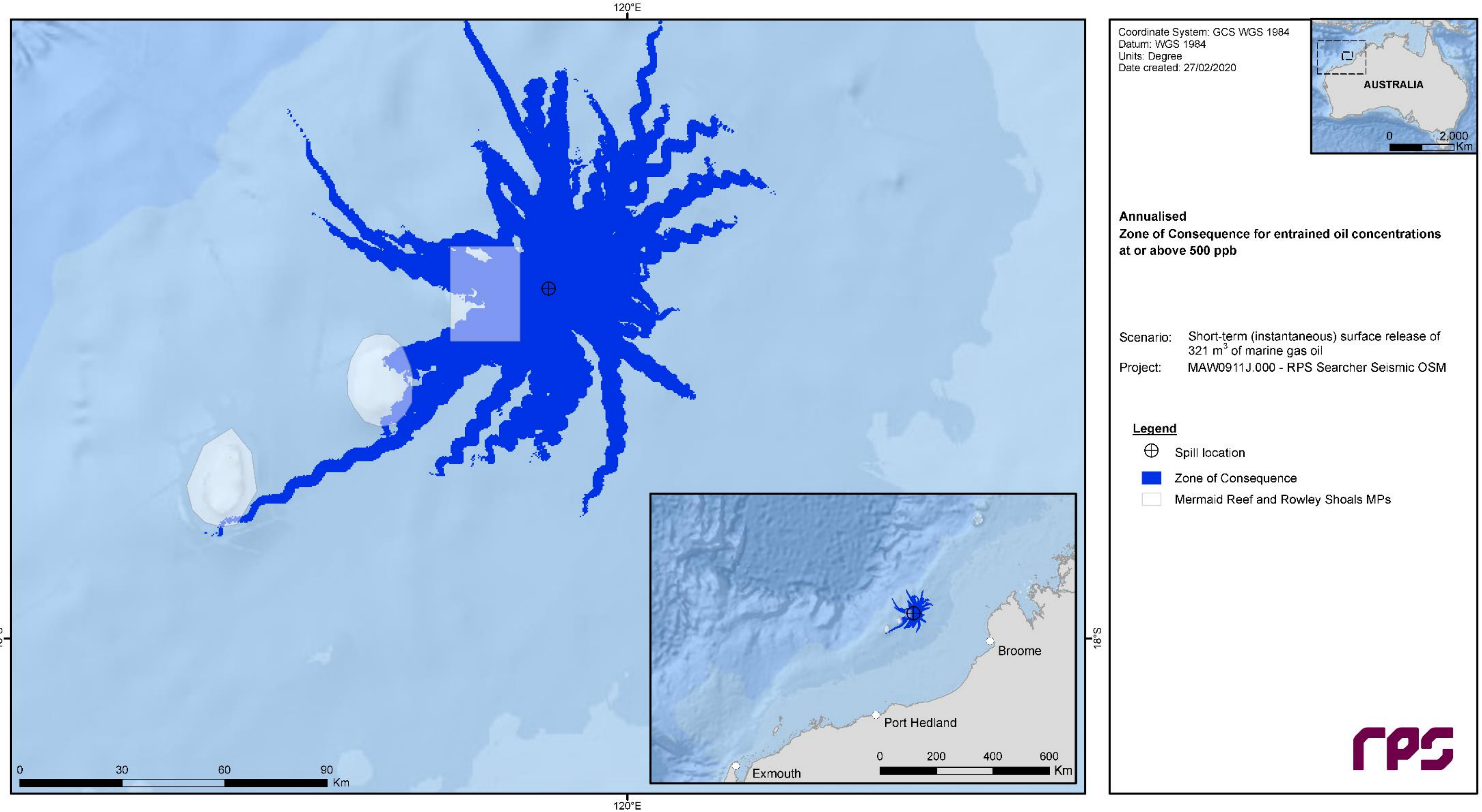

Figure 3.26 Predicted annualised zone of consequence of entrained oil concentrations at or above 500 ppb resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

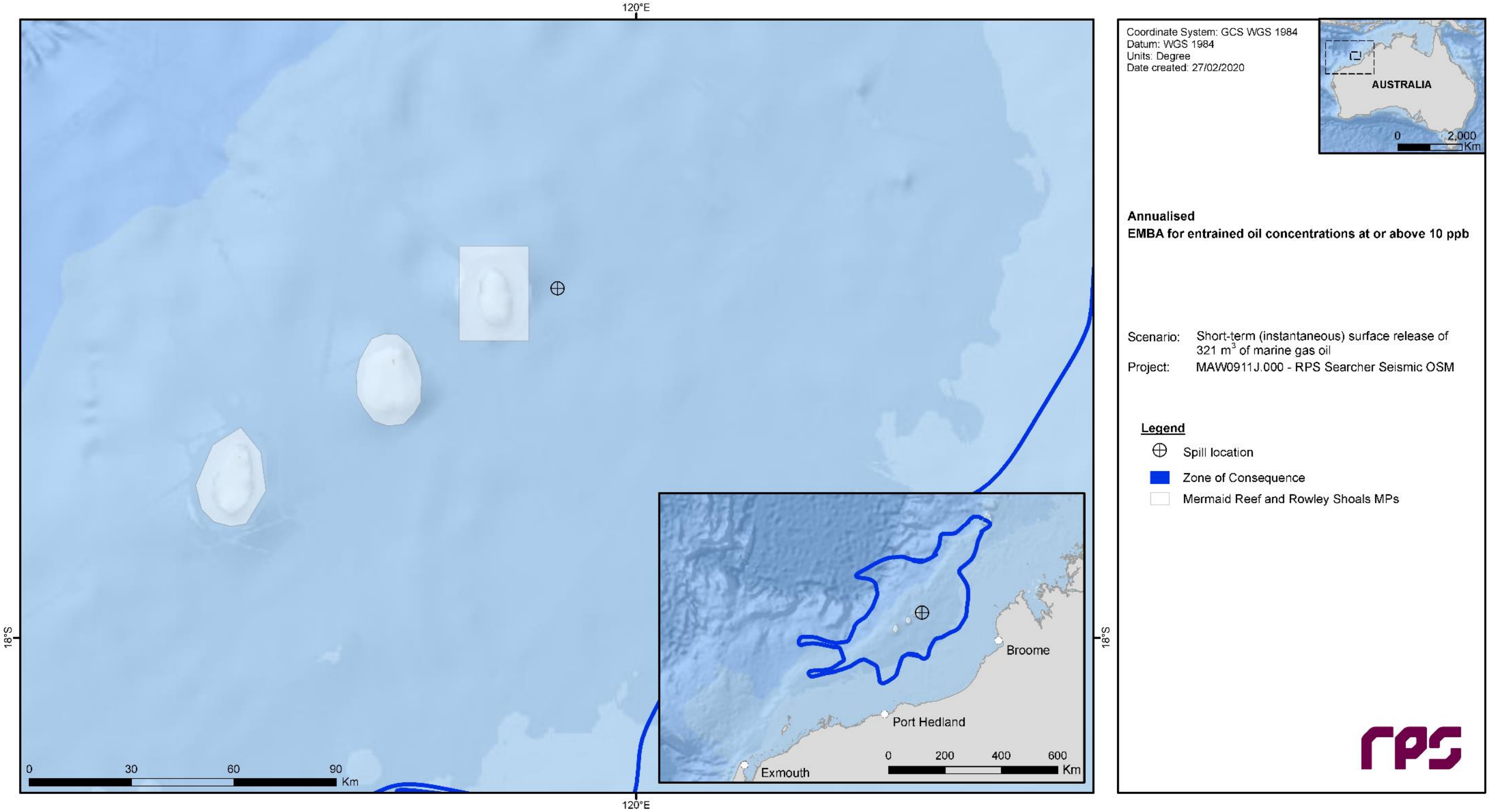

Figure 3.27 Predicted annualised smoothed EMBA of entrained oil concentrations at or above 10 ppb resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

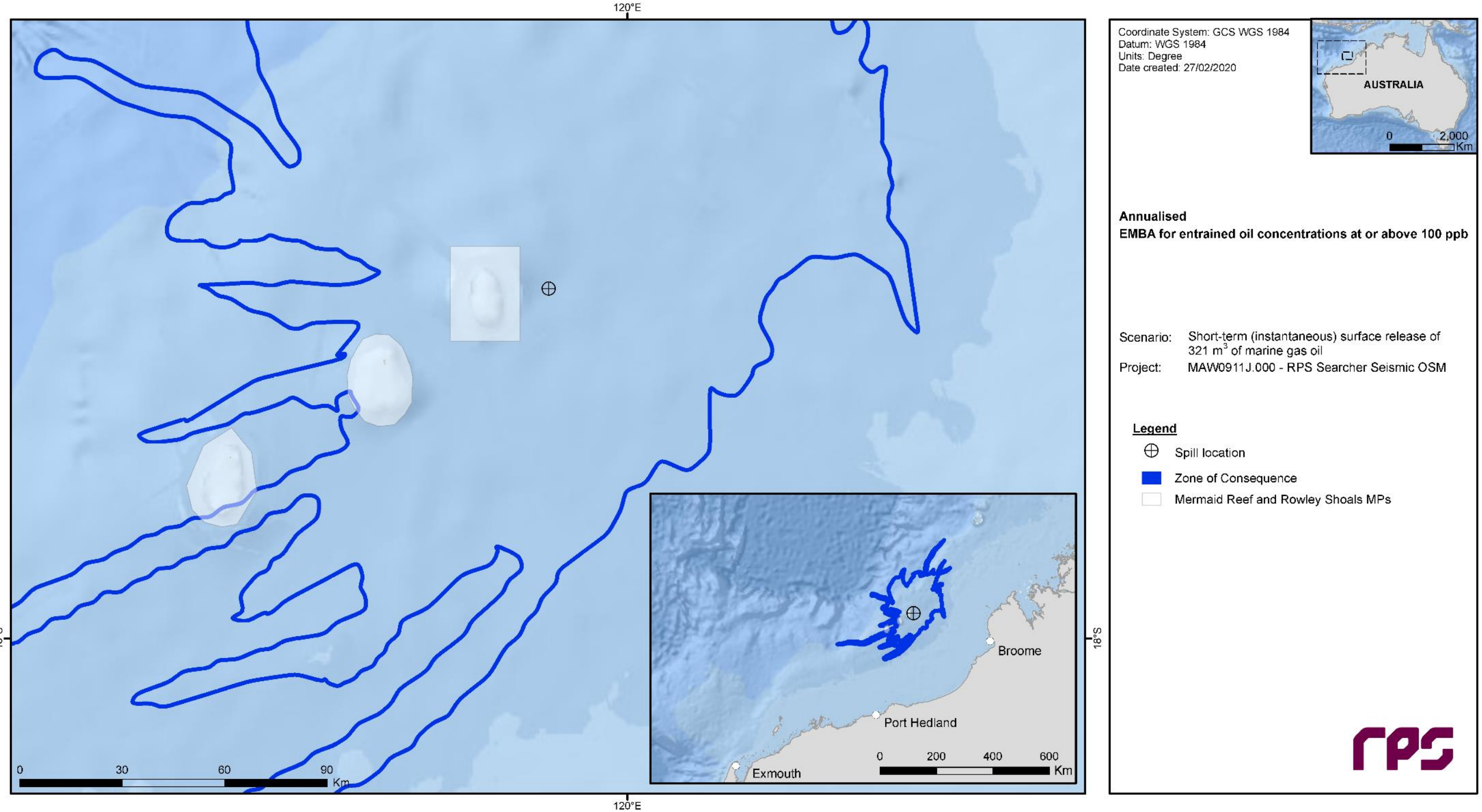

Figure 3.28 Predicted annualised smoothed EMBA of entrained oil concentrations at or above 100 ppb resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

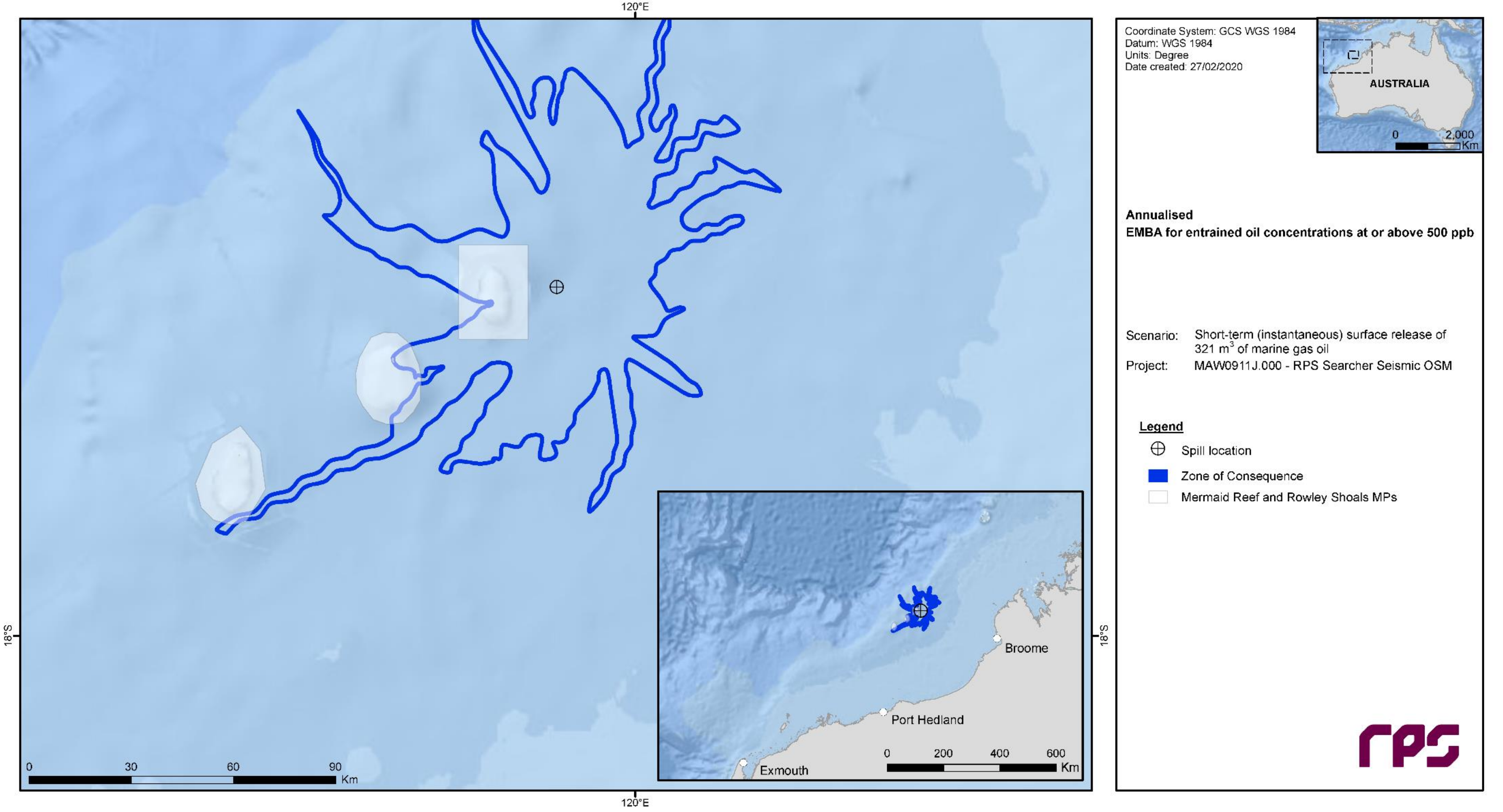

Figure 3.29 Predicted annualised smoothed EMBA of entrained oil concentrations at or above 500 ppb resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

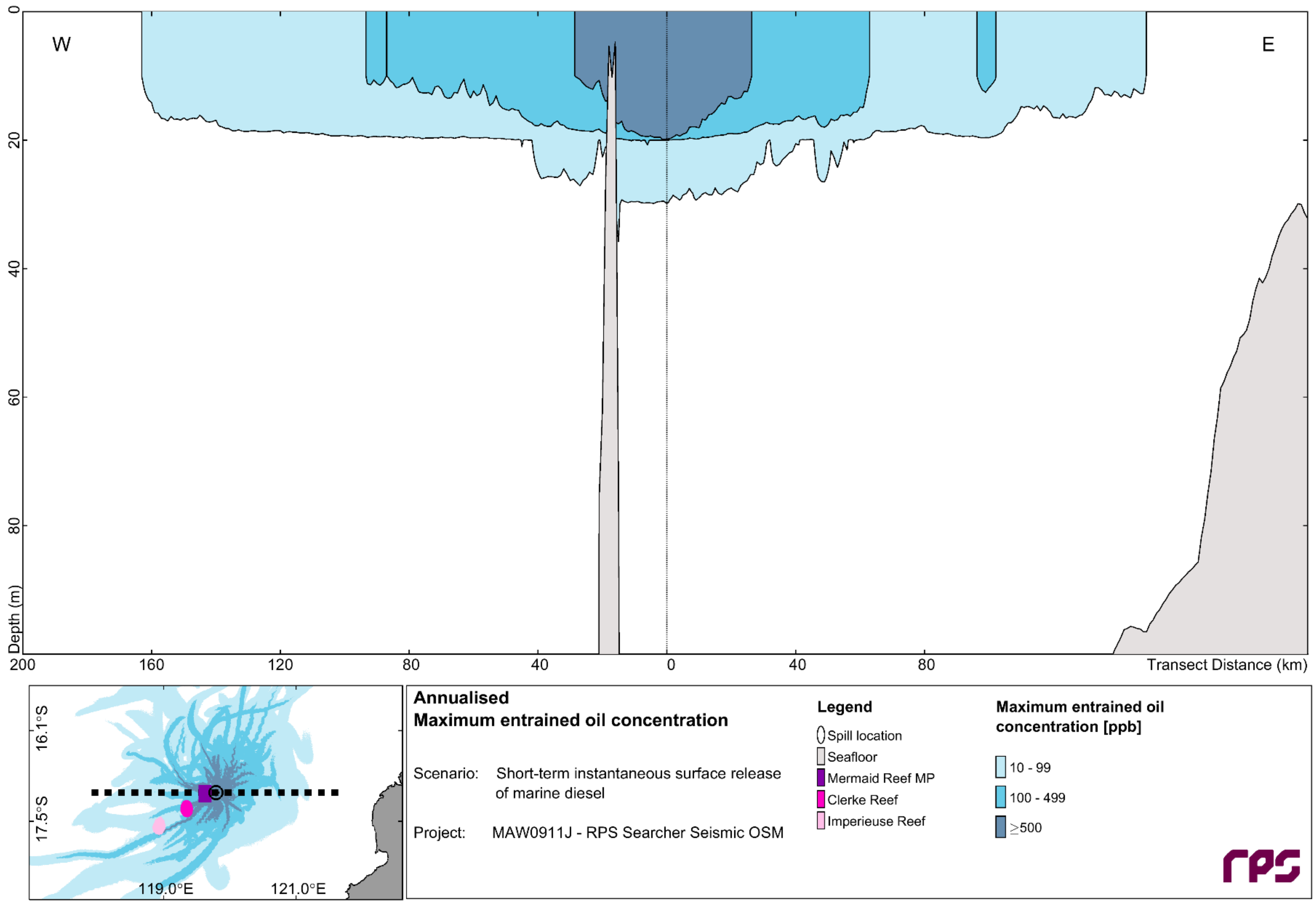

Figure 3.30 West-East cross-section transect of predicted annualised maximum entrained oil concentrations from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals. The results were calculated from 100 spill trajectories.

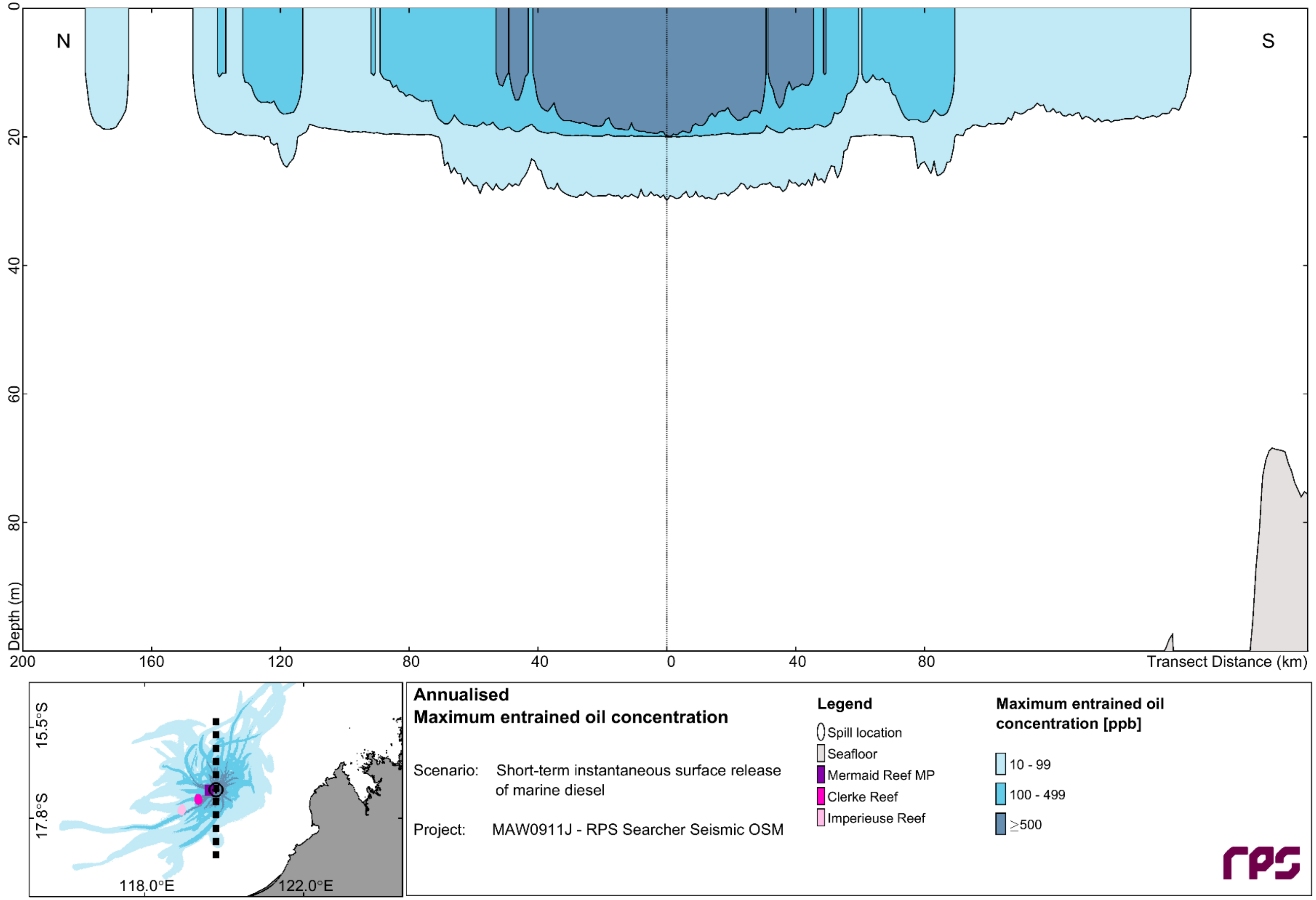

Figure 3.31 North-South cross-section transect of predicted annualised maximum entrained oil concentrations from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals. The results were calculated from 100 spill trajectories.

3.2.2.3 Dissolved Aromatic Hydrocarbon

Table 3.3 Expected annualised dissolved aromatic hydrocarbon outcomes at sensitive receptors resulting from a short-term (instantaneous) surface release of marine gas oil during marine seismic survey operations near Rowley Shoals.

Receptors		Probability (%) of dissolved aromatic concentration				Maximum dissolved aromatic hydrocarbon concentration (ppb)	
		≥ 10 ppb	≥ 50 ppb	≥ 400 ppb	≥ 500 ppb	averaged over all replicate simulations	at any depth, in the worst replicate
Australian Marine Parks	Argo-Rowley Terrace MP	8	3	<1	<1	4	236
	Kimberley MP	<1	<1	<1	<1	<1	2
	Mermaid Reef MP	15	5	<1	<1	7	258
State Marine Parks	Clerke Reef (Rowley Shoals MP)	3	1	<1	<1	<1	60
	Imperieuse Reef (Rowley Shoals MP)	1	1	<1	<1	<1	87
Key Ecological Features	Ancient Coastline at 125m Depth Contour KEF	1	<1	<1	<1	<1	17
	Continental Slope Demersal Fish Communities KEF	1	<1	<1	<1	<1	33
	Mermaid Reef and Commonwealth Waters surrounding Rowley Shoals KEF	26	16	1	<1	21	455
	Seringapatam Reef and Commonwealth Waters in the Scott Reef Complex KEF	<1	<1	<1	<1	NC	NC
Fisheries	North-West Slope Trawl Fishery	35	22	2	2	41	671
	Southern Bluefin Tuna Fishery	35	22	2	2	41	671
	Western Skipjack Fishery	35	22	2	2	41	671
	Western Tuna and Billfish Fishery	35	22	2	2	41	671
Biologically Important Areas	Marine Turtle BIA	<1	<1	<1	<1	<1	<1
	Seabirds BIA	35	22	2	2	41	671
	Sharks BIA	1	<1	<1	<1	<1	44
	Whales BIA	35	22	2	2	41	671
Reefs	Scott Reef South	<1	<1	<1	<1	NC	NC

NC: No contact to receptor predicted for specified threshold.

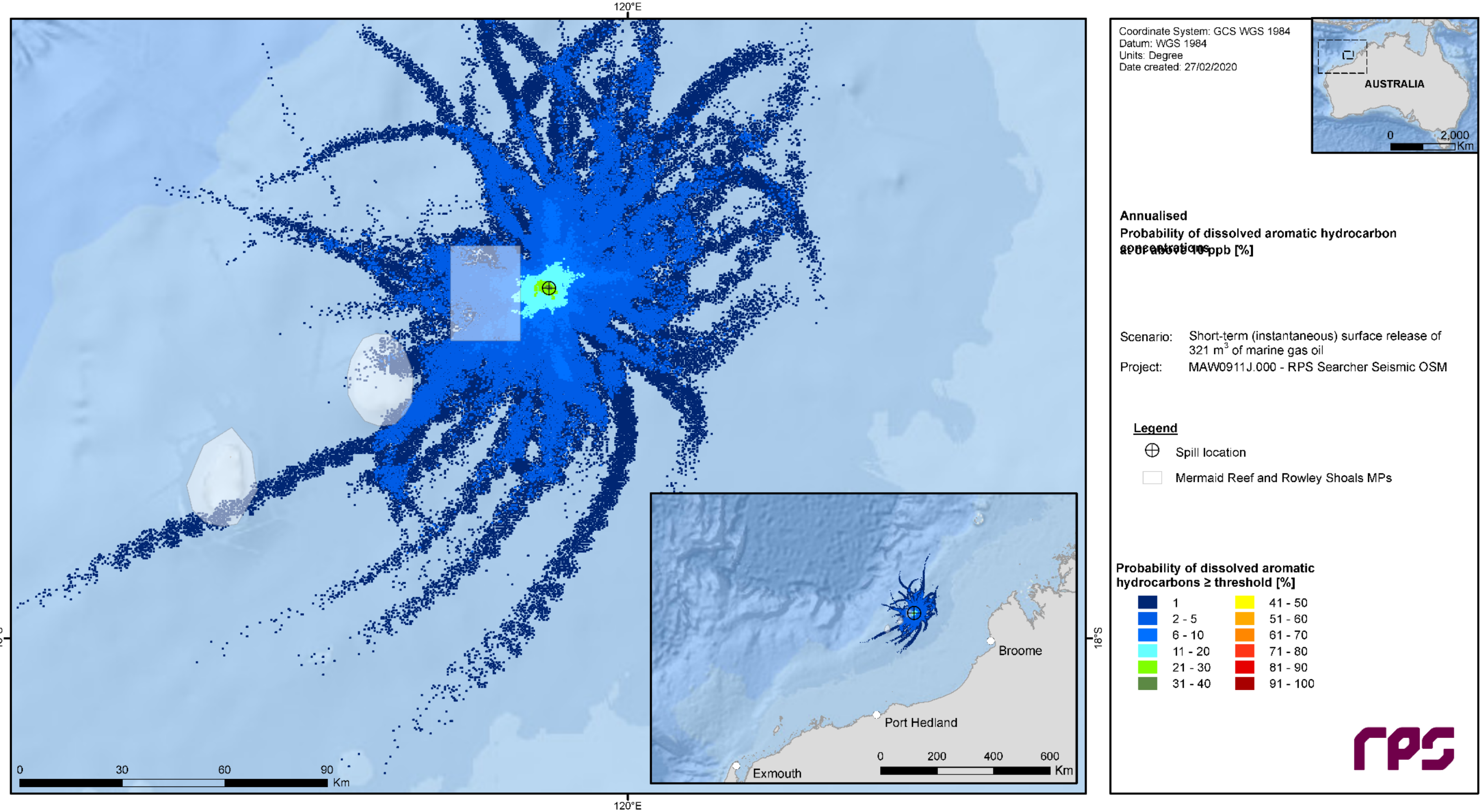

Figure 3.32 Predicted annualised probability of dissolved aromatic hydrocarbon concentrations at or above 10 ppb resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

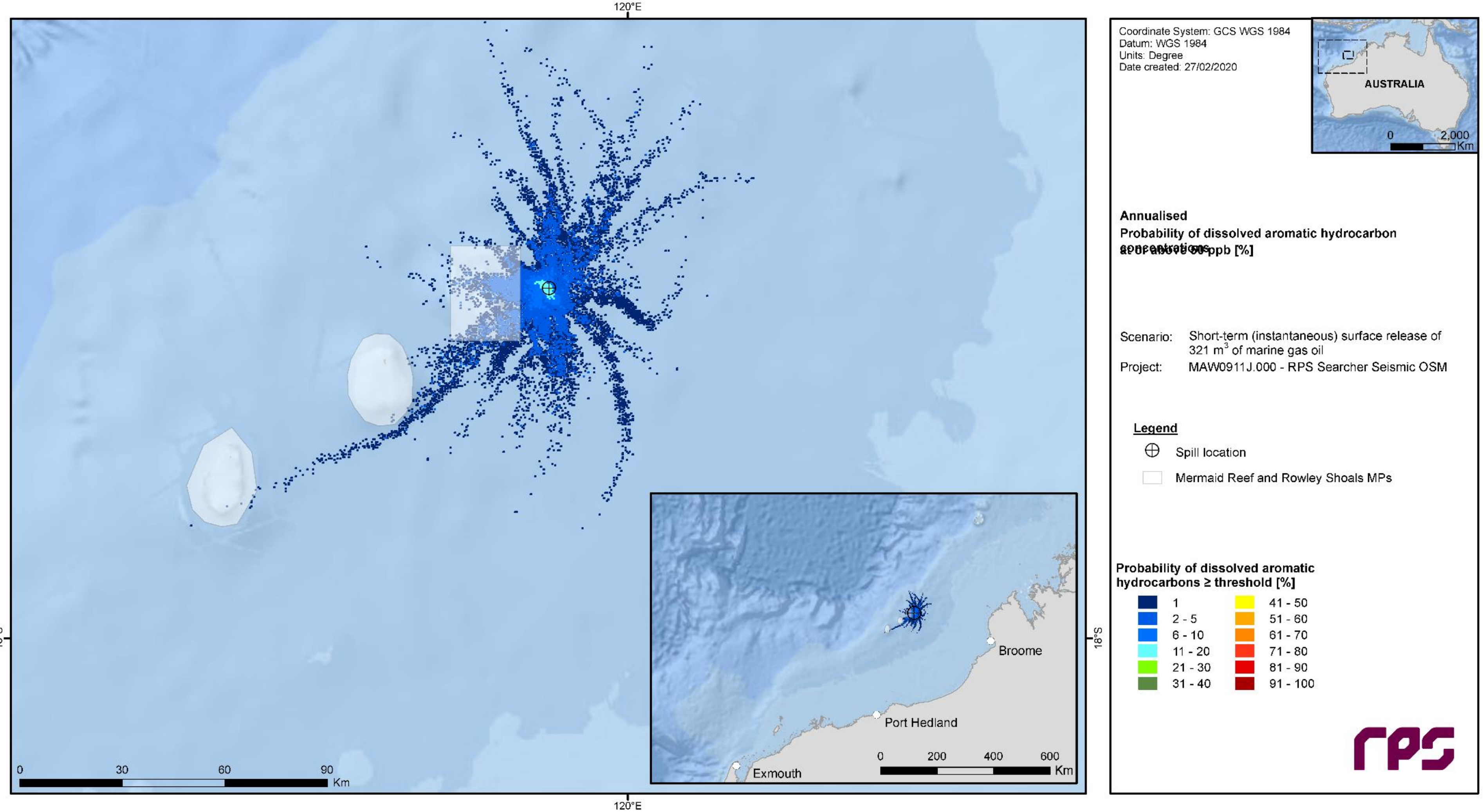

Figure 3.33 Predicted annualised probability of dissolved aromatic hydrocarbon concentrations at or above 50 ppb resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

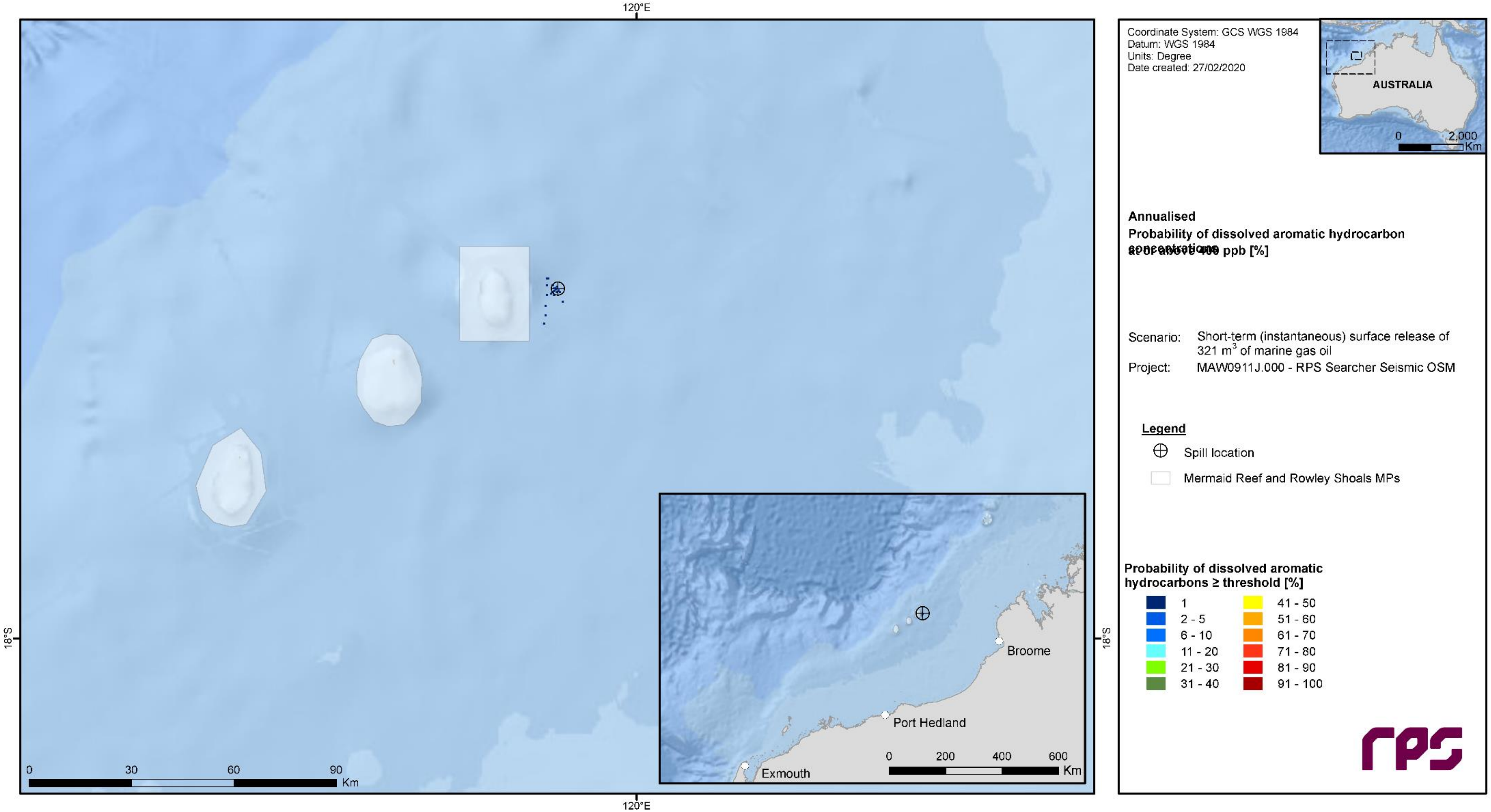

Figure 3.34 Predicted annualised probability of dissolved aromatic hydrocarbon concentrations at or above 400 ppb resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

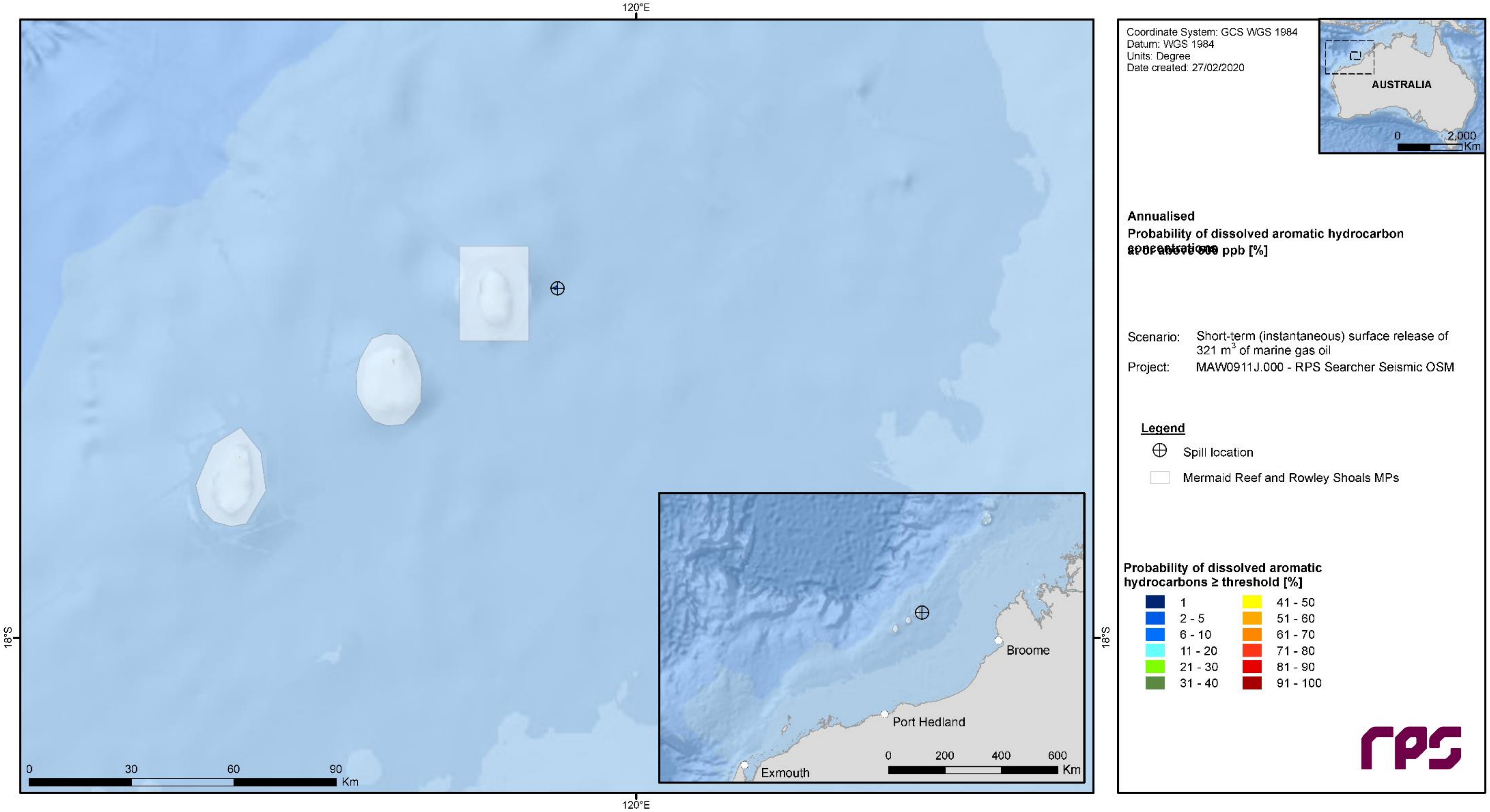

Figure 3.35 Predicted annualised probability of dissolved aromatic hydrocarbon concentrations at or above 500 ppb resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

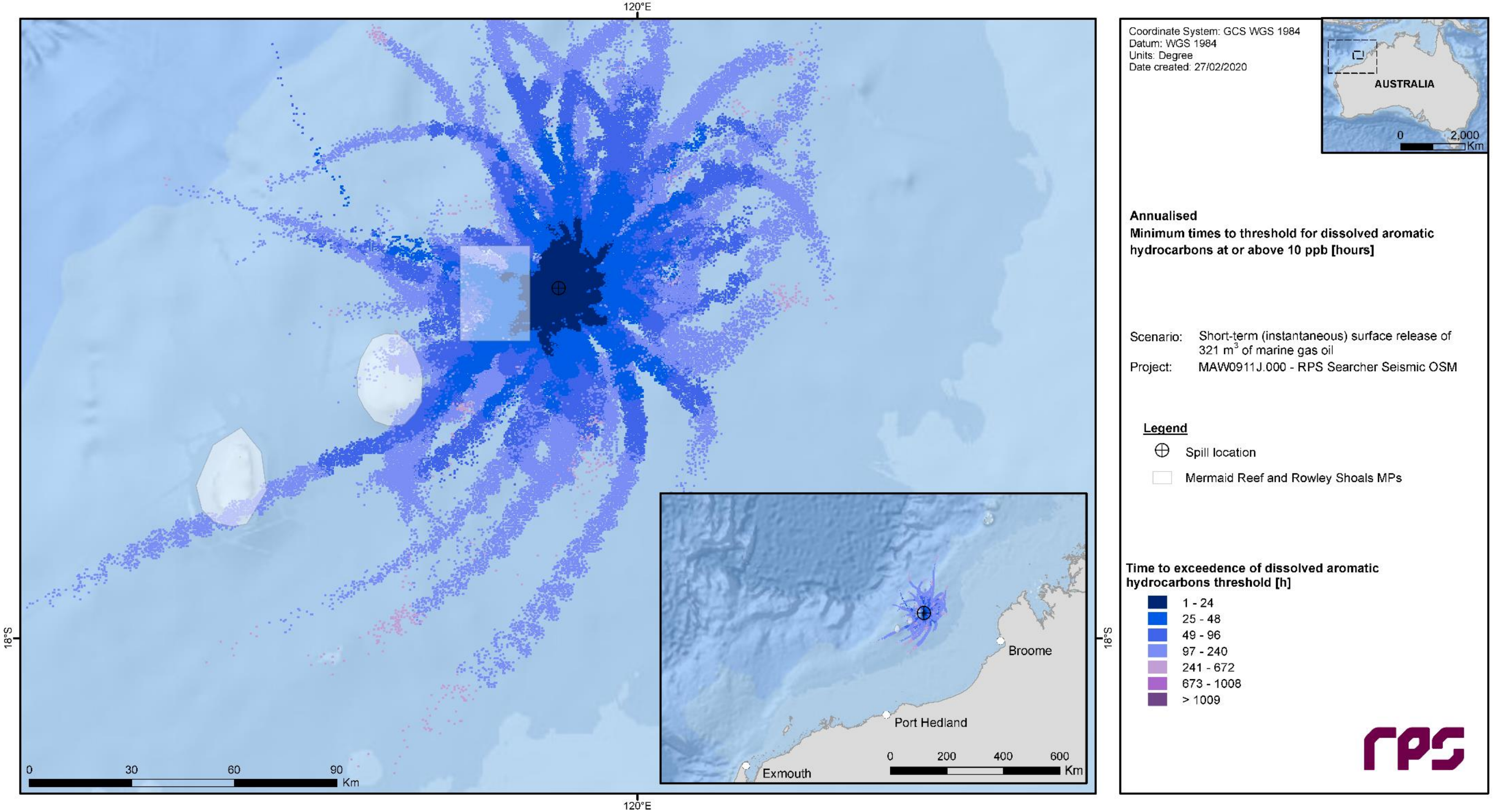

Figure 3.36 Predicted annualised minimum times to contact by dissolved aromatic hydrocarbon concentrations at or above 10 ppb resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

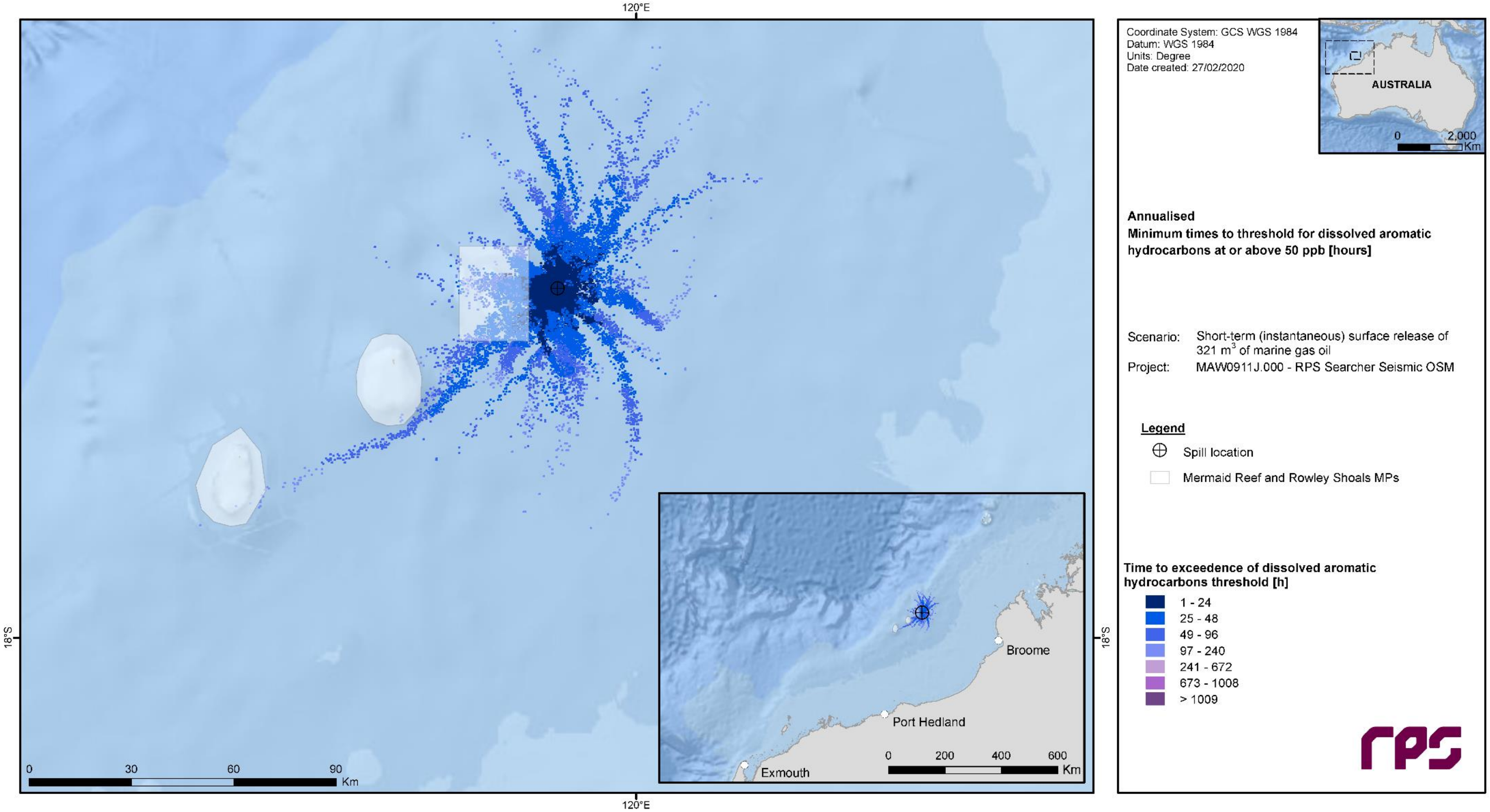

Figure 3.37 Predicted annualised minimum times to contact by dissolved aromatic hydrocarbon concentrations at or above 50 ppb resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

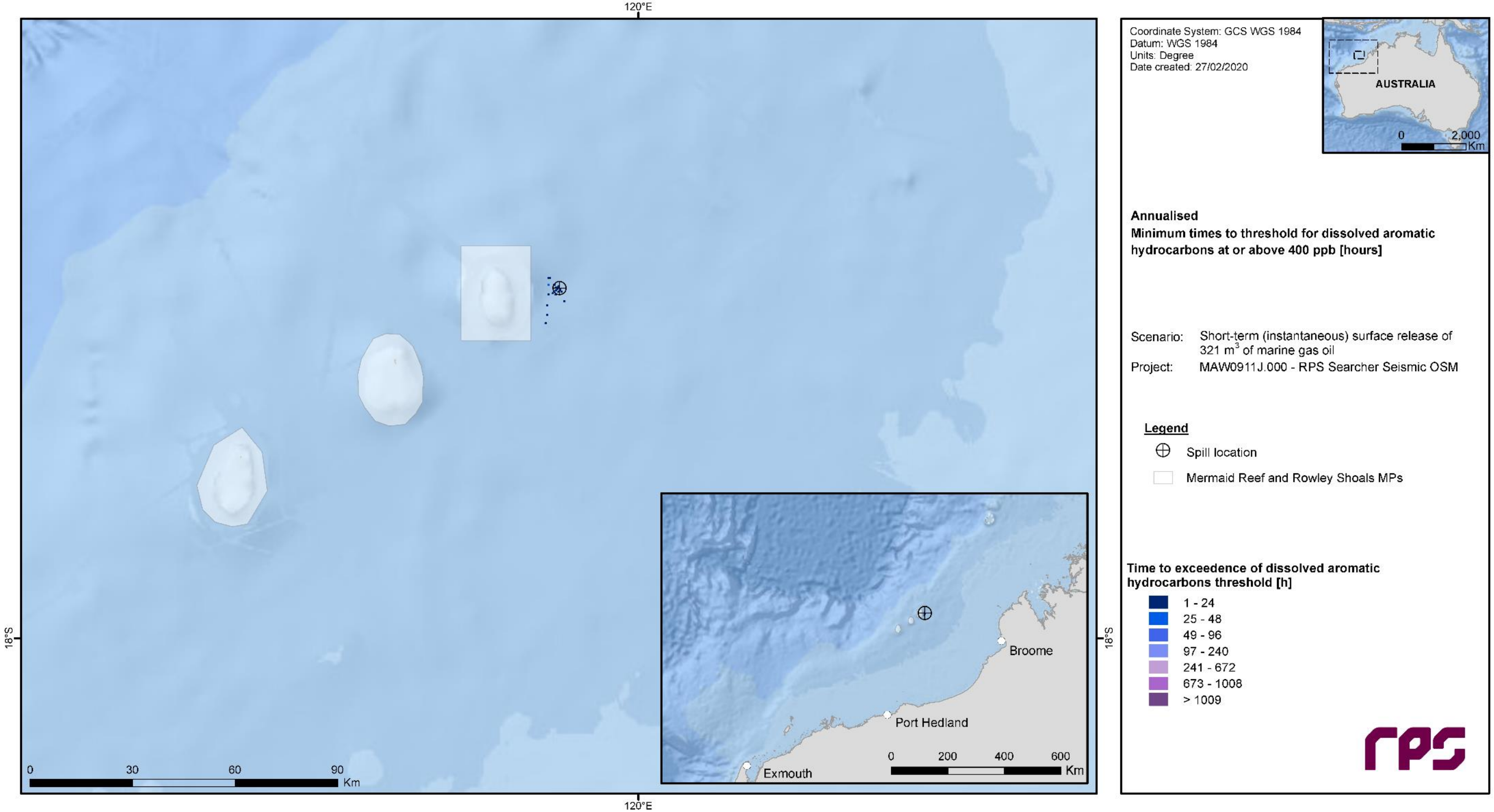

Figure 3.38 Predicted annualised minimum times to contact by dissolved aromatic hydrocarbon concentrations at or above 400 ppb resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

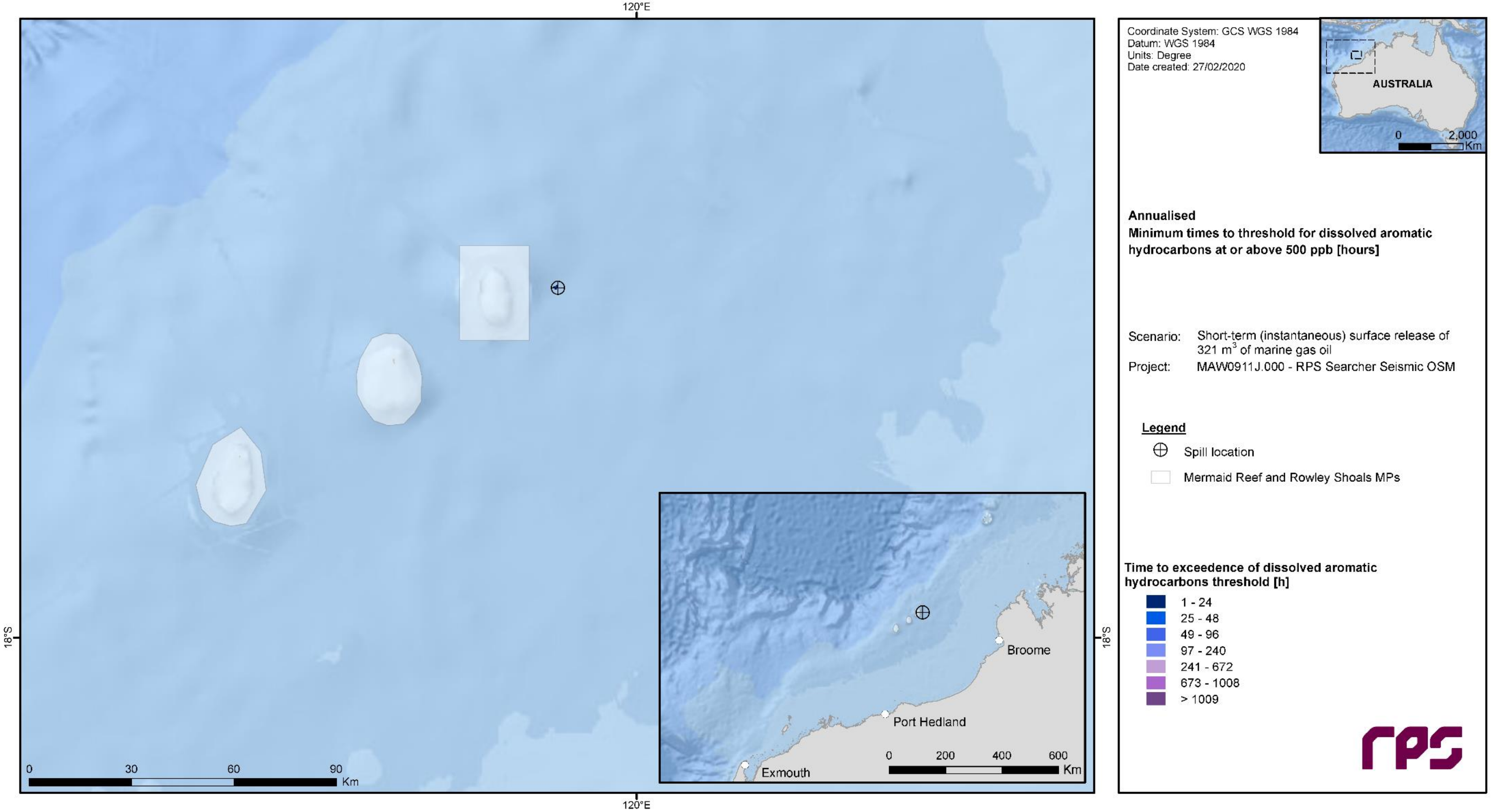

Figure 3.39 Predicted annualised minimum times to contact by dissolved aromatic hydrocarbon concentrations at or above 500 ppb resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

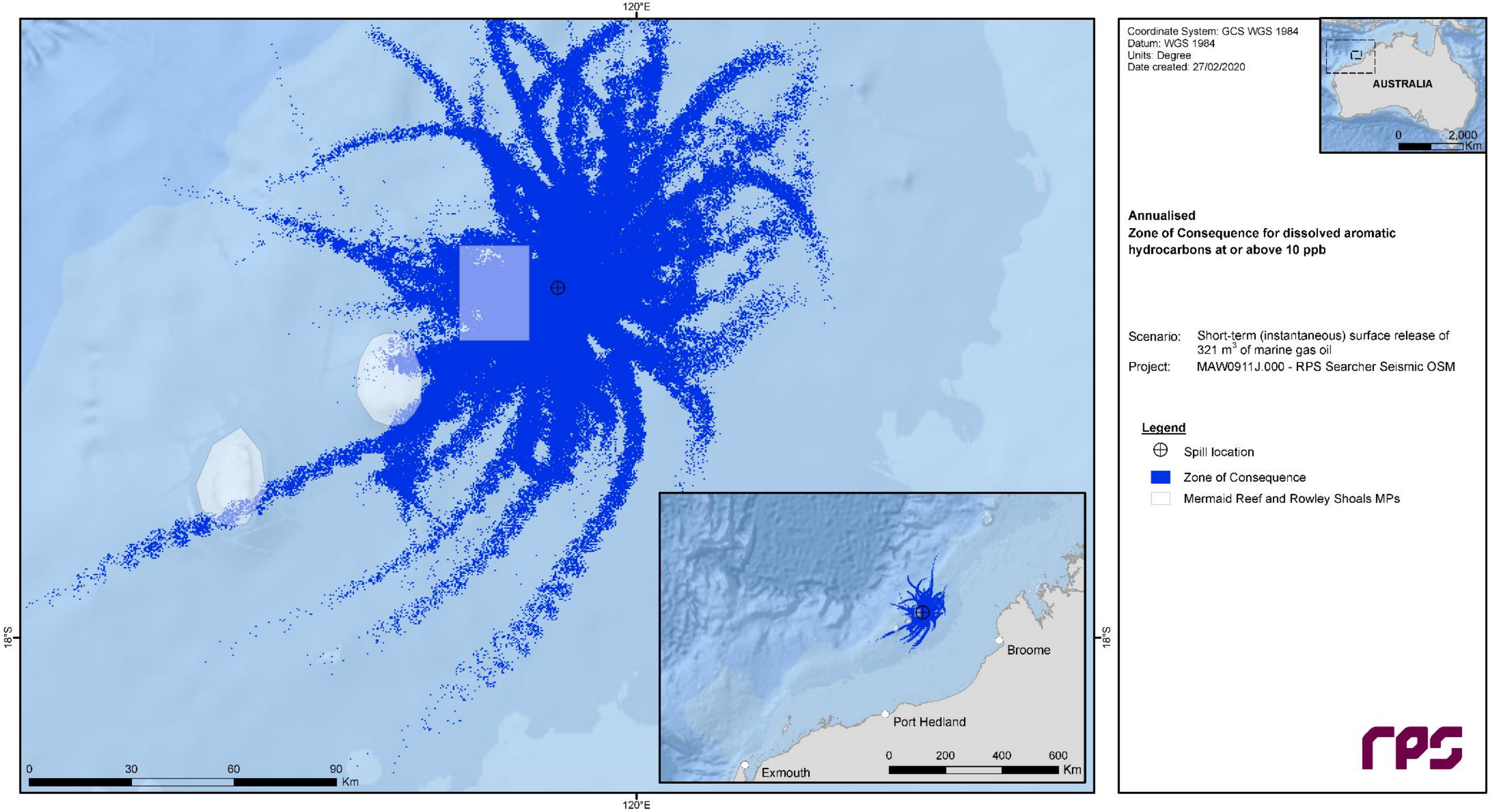

Figure 3.40 Predicted annualised zone of consequence of dissolved aromatic hydrocarbon concentrations at or above 10 ppb resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

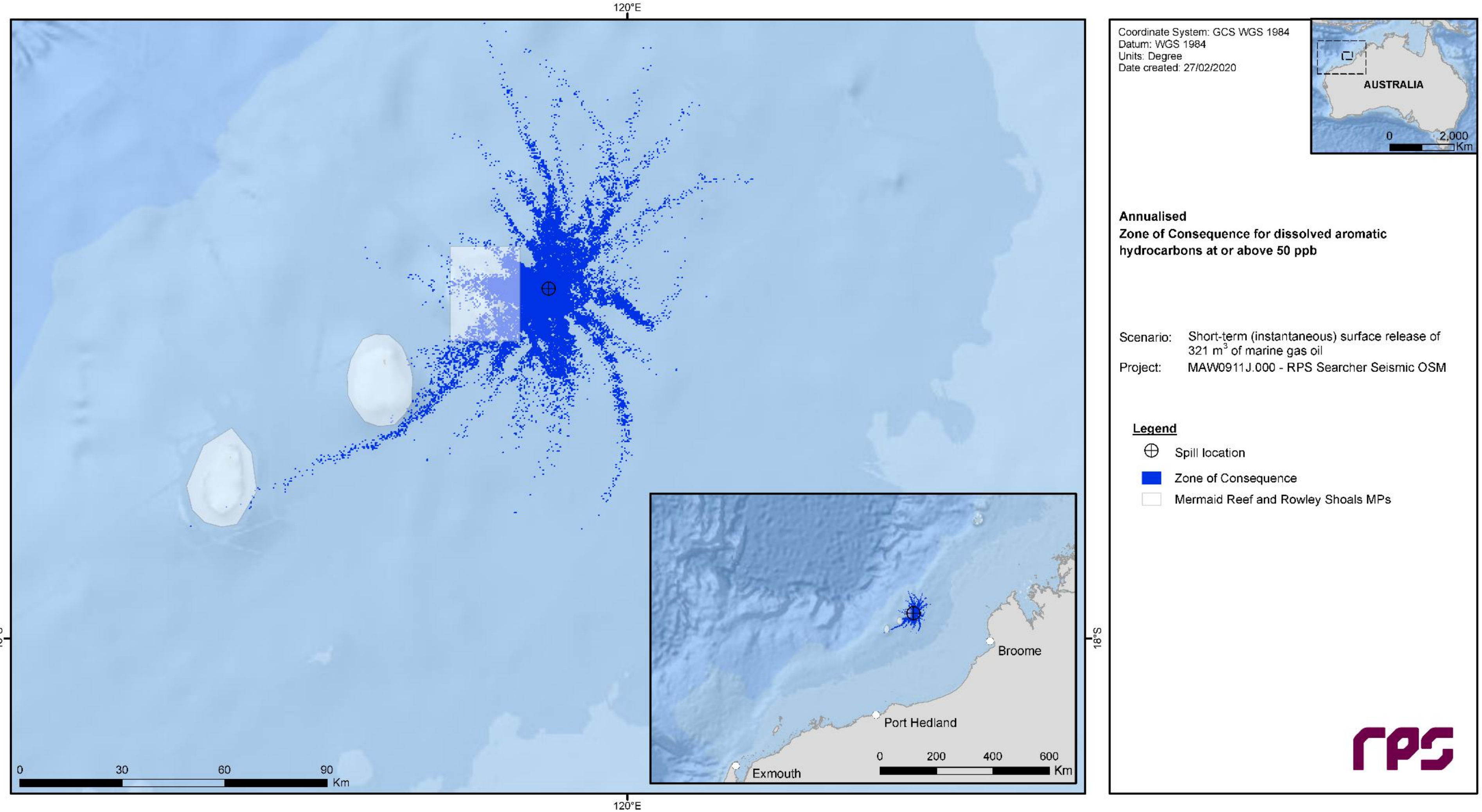

Figure 3.41 Predicted annualised zone of consequence of dissolved aromatic hydrocarbon concentrations at or above 50 ppb resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

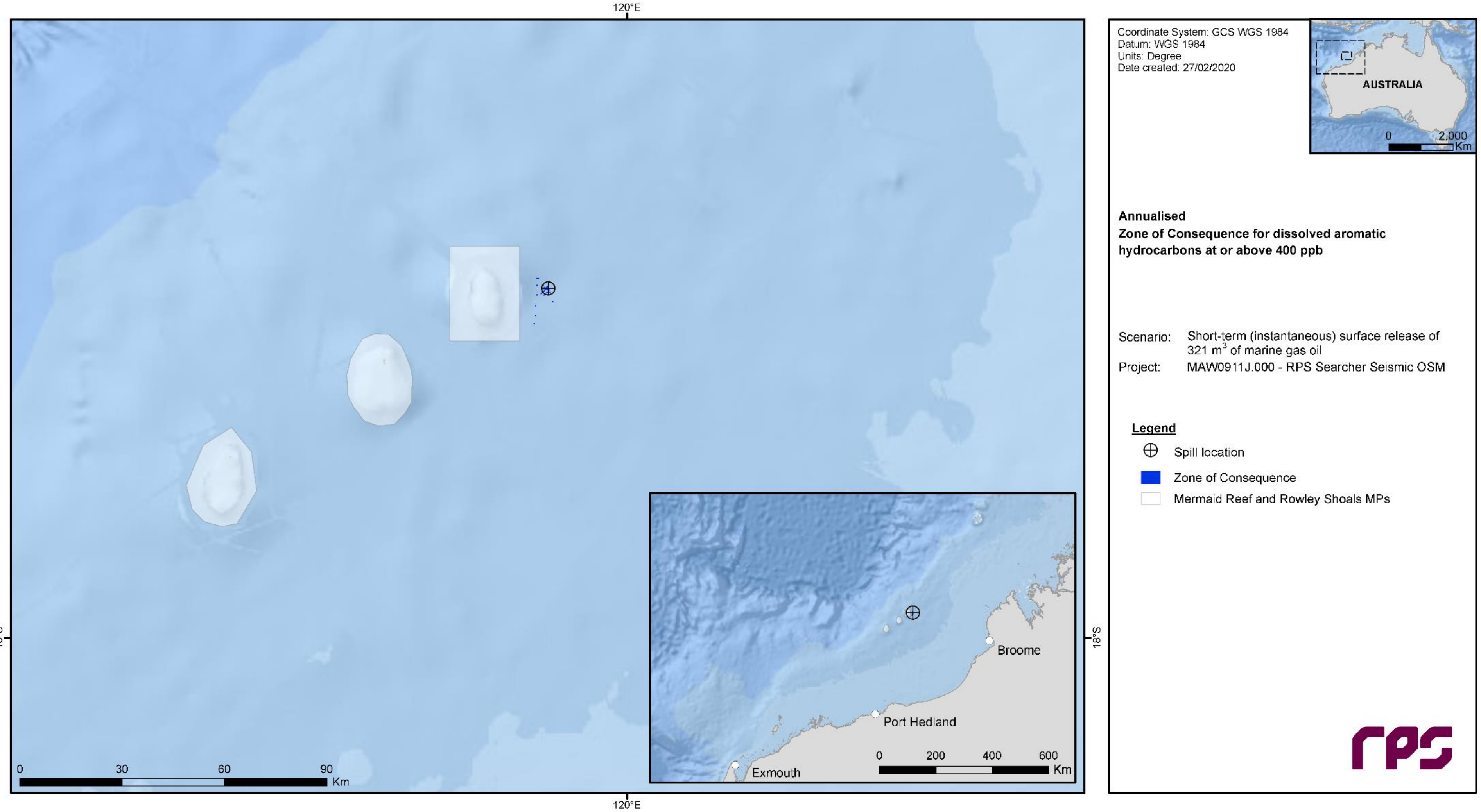

Figure 3.42 Predicted annualised zone of consequence of dissolved aromatic hydrocarbon concentrations at or above 400 ppb resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

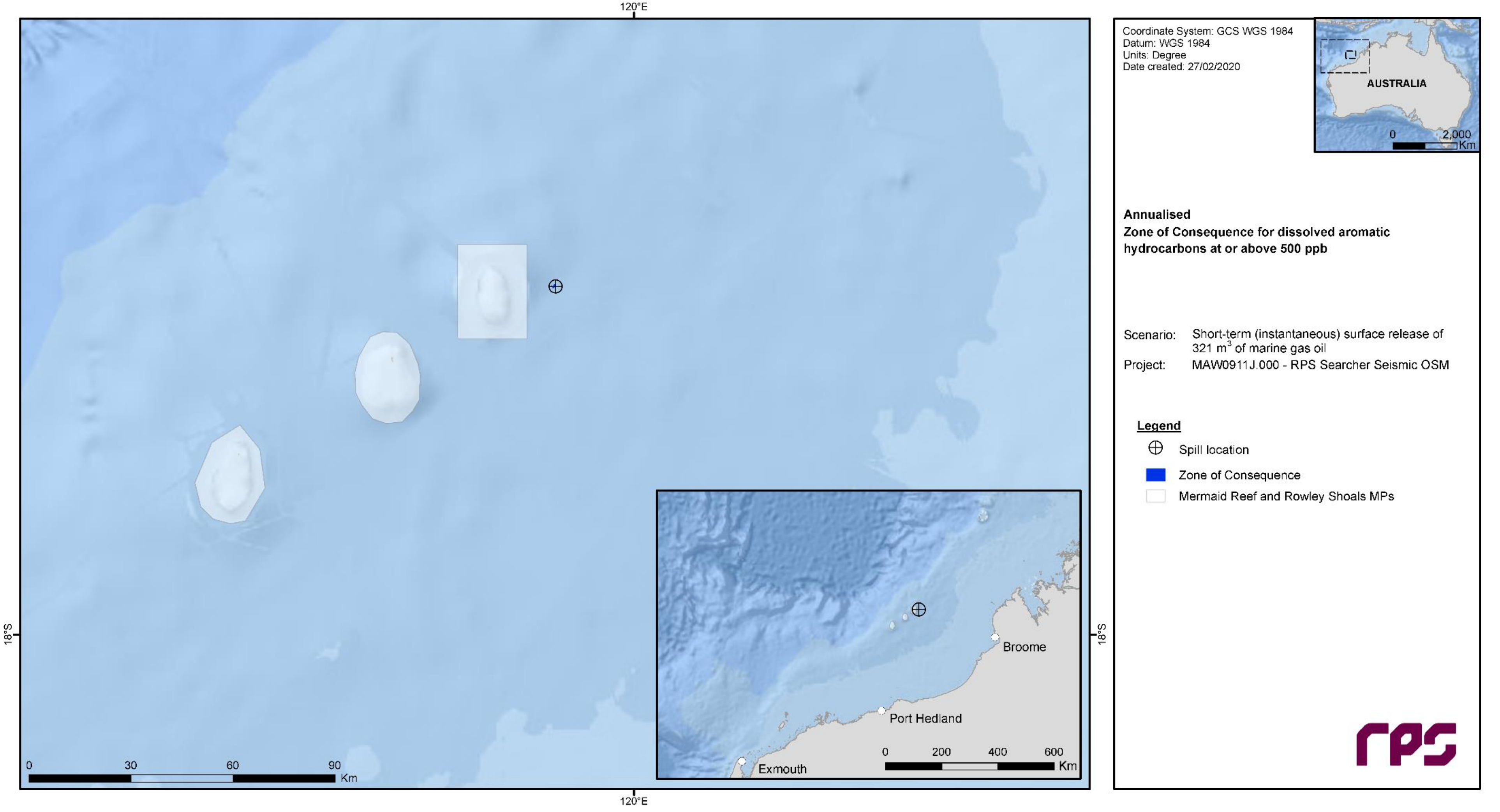

Figure 3.43 Predicted annualised zone of consequence of dissolved aromatic hydrocarbon concentrations at or above 500 ppb resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

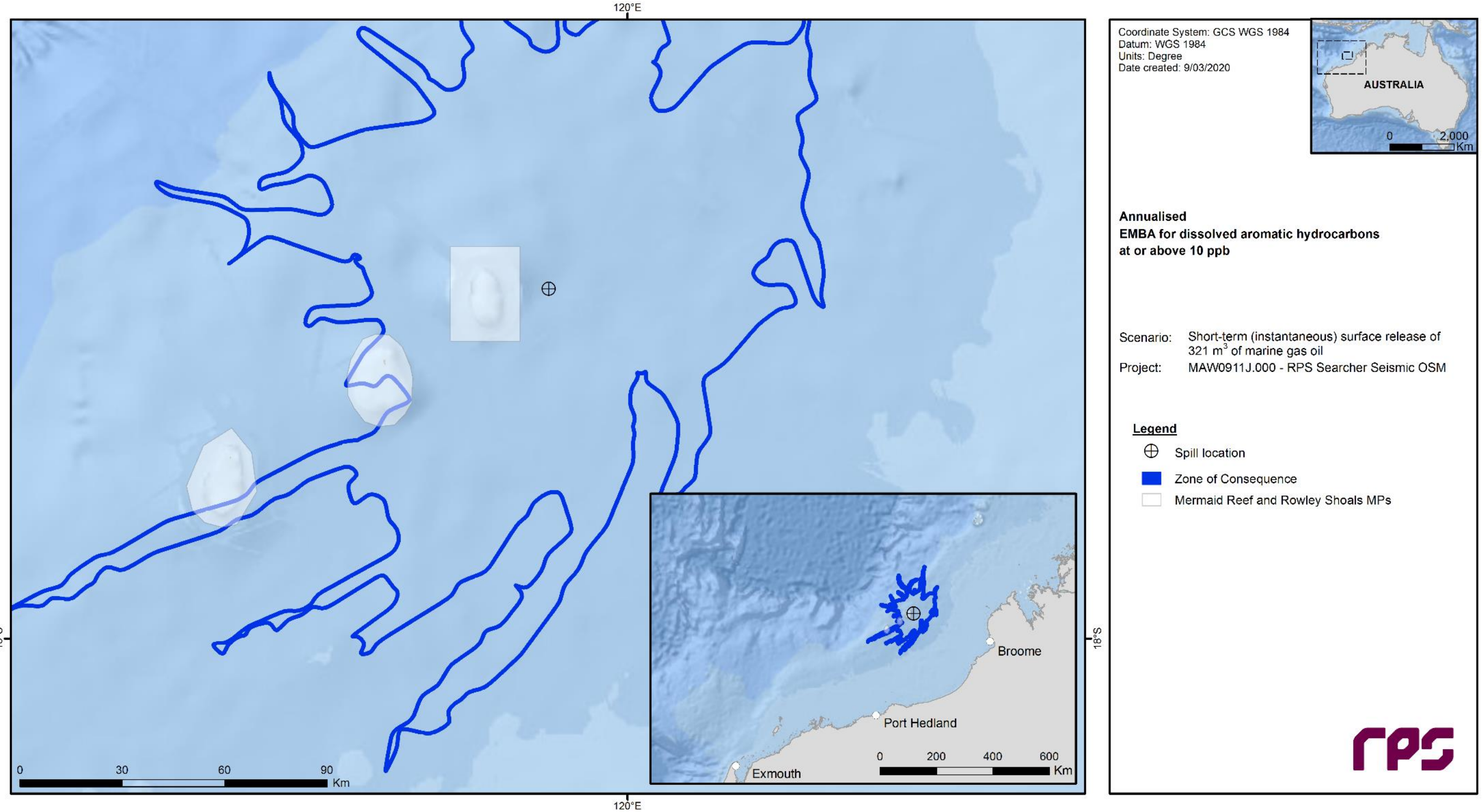

Figure 3.44 Predicted annualised smoothed EMBA of dissolved aromatic hydrocarbon concentrations at or above 10 ppb resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

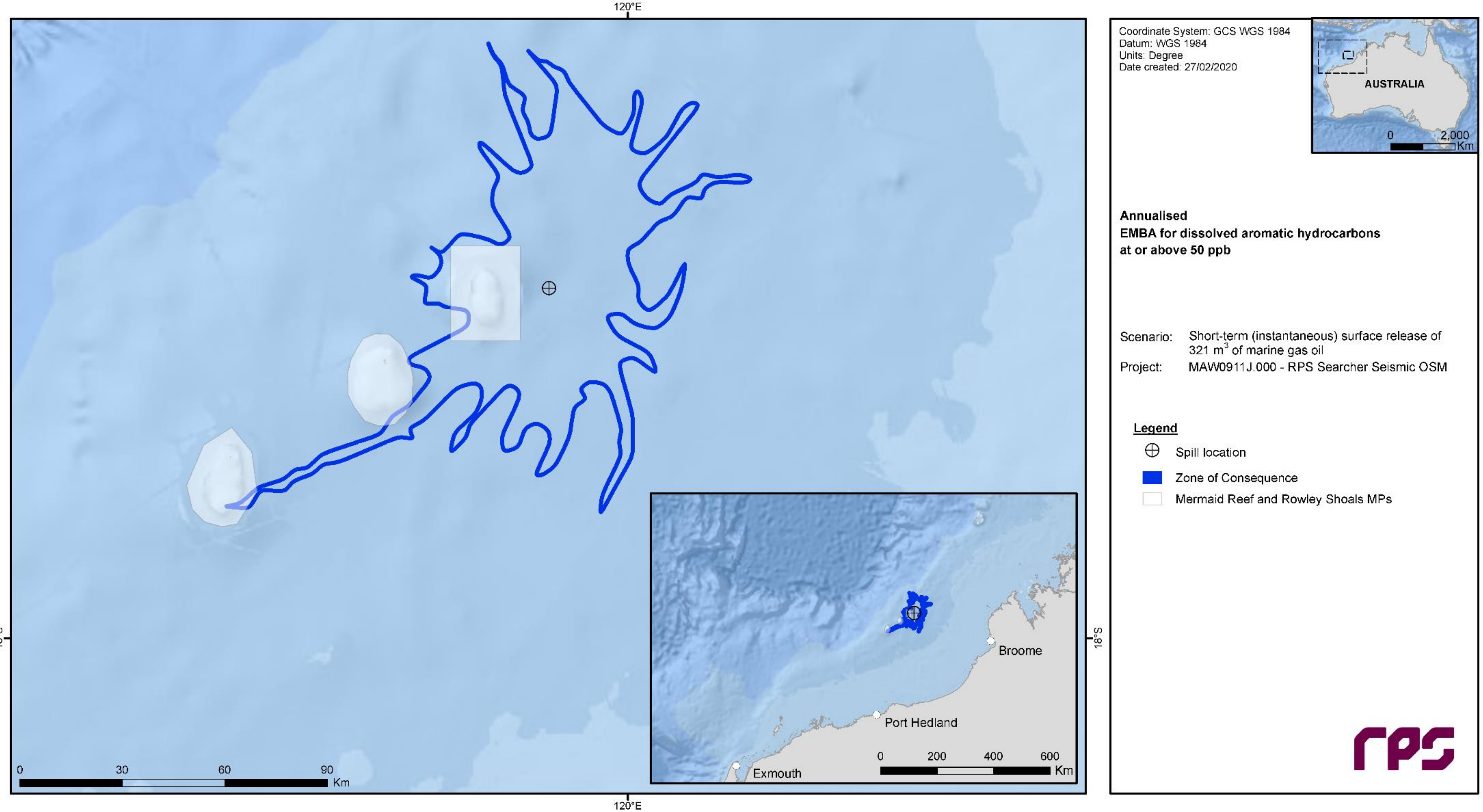

Figure 3.45 Predicted annualised smoothed EMBA of dissolved aromatic hydrocarbon concentrations at or above 50 ppb resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

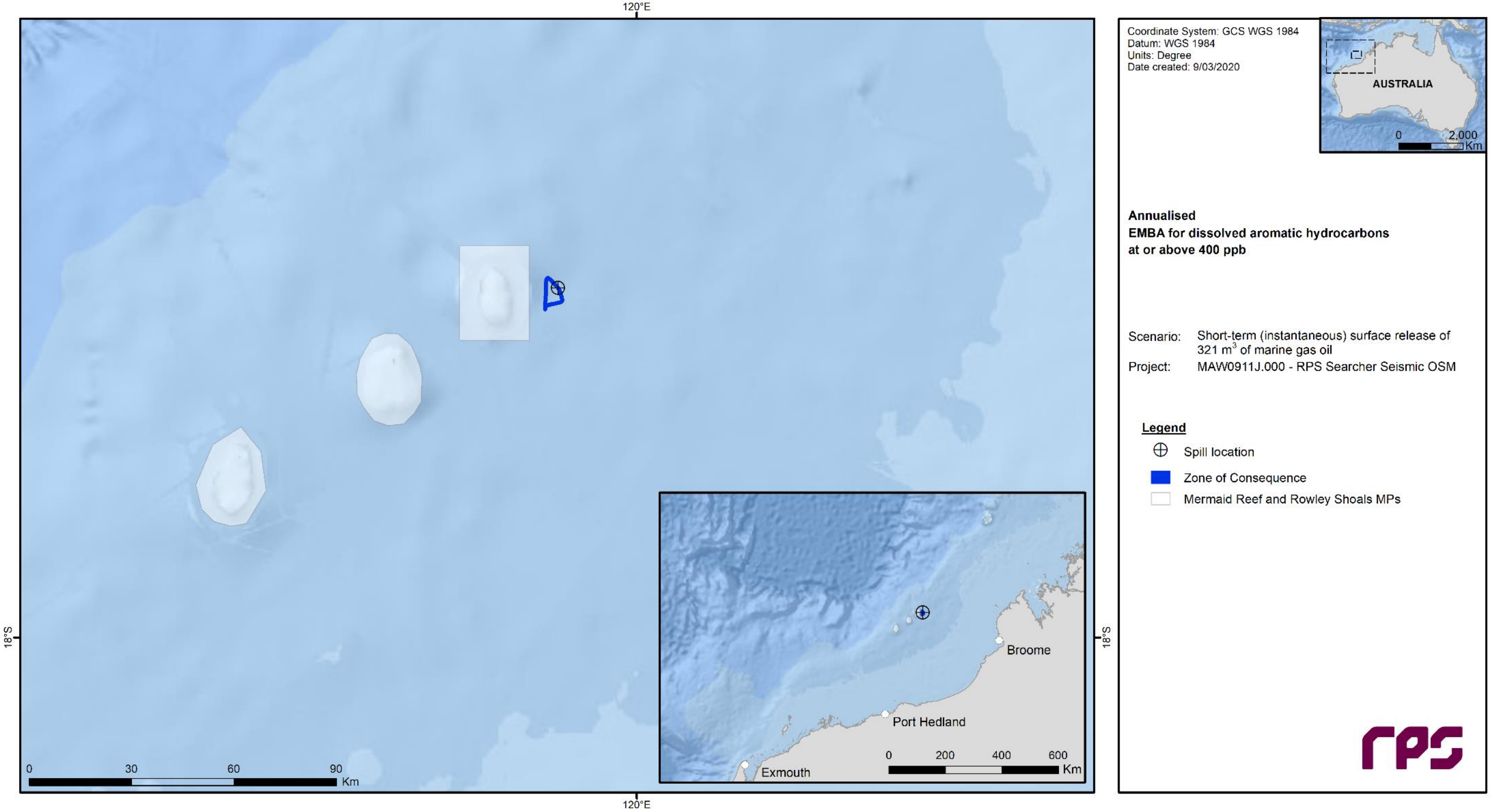

Figure 3.46 Predicted annualised smoothed EMBA of dissolved aromatic hydrocarbon concentrations at or above 400 ppb resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

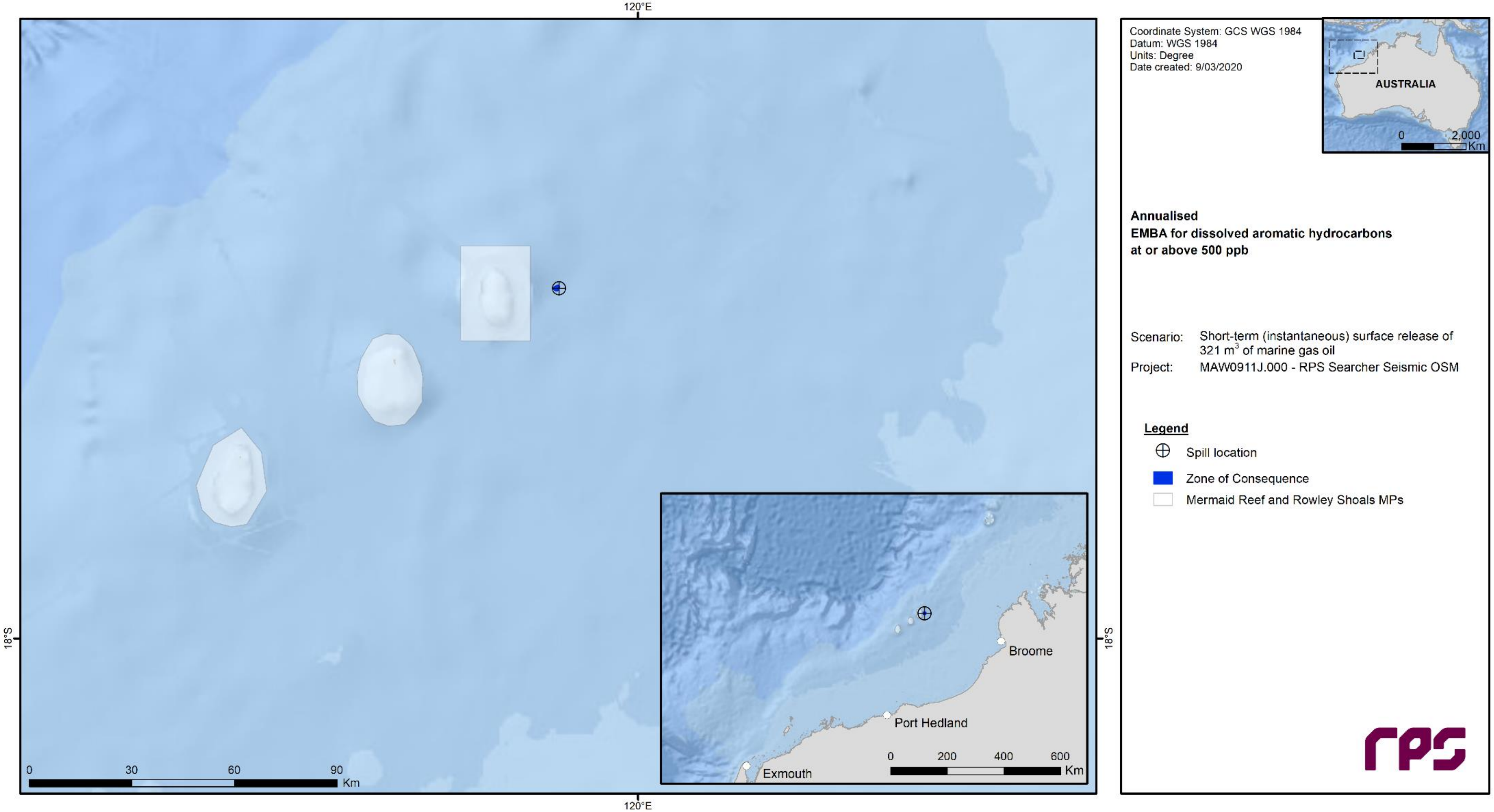

Figure 3.47 Predicted annualised smoothed EMBA of dissolved aromatic hydrocarbon concentrations at or above 500 ppb resulting from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals.

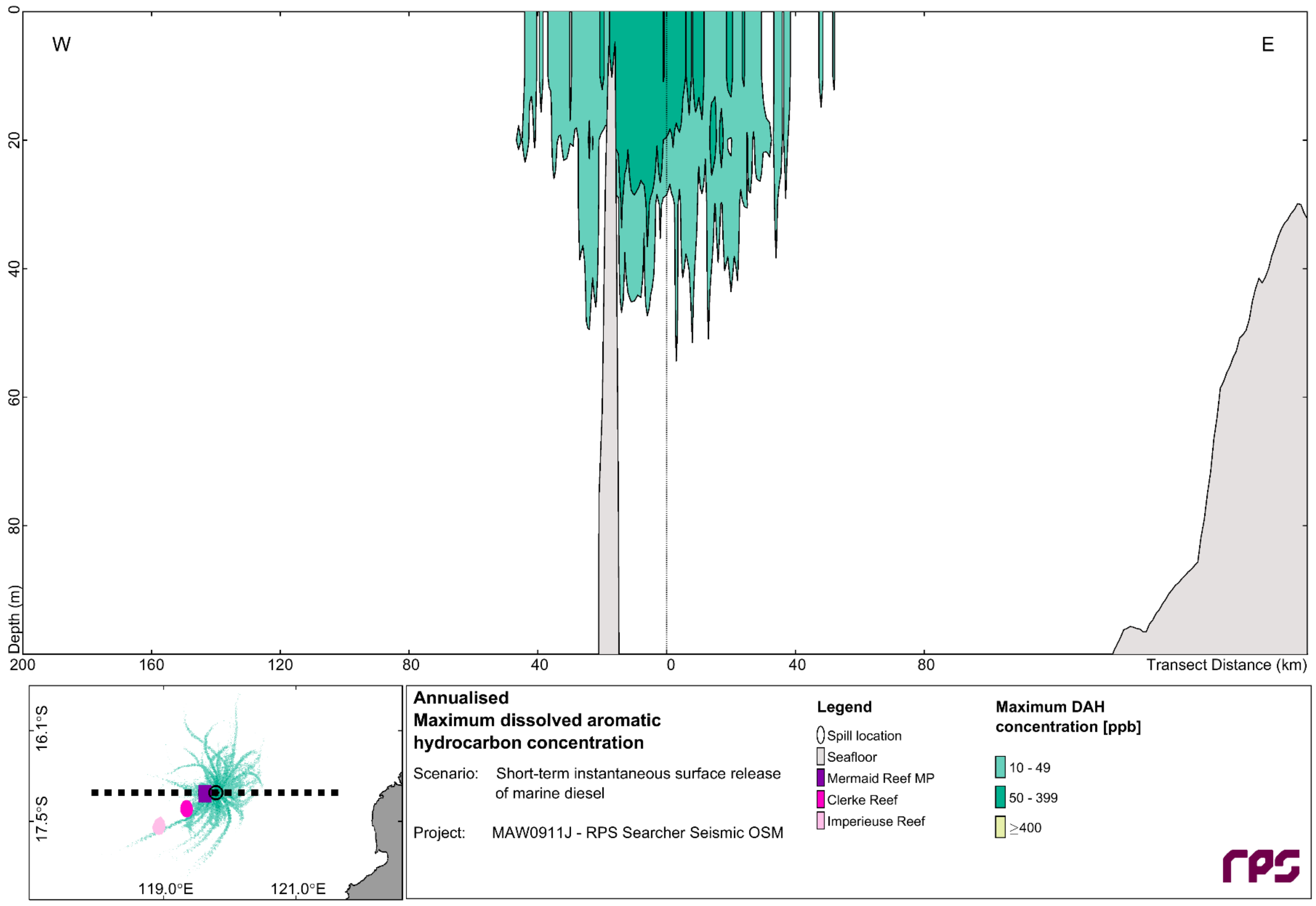

Figure 3.48 West-East cross-section transect of predicted annualised maximum dissolved aromatic hydrocarbon concentrations from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals. The results were calculated from 100 spill trajectories.

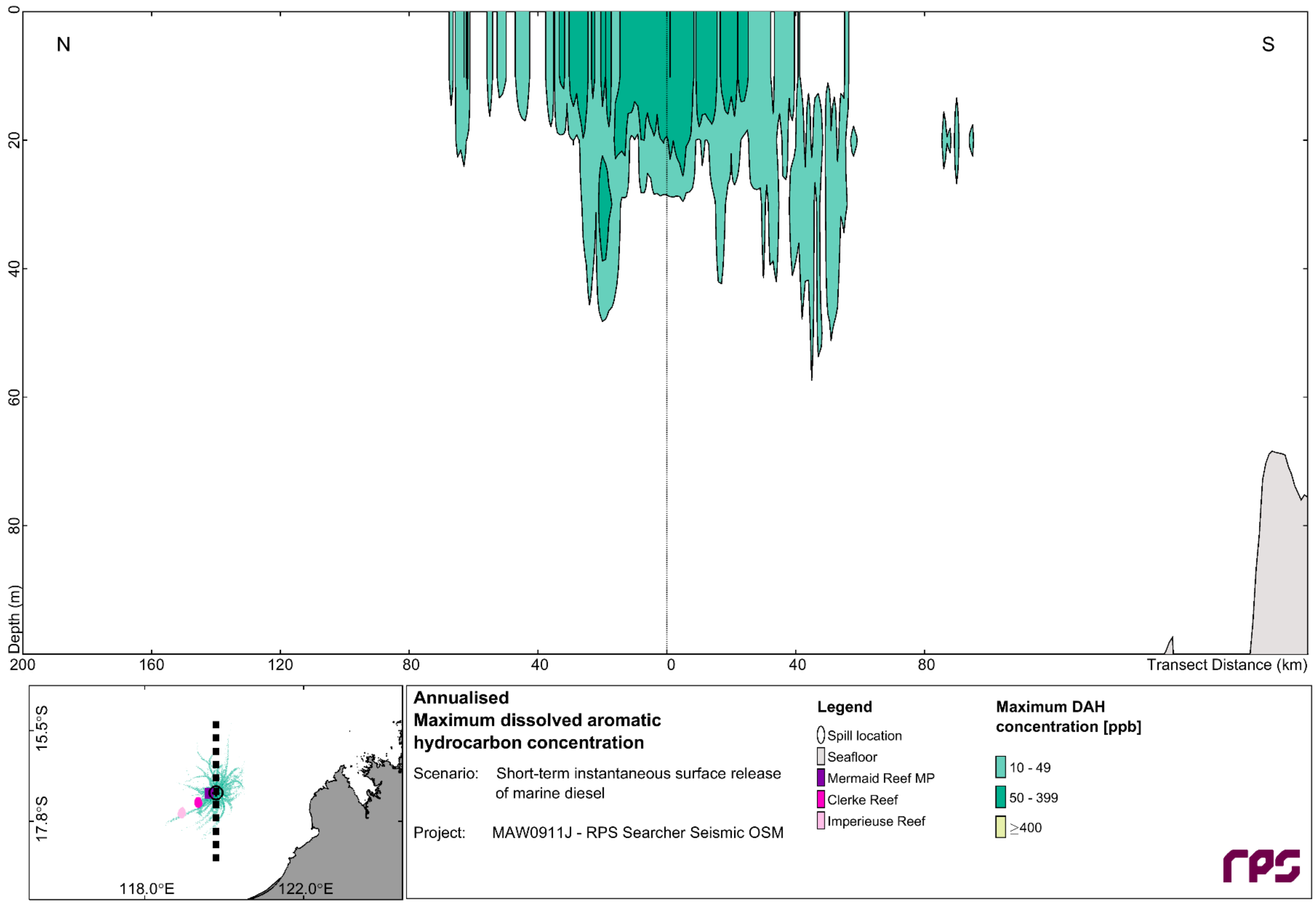

Figure 3.49 North-South cross-section transect of predicted annualised maximum dissolved aromatic hydrocarbon concentrations from a short-term (instantaneous) release of marine gas oil during marine seismic survey operations near Rowley Shoals. The results were calculated from 100 spill trajectories.

4 CONCLUSION

The main findings of the study are as follows:

- Floating oil concentrations at ≥ 1 g/m^2 could potentially occur up to 148 km, from the spill site. Shorter potential effect distances were calculated for higher concentration thresholds, reducing to 84 km for ≥ 10 g/m^2, 32 km for ≥ 50 g/m^2 and 19 km for ≥ 100 g/m^2.
- Highest probabilities of contact with floating oil at ≥ 100 g/m^2 (100%) were calculated for the Commonwealth Fisheries Zones that encompass the release site because concentrations were calculated to exceed 100 g/m^2 initially during all simulations. Similarly, the Biologically Important Area (BIA) for seabirds and whales encompassed the release site and was calculated to have 100% probability of contact at ≥ 100 g/m^2.
- Two Key Ecological Features (KEFs) that were defined by boundaries on the water surface were calculated to have relatively low probability of contact at ≥ 100 g/m^2 but the highest probability of contact by floating oil at ≥ 10 g/m^2: Mermaid Reef Marine Park (1% at ≥ 100 g/m^2; 5% at ≥ 10 g/m^2); Mermaid Reef and Commonwealth waters surrounding Rowley Shoals (1% at ≥ 100 g/m^2; 13% at ≥ 10 g/m^2); Note that this is the probability that such oil concentrations might occur at some part of the boundary of these receptor areas.
- Floating oil ≥ 10 g/m^2 could potentially arrive at the boundaries of Mermaid Reef Marine Park and Mermaid Reef and Commonwealth waters surrounding Rowley Shoals within 1 hour after a spill commencement.
- A low probability of contact (< 1%) with any shoreline is indicated for floating oil at ≥ 1 g/m^2. However, the potential for accumulation of oil that arrives at lower concentrations indicated on some shorelines. The worst-case is indicated for emergent land within the Mermaid Reef and Commonwealth waters surrounding Rowley Shoals Key Ecological Feature and the Seabirds Biologically Important Areas.
- Entrained oil at concentrations equal to or greater than the 10 ppb, 100 ppb and 500 ppb thresholds are predicted to be found up to around 441 km, 280 km and 120 km from the spill site, respectively.
- The probability of contact by entrained oil concentrations at or greater than 100 ppb is predicted to be greatest at North-West Slope Trawl Fishery, Southern Bluefin Tuna Fishery, Western Skipjack Fishery, Western Tuna and Billfish Fishery, Seabirds and Whales Biologically Important Areas with a probability of 49%.
- The worst-case instantaneous entrained oil concentration at any receptor is predicted at North-West Slope Trawl Fishery, Southern Bluefin Tuna Fishery, Western Skipjack Fishery, Western Tuna and Billfish Fishery, Seabirds and Whales Biologically Important Areas as 58,739 ppb.
- Mermaid Reef Marine Park is predicted to have a worst-case entrained oil concentration of 4,922 ppb.
- Cross-sectional transects of maximum entrained oil concentrations in the vicinity of the release site indicate that entrained oil concentrations at or greater than 100 ppb are not likely to occur at depths greater than ~20 m BMSL.
- Dissolved aromatic hydrocarbons at concentrations ≥ 10 ppb are calculated to occur up to 215 km from the spill site. The potential contact zone is calculated to decrease exponentially as the threshold concentration is raised.
- Highest probability of contact by dissolved aromatic hydrocarbon concentrations at ≥ 50 ppb is calculated for North-West Slope Trawl Fishery, Southern Bluefin Tuna Fishery, Western Skipjack Fishery, Western Tuna and Billfish Fishery, Seabirds and Whales Biologically Important Areas, each with a probability of 22%.
- The worst-case dissolved aromatic hydrocarbon concentration at any receptor (671 ppb) is calculated for North-West Slope Trawl Fishery, Southern Bluefin Tuna Fishery, Western Skipjack Fishery, Western Tuna and Billfish Fishery, Seabirds and Whales Biologically Important Areas.
- Mermaid Reef Marine Park is predicted to have a worst-case dissolved aromatic hydrocarbon concentration of 258 ppb.
- Cross-sectional transects of maximum dissolved aromatic hydrocarbon concentrations in the vicinity of the release site indicate that dissolved aromatic hydrocarbon concentrations at ≥ 50 ppb should not reach depths greater than ~40 m BMSL.

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APPENDIX I OIL POLLUTION EMERGENCY PLAN AND OPERATIONAL AND SCIENTIFIC MONITORING PLANS

POSSUM MULTI-CLIENT MARINE SEISMIC SURVEY

OIL POLLUTION EMERGENCY PLAN

Searcher Seismic

April 2020

Rev C

Document Title: Possum Multi-Client 3D Marine Seismic Survey Oil Pollution Emergency Plan

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DISTRIBUTION LIST

Copies To:

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ACRONYMS AND ABBREVIATIONS

Term	Description
3D	3-dimensional
ALARP	As low as reasonably practicable
AMOSC	Australian Marine Oil Spill Centre
AMSA	Australian Maritime Safety Authority
ASAP	As soon as possible
BAOAC	Bonn agreement oil appearance code
BIA	Biologically important area
CA	Control agency
CMR	Commonwealth marine reserve
CoC	Chain of custody (form)
DAWE	Australian Department of Agriculture, Water and the Environment
DBCA	Western Australian Department of Biodiversity, Conservation and Attractions
DMIRS	Western Australian Department of Mines, Industry Regulation and Safety
DNP	Director of national parks
DoT	Western Australian Department of Transport
DPAW	Western Australian Department of Parks and Wildlife (now DBCA)
EMBA	Environment that may be affected
EP	Environment plan
ERP	Emergency response plan
ESI	Environmental sensitivity index
GPS	Global positioning system
GRT	Gross register tonnage
HMA	Hazard management agency
HSE	Health, safety and environment
HSEMS	Health, safety and environment management system
IAP	Incident action plan
IC	Incident commander
IMT	Incident management team
ITOPF	International tanker owners pollution federation
KEF	Key ecological feature
L1	Level 1 spill
L2	Level 2 spill
MARPOL	International convention for the prevention of pollution from ships
MDO	Marine diesel oil
MEE	Western Australian state hazard plan - maritime environmental emergencies
MEER	Western Australian marine environmental emergency response
MGO	Marine gas oil
MIMT	Maritime incident management team
MSS	Marine seismic survey
NATA	National association of testing authorities
NATPLAN	National plan for maritime environmental emergencies
NEBA	Net environmental benefit analysis
NES	National environmental significance
NOPSEMA	National offshore petroleum safety and environment management authority
NOPTA	National offshore petroleum titleholders administrator
NRT	National response team
NWMR	North-west marine region
OHS	Occupational health and safety
OMP	Operational monitoring plan
OPEP	Oil pollution emergency plan
OPGGS Act	Offshore Petroleum and Greenhouse Gas Storage Act 2006
OPGGS(E)R	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009
OSMP	Operational and scientific monitoring program

Term	Description
OSRO	Oil Spill Response Organisation (e.g. AMOSC)
OSTM	Oil spill trajectory modelling
OWR	Oiled wildlife response
POLREP	Marine pollution report
PPE	Personal protective equipment
QA/QC	Quality assurance/quality control
SAP	Sampling and analysis plan
SCAT	Shoreline clean-up and assessment technique
Searcher	Searcher Seismic Pty Ltd
SIMA	Spill impact mitigation assessment
SIMOPS	Simultaneous operations
SME	Subject matter expert
SMP	Scientific monitoring plan
SOPEP	Shipboard oil pollution emergency plan
SRT	State Response Team
VHF	Very high frequency
VOCs	Volatile organic compounds
WA	Western Australia

1 INITIAL 'FIRST STRIKE' ACTIONS

1.1 IMMEDIATE ACTIONS:

Action	Timeframe	Responsibility
Identify the source of the hydrocarbon release and raise the alarm	Immediate; as soon as a release has been identified.	All offshore personnel
Activate the vessel shipboard oil pollution emergency plan (SOPEP)/spill management plan to stop the spill: • isolate the source of the spill • minimise the release volume (consider transfer of fuel from leaking tank) • clean up spill to deck	Following alarm being raised and rapid considerations of health and safety risks.	Vessel master (on-scene incident commander)
Classify the Level of the spill (see Table 1-2)	Immediately following activation of the SOPEP/OPEP	Vessel master
Verbally notify Australian Maritime Safety Authority (AMSA) via the AMSA Rescue Coordination Centre (JRCC) Australia on +61 (02) 6230 6811 (1800 641 792)	Immediately (as soon as possible) following alarm being raised	Vessel master
Notify Searcher Seismic: Main contact: Operations Manager: (+61 (08) 9327 0330) Secondary contacts: General Manager (+61 424 190 151)	Immediately (as soon as possible) following alarm being raised	Vessel master
Activate Searcher Incident Management Team (IMT)	Immediately, following verbal notification of release from vessel master	Searcher IMT IC
Activate monitor and surveillance response strategy (see Section 5.2): • maintain visual observations (Section 5.2) • manual spill trajectory calculations	Within 1 hour of first report of spill	Vessel master, supported by Searcher IMT
Undertake other relevant regulator notifications and reporting (see Table 1-1)	In a timely manner	Vessel master, supported by Searcher IMT
Conduct a Net Environmental Benefit Assessment (NEBA) of spills response strategies and tactics	Within 2 hours of first report of spill	Searcher IMT / AMSA
If wildlife are likely to be oiled, notify relevant jurisdictional control agency	Within 2 hours of identifying risk to oiled wildlife	Searcher IMT / AMSA
For a Level 2 spill, activate Operational and Scientific Monitoring Plan (OSMP) and review activation triggers for individual monitoring plans	Within 2 hours of first report of the spill to the Searcher on-call incident commander	Searcher IMT / Control Agency(ies)

1.2 RESPONSE PROCESS

A summary of the response process is provided in Figure 1-1.

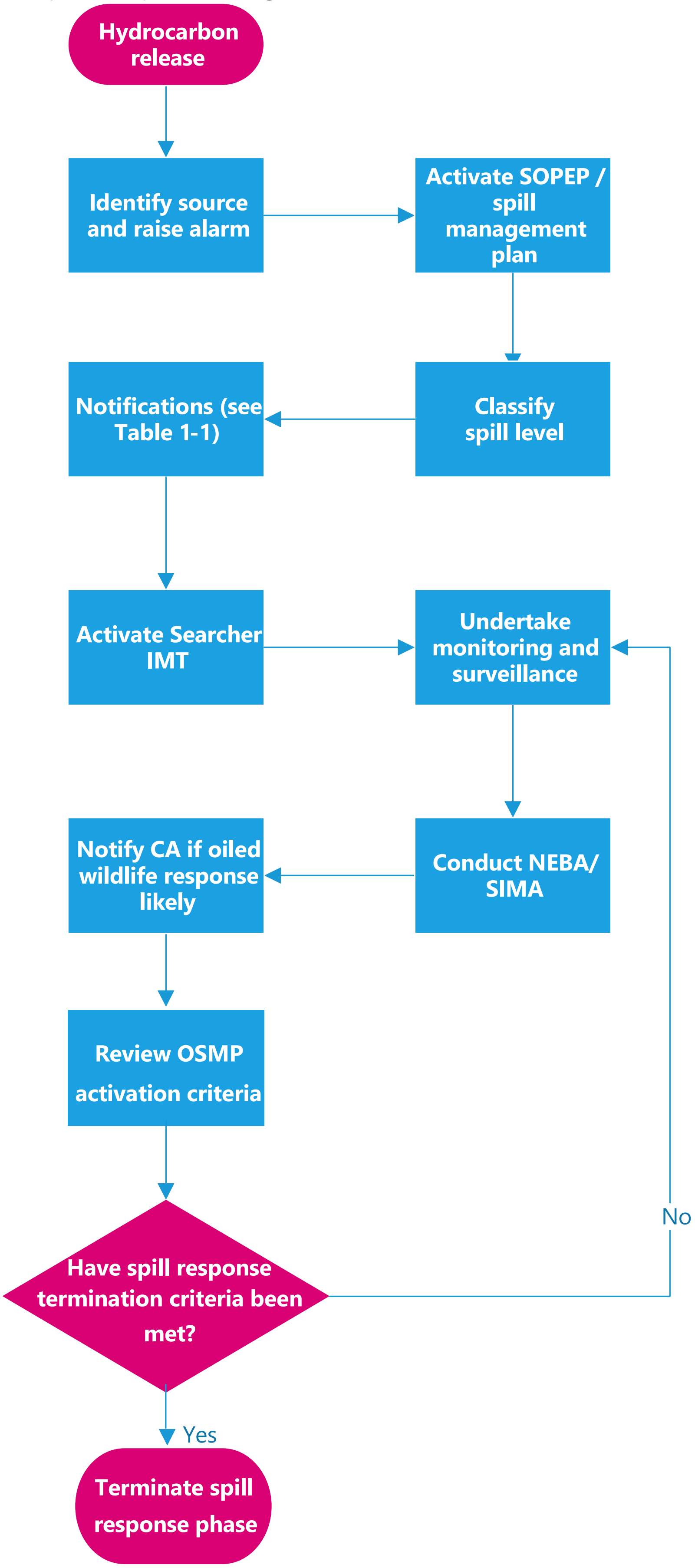

Figure 1-1: Spill response process

1.3 NOTIFICATION REQUIREMENTS

Notification requirements for hydrocarbon releases from the Searcher multi-client MSS activity are defined in Table 1-1. Oil spill incident levels are described in Table 1-2.

Table 1-1: Regulator notification rand reporting requirements

Organisation for notification	Responsible person	Contact details of organisation	Notification requirement and timeframe
Australian Maritime Safety Authority (AMSA)	Vessel Master	Verbal report: JRCC: +61 02 6230 6811; 1800 641 792	Verbal, ASAP
	Vessel Master	Email written report to rccaus@amsa.gov.au	Harmful substances report (POLREP) within 2 hours POLREP form is available in Appendix A and at https://www.amsa.gov.au/forms/harmful-substances-report-polrep-oil
National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA)	Searcher IMT	Verbal report (+61 08 6461 7090) followed up with written notification	*Any spill with the potential to cause moderate to significant harm.* Verbal report within 2 hours of the first report of the incident Written report within 3 days of the initial verbal report (which must also be cc'd to NOPTA[1] and DMIRS[2])
		Email written report to: submissions@nopsema.gov.au	Within 3 days Part 1 of Report of an Accident, Dangerous Occurrence or Environmental Incident (NOPSEMA form FM0831) https://www.nopsema.gov.au/assets/Freedom-of-information/F095/A543965.pdf
			Within 30 days Part 2 of Report of an Accident, Dangerous Occurrence or Environmental Incident (NOPSEMA form FM0831) https://www.nopsema.gov.au/assets/Freedom-of-information/F095/A543965.pdf
Department of Agriculture, Water and the Environment (DAWE)	Searcher IMT	Verbal: Compliance Hotline: 1800 110 395 (business hours only) Fauna: Phone: (02) 6274 1111	*Any spill with the potential to cause a significant impact to a matter of National Environmental Significance (NES) including impacts to protected species.* Verbal report within 48 hours of becoming aware of the incident or non-conformance.
		Email written report to: protected.species@environment.gov.au	Written report (no template). Follow incident-specific requirements.
Director of National Parks (DNP)	Searcher IMT Incident Commander (IC)	Verbal report (+61 419 293 465)	As soon as practicable before hydrocarbon release exposure to areas managed by Director of National Parks (DNP) (including Mermaid Reef Marine Park, Argo-Rowley Terrace Marine Park)
Spill heading towards WA Waters			
WA Department of Transport (DoT)	Searcher IMT IC	Verbal report: DoT Maritime Environmental Emergency Response Unit (MEER) Duty Officer (08) 9480 9924	Verbal notification as soon as it is identified that hydrocarbon may enter WA State waters
		Email written report to: marine.pollution@transport.wa.gov.au	Marine Pollution Report (POLREP) within 2 hours. DoT POLREP Form Template https://www.transport.wa.gov.au/mediaFiles/marine/MAC-F-PollutionReport.pdf
			Marine Pollution Report (POLREP) within 24 hours. DoT SITREP Form Template https://www.transport.wa.gov.au/mediaFiles/marine/MAC-F-SituationReport.pdf

Organisation for notification	Responsible person	Contact details of organisation	Notification requirement and timeframe
WA Department of Biodiversity, Conservation and Attractions (DBCA)	Searcher IMT IC	Verbally notify DBCA Duty Officer via (08) 9474 9055 if a spill is likely to contact areas managed by WA DBCA or if wildlife are oiled, followed by a written Marine Pollution Report (POLREP)	Verbal notification as soon as practicable before hydrocarbon release exposure to areas managed by DBCA (Rowley Shoals Marine Park) Witten notification as soon as practicably following the initial report

[1] National Offshore Petroleum Titles Administrator (resources@nopta.gov.au)

[2] Department of Mines, Industry, Regulation and Safety (petreps@dmirs.wa.gov.au).

1.4 OIL SPILL INCIDENT LEVELS

As defined in the National Plan for Maritime Environmental Emergencies (AMSA 2019) (NATPLAN), marine hydrocarbon spills are divided into three categories (termed 'Levels') depending on the volume released, the resources and capabilities required for an effective response, and to some extent the scale of environmental risk.

Table 1-2: Oil spill incident levels

Aspect	Level 1	Level 2	Level 3*
Spill volume (m^3)	0-10	10-1,000	>1,000
Response period	Likely to be <48 hrs	48 hrs to weeks	Weeks to months
Description	Generally can be resolved through the application of local or initial response resources (first strike response).	Typically more complex in size, duration, resource management and risk than Level 1 incidents. May require escalated deployment of resources beyond the first strike response.	Characterised by a high degree of complexity, potentially with multiple hazards. Requiring strategic leadership and response coordination. May require national and international response resources.
Potential environmental impacts	Potential impacts are likely to be short-term, with recovery in days to weeks. A Level 1 release may be upgraded to a Level 2 release if there is a risk of significant environmental impacts.	Potential impacts are likely to be significant and with a more prolonged recovery period (weeks to months). A Level 2 release may be upgraded to a Level 3 release if there is a risk of significant environmental impacts.	Potential impacts are likely to be significant over large spatial scales with a prolonged recovery period (months to years). Remediation may be required.

*(Not considered credible for the Possum 3D MSS).

2 INTRODUCTION

2.1 PURPOSE

The Oil Pollution Emergency Plan (OPEP) is an operational document and contains all information necessary to carry out a response to spill of hydrocarbons to the marine environment during the Possum multi-client three-dimensional (3D) marine seismic survey (Possum 3D MSS), and to support ongoing response by the statutory Control Agency (CA). This plan describes the response arrangements, preparedness, capability, roles and responsibilities and competencies required for the response.

This OPEP has been developed in accordance with the requirements of the Offshore Petroleum and Greenhouse Gas Storage Act 2006 (OPGGS Act) and associated the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS(E)R). It has also been prepared with reference to the following documents published by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA):

- GN1488 Oil Pollution Risk Management guidance note (Rev 2, Feb 2018)
- N-04700-IP1349 Operational and scientific monitoring programs information paper (Mar 2016).

This OPEP aims to define response activities relevant to the nature and scale of a credible spill scenarios, that can be implemented in such a way that environmental risks can be reduced to as low as reasonably practicable (ALARP).

The OPEP includes an OSMP to be implemented in the event of a Level 2 spill.

2.2 SCOPE

Any spill resulting in a release of hydrocarbons into the marine environment is an oil pollution incident for the purposes of this OPEP.

This document has been prepared to cover Possum 3D MSS activities within the operational area, located within the North-west Marine Region (NWMR) offshore from Western Australia (WA). The operational area comprises approximately 13,450 square kilometres (km^2) and extends across Exploration Permits WA-436-P, WA-479-P, WA-487-P, WA-527-P and WA-540-P (Figure 2-1).

Potential spills scenarios considered in the development of this OPEP are:

- Level 1: Spill of hydrocarbons (lubrication oil or hydraulic fluid)
- Level 1: Spill during vessel refuelling resulting in release of up to 10 m^3 of Marine Gas Oil (MGO)/Marine Diesel Oil (MDO)
- Level 2: Release of marine diesel to the environment following a vessel collision and resulting in rupture of one or more fuel storage tanks. Based on the maximum volume of the proposed survey vessel(s), the maximum credible release volume would be 321 m^3 over a period of six hours.

The document provides guidance for response personnel for the initial hours following a hydrocarbon release. Upon notification the CA Incident Management Team (IMT) will have taken over responsibility for the response and will develop their own incident action plan (IAP). The IAP will form the basis of transitioning to an ongoing response following the first strike response period.

OSMP implementation will continue beyond the initial response by the vessel and will remain the responsibility of Searcher Seismic Pty Ltd (Searcher).

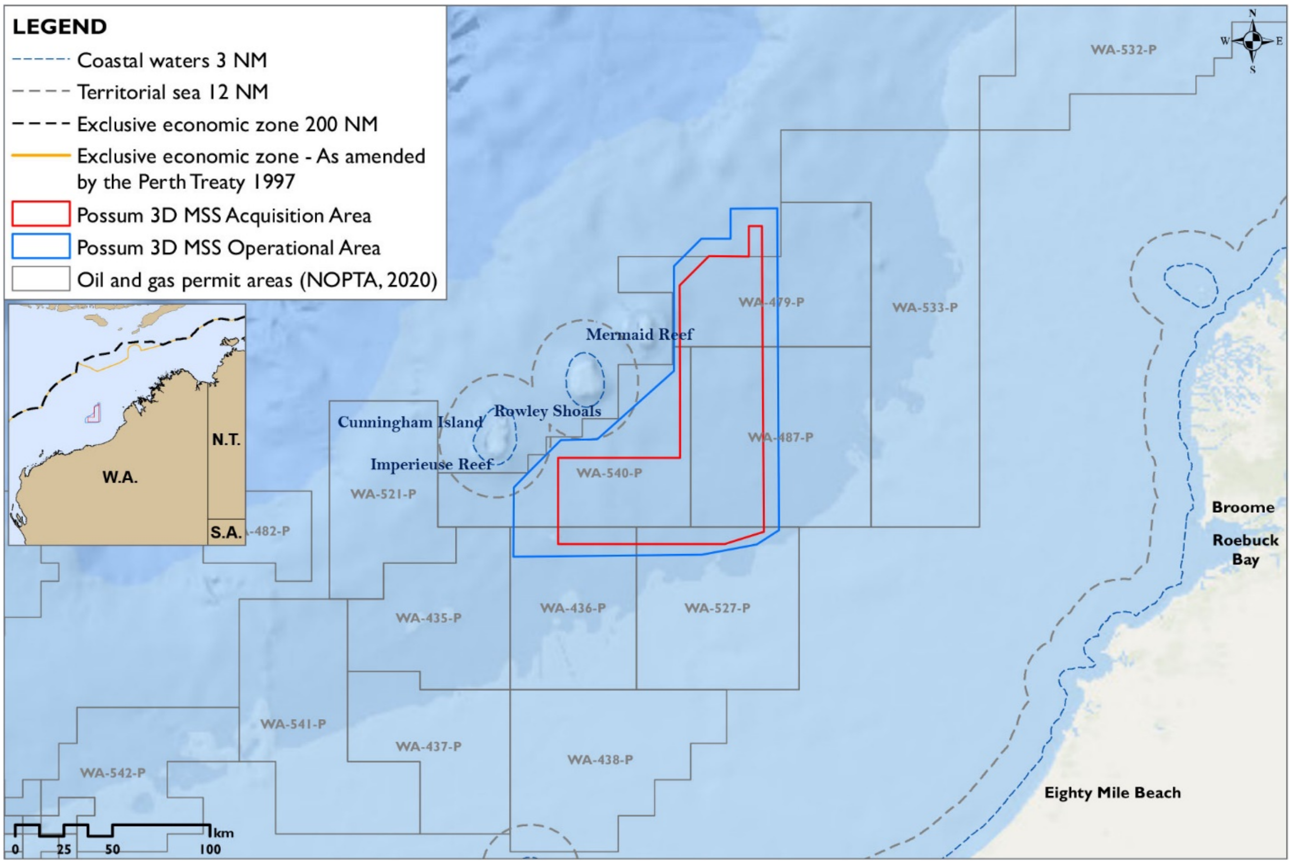

Figure 2-1: Location of Searcher Possum 3D MSS

2.3 INTERFACE WITH OTHER PLANS

This OPEP forms part of a wider emergency response framework, linking to the following emergency response documents:

- survey or support vessel(s) >400 GRT SOPEP - deals with hydrocarbon spills which are either contained on the vessel or which can be dealt with from/by the vessel
- survey or support vessel(s) <400 GRT spill management plan - deals with spills which are either contained on the vessel or which can be dealt with from/responded by the vessel
- the National Plan for Maritime Environmental Emergencies (NATPLAN) (AMSA 2019)
- the State Hazard Plan - Maritime Environmental Emergencies (MEE) (WA State Emergency Management Committee 2019)
- WA Department of Transport: Oil Spill Contingency Plan 2015 (WA DoT 2015)
- WA Oiled Wildlife Response Plan (Version 1.1, DPaW 2014).

3 SPILL RESPONSE FRAMEWORK

3.1 JURISDICTIONAL AUTHORITIES AND CONTROLLING AGENCIES

The Jurisdictional Authority is the relevant Statutory Authority that has responsibilities for oil pollution in that jurisdiction. During a spill response, a CA will be assigned to the oil spill incident for all Spill Response Levels. The CA is the agency or company assigned by legislation, administrative arrangements or within the relevant contingency plan to control response activities to an oil pollution emergency.

Under existing Commonwealth and State Intergovernmental Agreements, various authorities have been nominated with CA responsibility for spills in State waters and Commonwealth waters in North-West Australia. The NATPLAN definition of a CA is "the agency or company assigned by legislation, administrative arrangements or within the relevant contingency plan, to control response activities to a maritime environmental emergency".

Table 3-1 defines the statutory CA arrangements required for Level 1 and Level 2/3 releases in the activity area.

Table 3-1: Response requirements and Control Agencies

Source of release	Jurisdiction	Jurisdictional Authority	Control Agencies	
			Level 1	**Level 2**
Vessel (survey or support vessel)	Within activity area (Commonwealth waters)	AMSA	AMSA	AMSA[1]
	WA State waters/shorelines	WA DoT	Vessel owner	WA DoT[2]

[1] Australian Maritime Safety Authority

[2] Western Australia Department of Transport

3.2 COMMONWEALTH WATERS

In the event of an oil spill in Commonwealth waters, initial 'first strike' actions will be undertaken immediately by the survey vessel. Further actions determined following immediate contact with the AMSA Emergency Response Centre, activated as CA under the NATPLAN. The AMSA Activation Procedure is available at https://www.amsa.gov.au/forms-and-publications/AMSA1522.pdf.

AMSA is the responsible CA for oil spills from vessels within the Commonwealth jurisdiction and will respond in accordance with its Marine Pollution Response Plan as approved by the AMSA Executive. AMSA will assume control following notification of an incident.

3.3 WA STATE WATERS

If surface slicks appear likely to enter WA State waters (e.g. Rowley Shoals Marine Park), response actions will be determined following consultation with the relevant personnel (i.e. AMSA, Searcher IMT and the vessel owner) and with the WA DoT under relevant State plans (see Section 1.4). The DoT is the designated CA for oil spills from vessels within the WA State jurisdiction. The DoT is a signatory to the Inter-governmental agreement under AMSA's NATPLAN. The DoT response network is comprised of two units: Maritime Environmental Emergency Response (MEER) and the State Response Team (SRT).

Regardless of the source, the DoT is the Hazard Management Agency (HMA) (Emergency Management Act 2005) for all marine oil pollution in WA State waters (DoT 2012). The DoT MEER Unit undertakes work to Prevent, Prepare, Respond and Recover from oil pollution and coordinates the State Response Team, personnel trained and competent at the team leader level for equipment operations, shoreline clean-up and assessment. They are members of the National Response Team and are trained and competent in roles ranging from team leader for equipment operations and shoreline response to Incident Management Team (IMT) roles. The MEER unit has access to AMSA's NATPLAN equipment to respond to spills in State waters. This equipment is located in Dampier and Fremantle.

In the event that a spill has any potential to enter WA State waters, the following response actions and descriptions are summarised from the WA DoT's Marine Oil Pollution Response and Consultation Arrangements Offshore Petroleum Industry Guidance Note (WA DoT 2018):

- for any Level 2 marine oil pollution incident, Searcher will undertake initial response actions in accordance with their OPEP. (Noting AMSA will become/remain the CA for activities in Commonwealth waters.)

- Searcher will continue to manage response operations until WA DoT can establish formal incident control
- to support the transition of formal incident control, the WA DoT IC will contact the Searcher IMT IC and complete the Controlling Agency Transfer Checklist in Appendix 1 of the Consultation Guidelines
- Searcher will continue to provide support (e.g. planning, resources, liaison officer(s) to WA DoT IMT and waste management) in line with this OPEP
- WA DoT will utilise this OPEP as a starting point for their response, but reserve the right to deviate from this plan where there is justifiable cause to do so
- in cases of deviation from this OPEP, Searcher must consult with NOPSEMA and DMIRS to determine any potential ramifications with respect to EP compliance.

4 SPILL RESPONSE STRATEGY SELECTION

This section provides a description of the response strategy selection which is based on:

- overarching response priorities
- the results of a conceptual NEBA
- response strategies which have been determined to be ALARP.

It should be noted that beyond the initial first strike response, response strategies implemented in the event of a spill will be determined by the CA.

4.1 SPILL RESPONSE PRIORITIES

The oil spill response priorities for this OPEP are:

1. Protection of human lives, health and safety
2. Control and containment of a release on board vessel before hydrocarbons enter the marine environment
3. Prevention and/or mitigation of potential exposure to environmentally sensitive locations
4. Prevention and/or mitigation of potential impacts to socio-economic resources (including cultural sensitivities)
5. Prevention and/or mitigation of potential impacts to recreational and human amenity resources.

4.1.1 Environment that may be affected

For the purpose of response planning, the environment that may be affected (EMBA) for the Possum 3D MSS is based on modelling of the worst-case unplanned event - an instantaneous surface release of 321 m^3 of MDO due to a vessel collision. The EMBA has been defined by overlaying the outer extent of the low exposure thresholds (see Section 6.1.11 of the EP). Note that low thresholds may not produce ecologically significant impacts but has been used as a 'worst-case' predictive tool to set the outer limit of the EMBA (as per guidance provided in NOPSEMA Bulletin #1, 2019). The EMBA covers an area significantly larger than the area that is likely to be affected by a single spill event as it encompasses the area predicted to be affected over 100 replicate spills over the year. The extent of the modelled oil spill was determined from one location in the operational area judged by subject matter experts as likely to be of the highest sensitivity (east of Mermaid Reef within the operational area). To indicate the full extent of an unplanned hydrocarbon spill within the operational area, a simple shift of the modelling location to the extreme south-east of the operational area was conducted.

The extent of the EMBA and the environmentally sensitive locations and receptors within the EMBA have been identified in detail within Section 4 the EP.

For a Level 2 spill, real-time spill modelling and observation would be undertaken, and the spill trajectory, size and season may result in a different spill trajectory and area of exposure to those indicated in the original oil spill modelling.

4.2 NET ENVIRONMENTAL BENEFIT ASSESSMENT / SPILL IMPACT MITIGATION ASSESSMENT

NEBA and spill impact mitigation assessment (SIMA) are commonly-used globally for evaluating the potential benefits versus impacts of implementing a spill response strategy. In this way, the most appropriate response strategies can be identified to maximise potential environmental protection. The CA will conduct an ongoing NEBA/SIMA process for a Level 2 spill. The following is a summary of steps normally used to conduct a NEBA (IPIECA-IOGP 2015) or a SIMA (IPIECA-API-IOGP 2017):

1. Compile and evaluate data (oil properties, situational awareness, oil spill trajectory modelling (OSTM), environmental sensitivities, identification of available response options).
2. Predict outcomes (characterising effects of different response options against an unmitigated spill impact).
3. Balance trade-offs (assess the potential impact on each environmental sensitivity by the oil and additional potential impacts of response options).
4. Determine the most appropriate method(s) of response to maximise potential for environmental protection.
5. Searcher will support AMSA in the NEBA/SIMA process as required by utilising internal and/or third-party environmental and oil response expertise.

Searcher will provide support to the AMSA IMT for NEBA/SIMA though utilisation of existing Searcher personnel, or third-party subject matter experts (SMEs). Where the WA DoT is CA in WA State waters, Searcher will also provide support. The WA

DoT have an MS Excel-based NEBA/SIMA tool accessible as part of their oil spill response planning tools (https://www.transport.wa.gov.au/imarine/oil-spill-response-and-planning-tools.asp).

4.2.1 Preliminary NEBA

The fuel oils to be used during the Possum 3D MSS will be MDO or marine gas oil (MGO). Any fuel oil spill to the marine environment is expected to undergo rapid spreading together with physical dispersion (e.g. entrainment) and evaporative loss, resulting in surface slicks thinning and breaking up quickly while the light-end hydrocarbon components will weather off. A preliminary NEBA for a Level 2 spill is provided in Appendix B. It is considered that a Level 1 spill will not require a response beyond the initial first strike activities (mainly source control) and ongoing monitoring and evaluate.

Accounting for the potential spill volumes, location of the survey and metocean conditions, the response strategies in Table 4-1 have been assessed and those identified as appropriate for a Level 2 hydrocarbon release from this activity have been identified.

Table 4-1: Preliminary assessment of response strategies

Response strategy	Applicable?	Advantages	Disadvantages	NEBA Summary	Appropriate/feasible response?
Source control	Yes - regain control of the release, which may include transferring fuel oil into another secured container where practicable	Prevent/reduce volume of fuel oil entering the environment	None, if human health and safety risks have been assessed as acceptable	Reduces potential for and scale of impacts to marine environment	Yes
Monitor and evaluate	Marine MDO/MGO is visible on the water surface and the movement of slicks can be visually monitored from vessels or aircraft (e.g. using the Bonn Agreement Oil Appearance Code (BAOAC) (Bonn Agreement 2016)). Components of marine diesel may remain entrained or dissolved in the water column, which can be detected during operational monitoring of marine waters.	Provides situational awareness of areas and resources that may potentially be impacted by released hydrocarbons. Minimal health and safety risks to responders.	None	Provides valuable information with a low level of environmental risk associated with this response strategy	Yes, based on the nature and scale of the credible scenarios
Mechanical dispersion	Prop wash from support vessels and/or repeated transits of the survey vessel through the slick may help entrain and break up the slick	Some potential increase in hydrocarbon entrainment. Some potential localised reduction in volatile organic compounds (VOCs).	Potential significant health and safety risks from VOCs (e.g. inhalation, ignition/explosion risk)	Minimal, highly-localised environmental benefit	Subject to approval by AMSA due to the potential health and safety risks of this response. Not recommended.
Containment and recovery (boom and skimmers)	The properties of light fuel oils (including MDO/MGO) will preclude use of this strategy. In very calm conditions, it may be feasible to deploy sorbent materials to remove some marine fuel oil from the water surface. Likely to take significant time to mobilise.	May remove some of the fuel oil volume from the water surface prior to reaching sensitive resources	Limited by metocean conditions (wind speed, surface current speeds and sea state). Containment boom is generally not suited to strong currents (>0.8 knots), winds (>15 knots) or high sea state (Beaufort scale >3 to 4). Hydrocarbon type and likely thickness of surface slick are not amenable to effective containment and recovery. Not effective/safe in high energy environments. Risk of response equipment being lost or damaged.	Marine fuel oil (MDO/MGO) will naturally degrade, with weathered residues being likely to be of limited toxicity. Low likely efficacy on this hydrocarbon type, and the short duration of exposure to shorelines in the Seabirds BIA (relative to time to mobilise this response) mean that this response is unlikely to have a benefit to shorelines in the Seabirds BIA, Mermaid Reef and at Clerke Reef at which modelling indicates potential accumulation.	No, not appropriate due to small release volumes, high energy offshore seas, logistical constraints (including time to mobilise), negligible environmental benefit.

Response strategy	Applicable?	Advantages	Disadvantages	NEBA Summary	Appropriate/feasible response?
			Increased waste generation. This response could not be mobilised in time to reduce risks to shorelines (particularly Mermaid Reef/Shorebirds Biologically important area (BIA)) or surface receptors.	Containment and recovery would generate considerable additional waste for specialist disposal, whereas MDO/MGO may be best left to degrade naturally. The Level 2 credible scenario has a limited volume (i.e. the fuel capacity of the vessel storage tanks).	
Surface (vessel/aerial) dispersant application	Group II hydrocarbons (such as MDO/MGO) are readily dispersible at local sea temperatures without the use of dispersants. Chemical treatment (dispersant) use on surface thicknesses below Group II hydrocarbons are typically ineffective and therefore in-situ efficacy testing is a requirement prior to implementation. The timeframes for mobilisation of aircraft and AMSA personnel are likely to restrict timeframes for practical use.	Given the location, fuel type and volumes, there are no apparent advantages.	Health and safety risks associated with the operation of aircraft offshore for aerial application. Health and safety risks associated with the use of application equipment operated from vessels. Dispersed marine diesel may have higher toxicity to sensitive marine resources. Dispersion increases risk of exposure to subsurface habitats. May slow down natural weathering and degradation processes. Potential human health and environmental risks from use of chemical dispersants. Potentially low encounter rate due to potential "punching through", distribution of hydrocarbons on surface (e.g. windrows, insufficient surface thickness), and herding of the oil due to dispersants in the upper water column.	Immediate environmental impact through localized increase in toxicity levels within the marine environment from chemical dispersants. Weathered marine diesel has a low toxicity, with volatile elements likely to evaporate naturally. Although oil spill modelling indicates that marine diesel is likely to accumulate on shorelines and nearshore areas are likely to be exposed, dispersant application is unlikely to reduce this risk. Credible scenario has a low volume based on the fuel capacity of the largest fuel tank of the vessel.	No, not appropriate due to fuel type, release volume, low encounter rate and either negligible environmental benefit or potentially increased environmental risk.
Shoreline protection and clean up	Shoreline protection boom needs to be anchored in shallow water (~10 m water depth).	Potentially reduce the volume of marine fuel oil stranding on sensitive shorelines	Shoreline protection requires specialist booms and equipment. Shoreline response activities result in disturbance of and environmental impacts to shorelines, nearby subtidal areas and to wildlife.	Modelling indicates that shorelines at Clerke Reef have a 1% probability of shoreline oil at 10 g/m^2 after ≥92 hours, with a 1% probability of shoreline oil at 250 g/m^2 at Mermaid Reef and the Seabirds Biologically-	Shoreline protection is not appropriate – modelling indicates that shoreline exposure is unlikely at levels where this response would be effective, and the environmental impacts from the response would

Response strategy	Applicable?	Advantages	Disadvantages	NEBA Summary	Appropriate/feasible response?
			Shoreline response activities will have limited effectiveness for light fuel oils that will be well dispersed at this distance from the spill zone. Limited response - only a small area can be boomed due to site/ environmental conditions and resources required. Deflection booms / curtains not effective in sea current speeds of >0.7 knots. Deployment is difficult and/or unsafe in heavy sea states and/or high winds. Anchoring of booms may cause damage to benthic habitats (e.g. seagrass beds). This strategy potentially increases environmental risk to adjacent shorelines, as it requires "sacrificial" to be identified.	Important Area (BIA) after 16 hours. In the worst replicate modelled spill, maximum local accumulated concentration at Clerke reef was indicated to be 22 g/m^2 (maximum accumulated volume < 1 m^3); the worst replicate spill maximum local accumulated concentration at Mermaid Reef/the Seabirds BIA was indicated to be 496 g/m^2 (maximum accumulated volume = 3 m^3). The potential impacts of a shoreline clean-up operation would be greater than any potential benefit at Clerke Reef; it is also likely that the short timeframe to exposure at the Seabird BIA and accumulated shoreline oil would mean that shoreline response would be unlikely – but this would be the decision of the CA depending on e.g. time of year and occurrence of threatened species at the time. .	likely outweigh any potential for benefit. Also ineffective for highly weathered hydrocarbons. Shoreline response at the Shorebirds BIA would be considered at the time of any release by the CA through the NEBA process, depending on the nature and scale of the actual release. It is considered unlikely that shoreline response would be considered feasible for any other shoreline.
Oiled wildlife response	This response would only be activated where wildlife has been oiled. As modelling shows that no shorelines will be exposed to released marine fuel oils at levels to cause impact in an area of high wildlife concentrations, the requirement for this response is considered negligible to unlikely.	Pre-emptive capture or hazing may reduce risk of exposure of birds to oil. Rehabilitation of oiled wildlife may reduce impacts to populations.	Safety risks to responders collecting wildlife from the offshore environments	Hazing or pre-emptive capture of birds on shorelines may be considered of net benefit as modelling indicates that shorelines at Mermaid Reef/the Shorebirds BIA and at Clerke Reef will be exposed to spill hydrocarbons. Large numbers of oiled wildlife are unlikely to be captured and taken into care due to the offshore location, time to respond, potential of finding oiled wildlife, and mobility of wildlife.	Potentially appropriate for Level 2 spills when oiled wildlife are discovered and safely accessible. The response will be mobilised and coordinated by the CA. Note that this response is unlikely to be effective for marine mammals and reptiles but response to any oiled wildlife will be undertaken as and where required.

5 SPILL RESPONSE STRATEGY IMPLEMENTATION

This section defines the response actions for an MDO/MGO hydrocarbon release from the survey vessel.

5.1 SOURCE CONTROL

Source control activities will include:

- isolating the source of the spill if possible and safe to do so
- minimise the release volume, through potential transfer of fuel from ruptured tank(s) and cleaning up spills to deck.

Source control activities are also defined in the vessel SOPEP/spill management plan and bunkering procedures, where relevant.

5.2 MONITOR AND EVALUATE

5.2.1 Vessel surveillance

Vessel surveillance actions required following a spill are defined in Table 5-1.

Table 5-1: Vessel-based surveillance requirements

Task	Responsible party
Request any available vessel in close proximity to monitor spill, including Possum 3D MSS support vessels	Vessel Master/AMSA
Provide Searcher IMT IC/AMSA information on spill, including spill trajectory, appearance and area of coverage.	Vessel Master/AMSA
Activate additional vessel surveillance support through AMSA.	AMSA
Termination criteria: Continue to monitor spill through vessel surveillance until: • Slick is no longer visible • Aerial surveillance has commenced.	AMSA

5.2.2 Aerial surveillance

Vessel surveillance actions which may be activated by the CA are defined in Table 5-2.

Table 5-2: Aerial surveillance requirements

Task	Responsible party
Activate aerial surveillance support (aircraft and trained aerial observers) from AMSA	AMSA
Supply a copy of the Aerial Observer Log (Appendix C) if required.	Searcher IMT IC
Prepare and provide to the aviation contractor a pre-flight information pack containing: Safety considerations: • Identify and obtain the appropriate personal protective equipment (PPE), aviation lifejackets should be worn in aircraft • identify risks and necessary controls • Communicate the risks and controls in place through a pre-operation safety brief. Operational Communications Plan that documents: • Specific contacts and names of assets deployed • Methods of communication with personnel (including the crew of aircraft/vessels) • Call signs and radio communication frequencies.	AMSA
Conduct pre-flight briefing, which shall include: • Location of the area of operation • Radio frequencies used in the area and on the response • Call signs of other aircraft operating in the vicinity	AMSA

Task	Responsible party
• Locations of any temporary or permanent exclusion zones.	
Use a global positioning system (GPS) to track aerial surveillance operations.	AMSA
Conduct localised search: • Use the predicted spill location as a starting point and conduct a localised search to determine the exact position of the spill • The aerial observer should sit directly behind the pilot, so the same perspective is shared, making it easier to direct the aircraft to the spill • Observers will have different perspectives. Ensure a comprehensive hand over brief is given to maintain consistency of approach • Fly the length and width of the spill (noting time taken and speed) • Record and report observations of wildlife that are present in the area.	AMSA
Record aerial surveillance using: • Annotated maps or charts • Photographs (preferably geo-referenced) • Aerial surveillance logs.	AMSA
Undertake calculations (on the return journey or when the aircraft has landed): • Calculate distance of spill length or width : Distance of slick length or width (nm) = $\frac{\text{time taken to fly (seconds)} \times \text{speed (knots)}}{\text{3600 (or 60 if time taken to fly is in minutes)}}$ • Divide answer by 1.85 to convert to km • Calculate spill area : Spill area (km^2) = length (km) × width (km).	AMSA
Calculate spill volume: Use the Bonn Agreement Oil Appearance Code (BAOAC) (Appendix D) to estimate the percentage spill coverage: • Divide the spill into percentage areas based on its appearance (e.g. 10% sheen, 40% rainbow and 50% metallic) • Use the following equation to calculate the minimum and maximum spill volume for each oil type: Maximum / minimum estimated spill volume (m^3) for each appearance type = area covered with specific appearance (%) × total area of spill (km^2) x thickness of slick (in µm) • Add together all the calculated volumes to calculate a total volume. • The Air Operations Branch Director may decide that International Tanker Owners Pollution Federation (ITOPF) oil observation guidance could be used by aerial observers instead of the BAOAC. ITOPF methods are in the Aerial Observation of Marine Oil Spills Technical Information Paper (ITOPF 2011).	AMSA
Upon completion, provide the following: • Aerial surveillance logs • Location of oil identified (e.g. shown on a map or chart, waypoints on GPS or geo-referenced photo) • Quantity of oil observed and calculations • Other relevant information on the aerial surveillance operations (e.g. pilot operational hours, fuel logs, maintenance issues, logistical requirements, aerial simultaneous operations (SIMOPS) issues).	AMSA
Termination criteria: Continue routine aerial observations daily during daylight hours until no slick can be observed.	AMSA as the CA

5.2.3 Spill trajectory assessment

5.2.3.1 Computer-based modelling (Level 2 only)

Oil spill trajectory modelling (OSTM) requirements are defined in Table 5-3.

Table 5-3: Oil spill trajectory modelling requirements

Task	Responsible party
Request oil spill trajectory modelling (OSTM)	AMSA
Termination criteria: Repeat modelling as required until the response is terminated by the control agency.	AMSA

If computer-based modelling is not yet available for a specific tractor assessment, then a manual trajectory calculation may be used (Table 5-4).

Table 5-4: Manual trajectory calculation requirements

Task	Responsible party
Using vectors, draw the resulting distance of 3% of wind speed and 100% of current from the initial spill location for a 1-hour duration.	Searcher IMT IC/AMSA
Repeat this process for each hour using the new location and predicted wind/current.	Searcher IMT IC/AMSA (until OSTM data available)
Termination criteria: Level 1 – predictions completed for ≥12 hours Level 2 – Repeat manual calculations as required until computer modelling methods are available to provide the information required, or until the spill response phase has been terminated.	AMSA

5.3 OILED WILDLIFE RESPONSE (OWR)

Wildlife protection and response operations will be directed by AMSA in Commonwealth waters.

The Western Australian Oiled Wildlife Response Plan for a Maritime Environmental Emergency is administered by the DBCA. During a Maritime Environmental Emergency DBCA may lead the oiled wildlife response under the control of the appointed CA. Alternatively the CA may engage AMOSC to support/direct oiled wildlife response.

Searcher will provide support to the CA and DBCA/AMOSC for the duration of the response. Searcher will not undertake any oiled life response unless directed by the CA. Table 5-5 provides the process which would be undertaken in the event of wildlife response.

Table 5-5: Oiled Wildlife response requirements

Task	Responsible party
Notify the relevant agency when injured/oiled wildlife is confirmed or could potentially occur. Notifications of oiled wildlife will be undertaken by relevant control agency(ies)	CA supported by Searcher IMT IC
Obtain any licences required from the relevant state wildlife licensing authority, at the time of any incident and prior to undertaking any exclusion, hazing or fauna handling activities such as pre-emptive capture.	Relevant CA IMT(s)
Provide additional support to control agency/ies as directed by AMSA	Searcher IMT IC
Activate the relevant scientific monitoring program depending on species impacted, in consultation with AMSA.	Searcher IMT IC
Termination criteria: Continue supporting the control agency in oiled wildlife response until: • injured/oiled wildlife have all been treated or euthanised • dead wildlife and waste have been disposed of • control agency(ies) have terminated the response phase in line with their relevant plans.	Relevant CA IMT(s)

5.4 RESPONSE TERMINATION CRITERIA

The overall response will be terminated once Searcher/AMSA and relevant government agencies agree that the following criteria have been met:

- the source of the spill has been controlled such that no further hydrocarbons will be released
- all termination criteria are met for:
  - monitor and evaluate (Section 5.2)
  - oiled wildlife response (Section 5.2)
- all response strategies and tactics have been terminated after meeting termination criteria and/or where it has been identified that the response strategy is no longer ALARP as it is likely to result in an increased risk to human health, or environmental and socioeconomic receptors.

Searcher will appoint an investigation team following the termination of a spill response. The investigation team will be responsible for:

- undertaking an investigation into the cause of the spill. Feedback will be sought from stakeholders as part of the investigation and evaluation of response success
- organising an after-action review of both the emergency and spill response actions
- close-out of all Searcher IMT and emergency response actions
- implementation of a lessons learned assessment process, which will form the basis of a post-incident action plan
- liaison with all involved external agencies to support their post-incident investigations and close-out activities.

6 WASTE MANAGEMENT

The following types of oily waste are likely to be generated from a hydrocarbon release from this activity:

- oil (pure or near pure MGO or MDO)
- oily material (oily sorbents, Personal Protection Equipment (PPE), liquid mixed with debris, sediment, water, or other materials)
- oily water (large amount water with some oil, with possible small amounts of debris)
- deceased fauna.

Waste management for a Level 1 spill would be conducted by the vessel master (as per the vessel SOPEP), whilst AMSA will direct all requirements for a Level 2 spill. Searcher will provide support in both situations.

7 SPILL RESPONSE RESOURCES

This section provides an overview of response resources (equipment and people) that can be sourced in the event of a Level 1 or 2 spill (Figure 7-1).

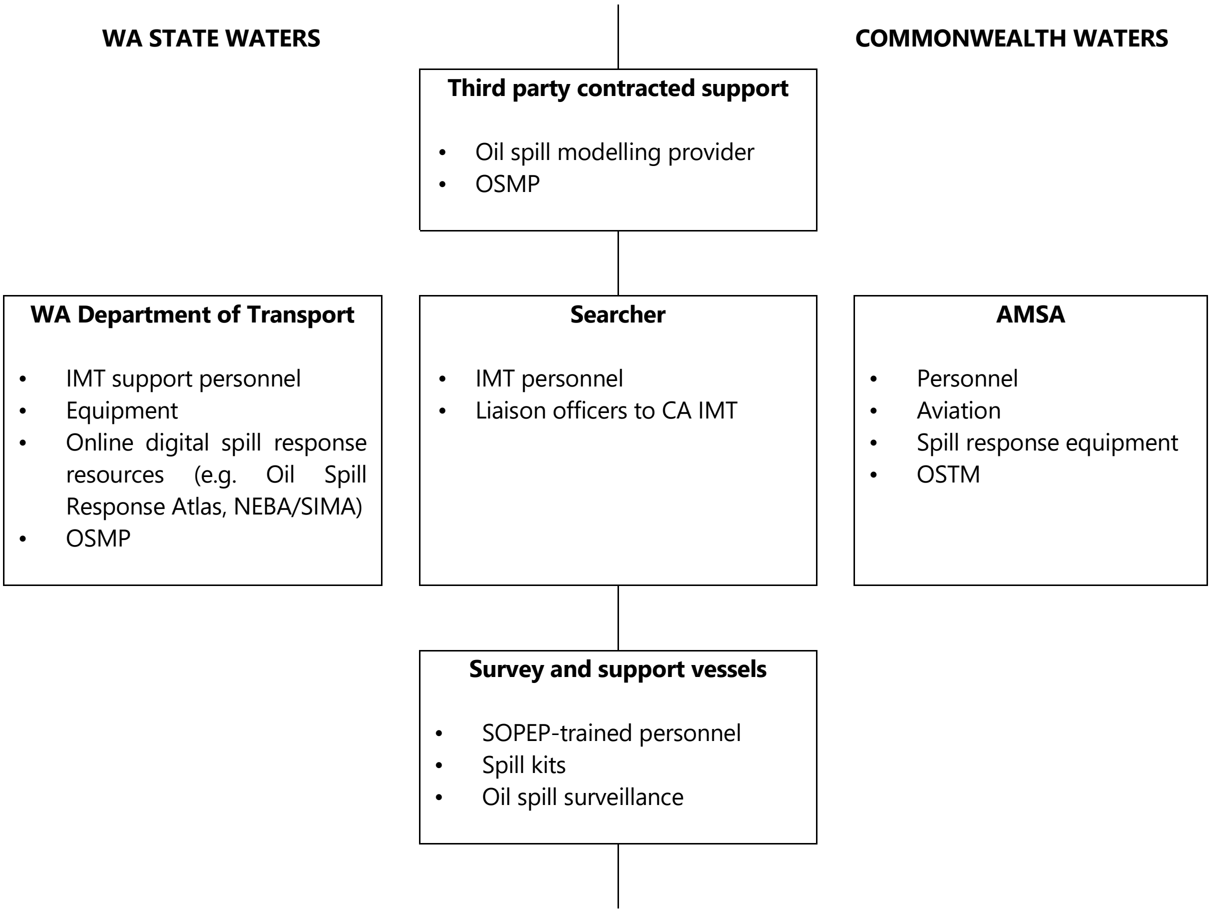

Figure 7-1: Response resources

7.1 VESSELS

In line with the vessel SOPEP (and any associated emergency response documentation), the seismic and support vessels will have aboard Level 1 spill response equipment, including sorbent materials, personal protective equipment (PPE), containment materials and waste bags.

7.2 PERSONNEL

7.2.1 Vessel

Vessel crew will be trained in the use of all spill response equipment on board as per the requirements of the vessel SOPEP.

7.2.2 Searcher

Selected Searcher personnel (e.g. IMT personnel) will be available to provide support as per the response processes described within this OPEP. The Searcher chain of command in the event of an emergency associated with the Possum 3D MSS is presented in Figure 7-2. The Searcher Operations Manager would adopt the role of Searcher IMT IC in the event of an oil spill incident and would be responsible for coordinating a response.

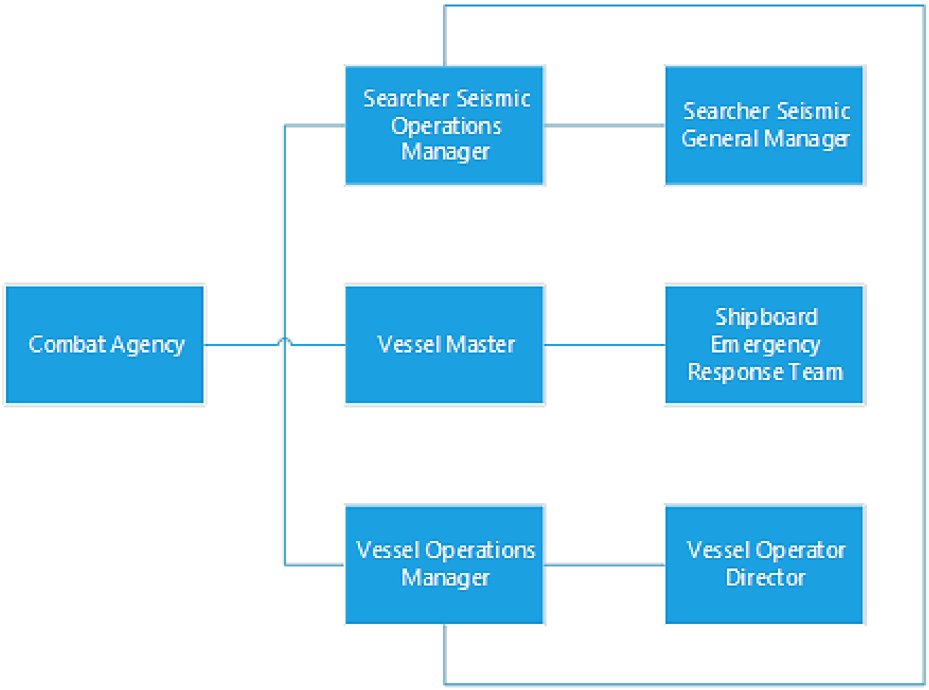

Figure 7-2: Chain of command during emergencies

7.3 AUSTRALIAN MARITIME SAFETY AUTHORITY (AMSA)

AMSA will be the CA for a Level 2 spill. They will provide trained personnel, aviation resources to conduct aerial surveillance activities and response (including aerial observers) and Level 2 spill response equipment from the National Plan stockpiles where they deem it necessary.

7.4 WA DEPARTMENT OF TRANSPORT (DOT)

The WA DoT will be the CA for a Level 2 spill in WA State waters. Section 3.3 of the Western Australia State Hazard Plan: Marine Environmental Emergencies (WA SEMC 2019) identifies that WA maintains a database of personnel in WA who have been trained by DoT/AMSA as incident management or spill responders. These personnel may be mobilised to assist in a maritime environmental emergency by (or at the request of) the State Maritime Environmental Emergency Coordinator. The following teams may also be mobilised:

- Maritime Incident Management Team (MIMT) – comprising DoT/State government personnel trained in IMT roles.
- State Response Team (SRT) – comprising DoT/State government/selected external organisation personnel trained in field response operations.
- National Response Team (NRT) and industry core group – experienced personnel from the Australian Government/State/Territory agencies and industry. NRT personnel are managed and trained by AMSA and can perform a range of operational roles. Industry core team members are managed by the Australian Marine Oil Spill Centre (AMOSC).

The DoT also maintains a database of response equipment managed by the DoT, WA port authorities, port facility operators and boat harbour operators.

8 OPERATIONAL AND SCIENTIFIC MONITORING PROGRAM

In the event of a Level 2 spill during the Possum 3D MSS, the OSMP will be activated. The OSMP comprises a number of monitoring studies that will be implemented to inform spill responses and to evaluate the impacts to and recovery of the marine environment (Scientific Monitoring). The overall OSMP is structured as follows:

- a general overarching OSMP framework that ties the operational and scientific monitoring studies together in order to manage overall implementation, synergies and delivery of the scopes of work
- operational monitoring plans (OMPs) that provide instructions on technical and logistical requirements to implement and deliver defined scopes of work related to a specific aspect of the 'monitor and evaluate' response. The objectives of the OMP scopes is to obtain situational awareness information, identify areas of exposure/impact and to identify any potential negative impacts of spill response strategies to inform continual NEBA/SIMA. OMPs are only implemented during the response phase
- scientific monitoring plans (SMPs) that provide instructions on technical and logistical requirements to implement and deliver defined scopes of work. The objectives of SMPs are to identify impacts and recovery from a spill in a scientifically robust manner. SMP scopes can be implemented during the response phase to collect opportunistic post-release pre-exposure baseline data but are generally implemented at the termination of the response phase. SMP scopes usually include topic areas covered by some OMP scopes (e.g. OMP3 and SMP2; see below and illustrated by the dashed line in Figure 8-1.

The relationship between these three elements that comprise the OSMP are illustrated in Figure 8-1.

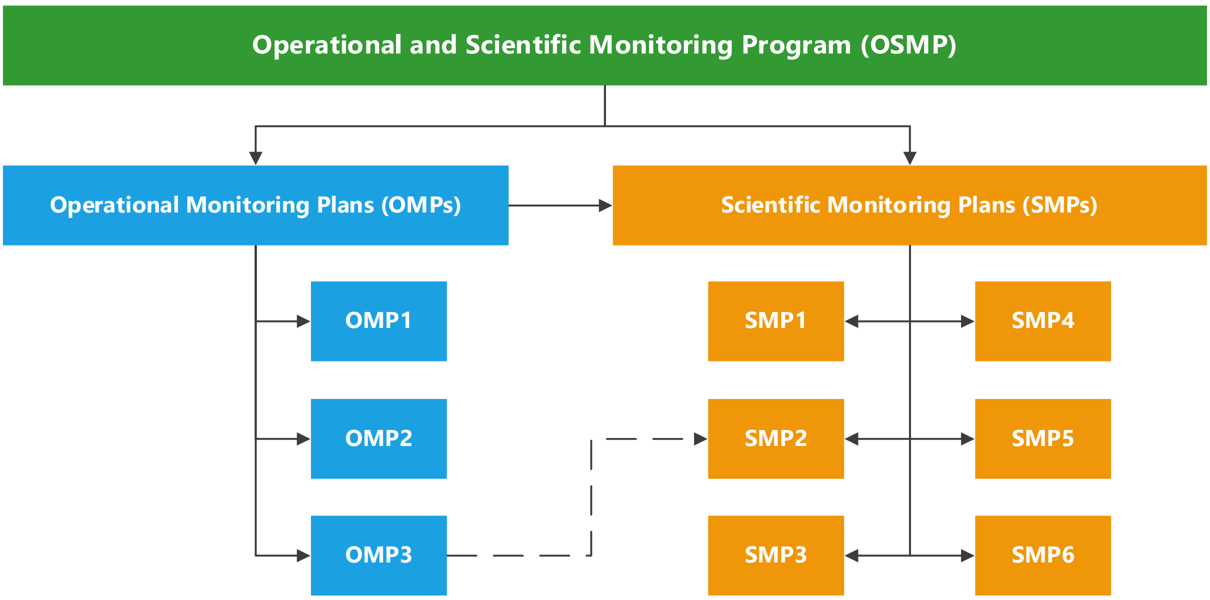

Figure 8-1: Overview of structure of OSMP elements

8.1 OSMP IMPLEMENTATION

Searcher will manage development of a detailed OSMP implementation plan for undertaking the operational and scientific monitoring activities as described in Table 8-7. Searcher will access vessel and aircraft contractors along the Western Australian coast, National Association of Testing Authorities accredited analytical laboratories, equipment suppliers and specialist sub-consultants on an 'as required' basis.

Marine science specialists and SMEs will provide support for the management and implementation of the Operational and Scientific Monitoring Program and would be mobilised to respond at short notice should they be required (under existing service contracting arrangements).

The OSMP Implementation Plan would detail the equipment required for each study, travel and freight arrangements, notifications, vessel support, HSE planning, and the sampling and analysis plan(s). Within 12 hours of the specialist sub-consultant being notified, a teleconference will be held between Searcher, AMSA, the nominated scientific personnel and the Vessel Master to finalise the requirements for implementation of monitoring plans. Survey teams can be on site within 48 to 72 hours of the implementation plan and budget being approved (and where permits are not required or have been approved).

The most likely hydrocarbon that could be spilled (MDO) is only likely to remain detectable in surface waters for a few days, and realistically a survey team would not be on site until it had dispersed. Given the extremely low probability of a catastrophic spill and MDO subsequently contacting sensitive biota, the rapid weathering and likely dispersal of spill hydrocarbons before a response team could be mobilised, Searcher considers the costs associated with pre-emptive development of the Implementation Plan and full assembly and preparation of the response team to be grossly disproportionate to the benefit of a more rapid response. Similarly, it is considered that post-spill pre-impact baseline data collection will likely not be feasible.

General requirements for the implementation for the OSMP are defined in Table 8-1.

Table 8-1: OSMP requirements

Task	Responsible party
Review data from surveillance and monitoring methods and compare against OSMP activation criteria (Table 8-5). Activate the individual operational and scientific monitoring plans if activation triggers have been met (see activation triggers for each plan in the following sections).	Searcher IMT
Mobilise relevant OSMP resources and commence monitoring in accordance with the requirements of the relevant OMPs/SMPs.	Searcher IMT
Continually review OSMP activation criteria and mobilise additional resources as necessary.	Searcher IMT
Review operational monitoring plan (OMP) termination criteria until termination of spill response phase.	Searcher IMT
Termination criteria: Continue scientific monitoring plan (SMP) activities until termination criteria have been met as per Table 8-7.	Searcher IMT

8.2 OPERATIONAL MONITORING

Operational (or Type I) monitoring is used to collect qualitative and quantitative information about the behaviour and potential impacts of the oil spill and the efficacy and/or impacts of associated response operations. This information supports situational awareness to aid decision making during the response. Operational monitoring is typically replaced by scientific monitoring when the spill response has been terminated (NOPSEMA 2016).

Operational monitoring resources are deployed by the CA in accordance with the NATPLAN. Real-time monitoring information, along with up to date information on weather conditions, satellite imagery and existing charts is used, as well as details of the spill (provided by the Vessel Master and/or reports from other marine users). Vessels and aircraft may be mobilised along with first strike response resources, which may include rapid response teams to gauge impacts on the environment. This allows information to be gathered and predictions to be made of the distribution and characteristics of the spill (e.g. extent, weathering, persistence, movement, sensitive resources at risk). This will inform what further responses may be required, including which scientific (or Type II) monitoring scopes may be activated.

The Vessel Master will fully cooperate with AMSA following a Level 1 or Level 2 spill in accordance with the vessel SOPEP. Searcher will implement, assist with, or contribute to (including funding) operational monitoring as directed by AMSA (for a Level 2 spill where AMSA are the CA).

The immediate response for all Level 2 spill incidents includes the Monitor and Evaluate Plan (operational monitoring). The Monitor and Evaluate Plan is comprised of the following three sub-plans for the operational monitoring studies:

- Operational Monitoring Study OS1: Hydrocarbon Surveillance and Tracking (refer below to Sections 8.2.1.1- Vessel Surveillance and 8.2.1.2- Aerial Surveillance).
- Operational Monitoring Study OS2: Oil Spill Trajectory Modelling (refer to Section 8.2.1.3.
- Operational Monitoring Study OS3: Shoreline Assessment (refer to Section 8.2.1.4). The only emergent land within the EMBA is Mermaid Reef and Commonwealth waters surrounding the Rowley Shoals Key Ecological Feature (KEF) and the Seabirds Biologically Important Area (BIA).

8.2.1 Hydrocarbon surveillance and tracking

8.2.1.1 Vessel surveillance

In the event of a Level 2 spill, vessel surveillance actions required are defined in Table 8-2.

Table 8-2: Vessel-based surveillance response requirements

Task	Responsible party
Request any available vessel in close proximity to monitor spill.	Vessel Master/AMSA
Provide Searcher Incident Commander/AMSA information on spill such as trajectory, appearance and area of coverage.	Vessel Master/AMSA
Termination criteria: continue to monitor spill through vessel surveillance until: • Slick is no longer visible • Aerial surveillance has commenced.	AMSA

8.2.1.2 Aerial surveillance

In the event of a Level 2 spill, aerial surveillance actions required are defined in Table 8-3.

Table 8-3: Aerial surveillance response requirements

Task	Responsible party
Determine the need for aerial surveillance support (aircraft and trained aerial observers)	AMSA
Supply a copy of the Aerial Observer Log (Appendix C) if required.	Searcher IMT IC
Prepare and provide to the aviation contractor a pre-flight information pack containing: Safety considerations: • Identify and obtain the appropriate personal protective equipment (PPE), aviation lifejackets should be worn in aircraft • Identify risks and necessary controls • Communicate the risks and controls in place through a pre-operation safety brief. Operational Communications Plan that documents: • Specific contacts and names of assets deployed • Methods of communication with personnel (including the crew of aircraft/vessels) • Call signs and radio communication frequencies.	AMSA
Conduct pre-flight briefing, which shall include: • Location of the area of operation • Radio frequencies used in the area and on the response • Call signs of other aircraft operating in the vicinity • Locations of any temporary or permanent exclusion zones.	AMSA
Use a global positioning system (GPS) to track aerial surveillance operations.	AMSA
Conduct localised search: • Use the predicted spill location as a starting point and conduct a localised search to determine the exact position of the spill • The aerial observer should sit directly behind the pilot, so the same perspective is shared, making it easier to direct the aircraft to the spill • Observers will have different perspectives. Ensure a comprehensive hand over brief is given to maintain consistency of approach • Fly the length and width of the spill (noting time taken and speed) • Record and report observations of wildlife that are present in the area.	AMSA
Record aerial surveillance using: • Annotated maps or charts • Photographs (preferably geo-referenced) • Aerial surveillance logs.	AMSA

Task	Responsible party
Undertake calculations (on the return journey or when the aircraft has landed): • Calculate distance of spill length or width: Distance of slick length or width (nm) = $\frac{\text{time taken to fly (seconds)} \times \text{speed (knots)}}{3600 \text{ (or 60 if time taken to fly is in minutes)}}$ • Divide answer by 1.85 to convert to km • Calculate spill area: Spill area (km^2) = length (km) × width (km)	AMSA
Calculate spill volume: Use the Bonn Agreement Oil Appearance Code (BAOAC) (Appendix D) to estimate the percentage spill coverage • Divide the spill into percentage areas based on its appearance (e.g. 10% sheen, 40% rainbow and 50% metallic) • Use the following equation to calculate the minimum and maximum spill volume for each oil type: Maximum / minimum estimated spill volume (m^3) for each appearance type = area covered with specific appearance (%) × total area of spill (km^2) x thickness of slick (in μm) • Add together all the calculated volumes to calculate a total volume. • The Air Operations Branch Director may decide that International Tanker Owners Pollution Federation (ITOPF) oil observation guidance could be used by aerial observers instead of the BAOAC. ITOPF methods are in the Aerial Observation of Marine Oil Spills Technical Information Paper (ITOPF 2011).	AMSA
Upon completion, provide the following: • Aerial surveillance logs • Location of oil identified (e.g. shown on a map or chart, waypoints on GPS or geo-referenced photo) • Quantity of oil observed and calculations • Other relevant information on the aerial surveillance operations (e.g. pilot operational hours, fuel logs, maintenance issues, logistical requirements, aerial simultaneous operations issues).	AMSA
Termination criteria: Continue routine aerial observations daily during daylight hours until no slick can be observed.	AMSA as the CA

8.2.1.3 Oil spill trajectory modelling

A) Computer modelling (Level 2 spill only)

Computer-based Oil Spill Trajectory Modelling (OSTM) requirements are defined in Table 8-4.

Table 8-4: Requirements for oil spill trajectory modelling

Task	Responsible party
Request oil spill trajectory modelling (OSTM).	AMSA
Termination criteria: Repeat modelling as required until the response is terminated by the control agency.	AMSA

B) Manual calculation

If computer modelling is not yet available for a specific trajectory calculation, then a manual calculation can be completed (Table 8-5).

Table 8-5: Requirements for the manual calculation of spill trajectories

Task	Responsible party
Using vectors, draw the resulting distance of 3% of wind speed and 100% of current from the initial spill location for a 1-hour duration.	Searcher IMT IC/AMSA
Repeat this process for each hour using the new location and predicted wind/current.	Searcher IMT IC/AMSA (until OSTM data available)
Termination criteria: Level 1 Spill – predictions for >12 hours have been completed Level 2 Spill – Repeat manual calculations as required until computer modelling methods are available to provide the information required.	AMSA

8.2.1.4 Shoreline assessment

In the event of a Level 2 spill and where modelling identifies potential shoreline accumulation, shoreline assessment actions required are defined in Table 8-6.

Table 8-6: Shoreline assessment requirements

Task	Responsible party
Liaise with relevant CA to determine potentially exposed shorelines	AMSA
Prepare the following: • Report/log forms • methods of communication (e.g. mobile phones, satellite phones, VHF radio) • handheld GPS plus spare batteries • digital camera plus spare batteries • compass • ruler (for scale when taking photos) • tape measure(s) • spade/trowels (to check for buried oil) • flags/stakes to mark buried oil • Operational Communications Plan that documents: o specific contacts and names of assets deployed o methods of communication with personnel (including the crew of aircraft/vessels) o call signs and radio communication frequencies.	CA supported by Searcher IMT IC
Form shoreline assessment teams that should include: • representatives from Searcher and state authorities • representatives trained in shoreline and clean-up assessment technique (SCAT) • technical or subject matter experts (SMEs) on the environmental and socio-economic sensitivities at risk • representatives with designated responsibility for the sensitivities at risk	CA supported by Searcher IMT IC
Divide the shoreline into segments using SCAT: • geographic areas of similar features/sediment types • subsegments can be defined where oiling varies significantly within a segment.	CA supported by Searcher IMT IC
Using information from ground-truthed aerial surveillance and remote sensing information, assign an Environmental Sensitivity Index (ESI) rank from 1 to 10, with 10 being the most sensitive: • exposed rocky shore = 1 • exposed rocky platforms = 2 • fine-grained sandy beaches = 3 • coarse-grained sandy beaches = 4 • mixed sand and gravel beaches = 5 • gravel beaches = 6a • riprap structures = 6b • exposed tidal flats = 7 • sheltered rocky shores = 8a • sheltered artificial structures = 8b	CA supported by Searcher IMT IC

Task	Responsible party
• sheltered tidal flats = 9 • salt to brackish marshes = 10a • freshwater marshes = 10b • swamps = 10c • mangroves = 10d Note - Rankings may vary for specific areas at different times of year	
Agree standardised terms for describing oiling observed during shoreline surveys	CA supported by Searcher IMT IC
Assess the shoreline segments: • using SCAT where shorelines are accessible. Shorelines most likely to be exposed must be prioritised • using aerial surveillance and any remote sensing data for inaccessible shorelines • for shoreline sensitivity and any specific constraints that may affect shoreline protection options or clean-up operations (such as logistical, environmental or cultural constraints) • for shoreline area that have already been exposed to spill hydrocarbons, the nature and degree of oiling must be assessed.	CA supported by Searcher IMT IC
Identify the shoreline protection and clean-up strategies and tactics that will be used based on shoreline type, sensitivity, identified constraints and the level of oiling. A key consideration in selecting response methods will be the potential risk of further damage to habitats/resources from the response activities themselves. This is considered as part of the NEBA/SIMA process.	CA supported by Searcher IMT IC
Develop recommendations for shoreline protection and clean-up.	CA supported by Searcher IMT IC

8.3 SCIENTIFIC MONITORING

Scientific (Type II) monitoring addresses defined objectives and collects scientifically robust information for the purposes of determining short and long-term environmental impacts (both from the spill and associated response actions) and subsequent recovery from the spilled oil and oil spill response activities. Searcher will implement, assist with, and contribute to (including funding) scientific monitoring where triggered in the event of a Level 2 spill.

Scientifically robust monitoring plans would be developed and implemented in conjunction with support agencies, subject matter experts and other stakeholders (e.g. research organisations, Department of Agriculture, Water and the Environment (DAWE), oil and gas titleholders, fisheries stakeholders). Scientific monitoring may continue for some time after the termination of the operational monitoring response (NOPSEMA 2016).

In the event of the requirement to undertake scientific monitoring, Searcher would utilise its existing service contracting arrangements. with specialist marine science service providers to rapidly establish and deploy the required resources to undertake the monitoring activities. Scientific monitoring could include some, or all, of the elements described in Table 8-7 depending on the size, timing, type and location of the spill.

Where operational monitoring or situational awareness obtained during a spill indicates exposure to additional sensitive receptors/types, additional optional SMPs may be implemented, following agreement with AMSA.

Each Scientific Monitoring Study will have a detailed sampling and analysis plan (SAP) guided by NOPSEMA's Information Paper on Operational and Scientific Monitoring Programs (NOPSEMA 2016). For each SMP described in Table 8-7 a detailed study template would be developed following activation as summarised in Table 8-8.

Table 8-7: Scientific monitoring tasks, key receptors and initiation and termination triggers

Scientific Study	Objective	Key receptors	Trigger	Termination
SM01: Monitoring for Hydrocarbons in Marine Waters	To monitor hydrocarbons in marine waters in order to provide quantitative data on hydrocarbon distribution, concentrations and persistence	Marine water quality	If extent of the spill (based on modelling or operational monitoring of marine waters) is likely to have been sufficient to result in a potential impact to a sensitive resource (e.g. protected marine area)	When the results of the monitoring task have achieved the objectives When spatial extent of oil spill exposure has been established for marine water quality Where water quality is considered to have returned to a condition comparable with unimpacted areas
SM02: Monitoring for Hydrocarbons in Subtidal and Intertidal Sediments	To understand the behaviour, persistence and fate of hydrocarbons in marine sediments to provide data to quantify potential impacts and recovery to key habitats and sensitive receptors	Marine sediment quality	If modelling predicts – or operational monitoring has recorded – potential impacts to marine sediment quality in areas of sensitive resources	When the results of the monitoring task have achieved the objectives When the spatial extent and distribution of hydrocarbons have been established for marine sediment quality Where marine sediment quality is considered to have returned to a condition comparable with unimpacted areas
SM03: Benthic Communities	To enable assessment of impacts and subsequent recovery of benthic marine habitats (soft and hard substrate habitats) and associated demersal, macroepibenthic and infaunal organisms (e.g. corals, macroalgae, seagrass, sponges and other filter feeders, motile invertebrates and associated fishes) in response to a spill event and associated response activities.	Corals, seagrass, filter feeders, invertebrates, macroalgae, demersal fishes	If modelling predicts contact or operational monitoring has identified impacts Any reports of contact Dispersants used by Control Agency within 10 km of sensitive habitats/ assemblages	When all reasonable and practical measures have been taken to assess the effects or impact of the spill on benthic habitats / communities When oil pollution effects / impacts on benthos are no longer detectable (i.e. determined as 'not statistically significant' between the impact and reference sites) When restoration or recovery of impact sites including resumption of key biological processes (e.g. reproduction and recruitment) necessary for post-impact recovery is demonstrated
SM04: Marine Megafauna	To assess any short-term or longer-term environmental effects on non-avian marine wildlife that may have resulted from the oil spill (i.e. damage extent and recovery). Monitoring to document recovery of affected biota and habitats.	Sea snakes, marine turtles, marine mammals, whale sharks	Modelling indicates – or operational monitoring has recorded - possible contact with populations Reports of oiled non-avian marine wildlife indicating contact in important areas.	When all reasonable and practical measures have been taken to assess the effects or impact of the spill on non-avian marine wildlife When restoration or resumption of key biological processes (e.g. abundance, distribution, breeding) necessary to ensure post-impact recovery is demonstrated When oil pollution impacts on non-avian marine wildlife are no longer detectable (i.e. determined as 'not statistically significant' between the impact and reference sites).
SM05:	To assess any short-term or longer-term environmental effects on seabirds and (if relevant) shorebird populations within the	Seabird and shorebird populations	Modelling indicates – or operational monitoring has recorded - possible	When the extent of damage and rate of recovery of key seabird and (if relevant) shorebird behaviour and breeding activities has been determined

Scientific Study	Objective	Key receptors	Trigger	Termination
Seabirds and Shorebird Populations	study area that may have resulted from the oil spill, and subsequent recovery.		contact with seabird and/or foraging shorebird populations Any reports of oiled birds indicating contact in important areas.	When oil pollution impacts on seabirds and (if relevant) shorebirds are no longer detectable (i.e. determined as 'not statistically significant' between the impact and reference sites) When the affected environment or natural resource has returned to baseline conditions in terms of breeding population (for seabirds) or counts (for shorebirds), with regard to reference sites.
SMP06: Fisheries and Aquaculture	To assess the potential short and long-term impacts and recovery of fisheries (should they be closed) and aquaculture facilities/operations that have been exposed to spill hydrocarbons. Aim to: quantify hydrocarbons in tissue of organisms targeted by fisheries or aquaculture determine potential effects on population size/structure identify potential impacts to organism health determine potential risks to human health.	Target areas or species of Fisheries or Aquaculture interest, including shorelines that have been observed to be, or are predicted to have been, exposed to spill hydrocarbons	Level 2 spill or greater and where fisheries have been closed in response to a hydrocarbon spill and/or where modelling and/or operational monitoring indicates likely exposure to aquaculture operations or key brood stock collection locations.	The results of the monitoring tasks have achieved the objectives and appropriate, meaningful and defensible scientific monitoring results have been achieved and tissue contamination results have shown recovery to a point where risks to human health are understood and acceptable and data on population structure have shown that recovery is possible through retention of sexually mature adults and demonstrated recruitment of juveniles.

Table 8-8: Scientific monitoring studies overview

Study heading	**Description**
Monitoring Objective and Rationale	Details the monitoring objectives for the study to focus sampling design
Activation Trigger	Criteria to initiate the scientific monitoring study, based on likely exposure to harmful concentrations (acute / chronic)
Potential Sensitivity to Spilled hydrocarbons	General context of possible impacts associated with the spill, exposure pathways and effects concentrations
Information required	Outcomes of operational monitoring that support survey design
Monitoring methods / sampling and analysis plan	
Overview of the Monitoring Method	Provides the scientific context for the monitoring methods to be used Includes consideration of statistical methods and sampling effort required to achieve the monitoring objectives Defines relevant specifications, standards and requirements of the study
Permits	Details any permit requirements
Data Collection, Analysis and Reporting Requirements	Provides details on the necessary data requirements including baseline information, analytical parameters and detection limits, and metadata. Details the deliverables from the study
Personnel Resourcing Requirements, Qualifications and Skills	Provides minimum experience, qualifications/certifications and resource requirements to deliver the study Considers shifts and survey rotations for effective fatigue management, including contingency resource planning
Field Equipment, Survey Platforms and Logistics	Details equipment and logistics requirements to fulfil the study requirements
Recommended Procedures for Data Collection, Sampling, Storage, Transport and Analysis	Provides the study sampling and analytical techniques, and standards to ensure data quality and ensure consistency throughout the study (including Chain of Custody (CoC) forms) and with any relevant historic datasets
Risk Assessment, OHS Considerations	Describes the Operational Health and Safety (OHS) risks and mitigation controls associated with undertaking the study
Data Management, QA/QC, Transmittal and Archiving	Provides Quality Assurance / Quality Control (QA / QC) requirements for all data obtained as part of the study, data management and archiving requirements
Supporting Documents, Standards and References	Identifies the relevant guidelines and high-level references required to implement the study
Reporting Requirements	Provides description of reporting of the scientific outcomes of the survey(s), including identification and quantification of potential impacts and subsequent recovery
Termination criteria	
Criteria for the Terminating the Monitoring Activity	Completion criteria to be met to demonstrate that study objectives have been achieved to terminate the study

9 REFERENCES

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APPENDIX A MARINE POLLUTION REPORT (POLREP)

Australian Government
Australian Maritime Safety Authority

HARMFUL SUBSTANCES REPORT (POLREP)

Marine Order 91 *(Marine pollution prevention – Oil) 2013*

To:	General Manager, Ship Safety Division, General Manager, Marine Environment Division and General Manager, Emergency Response Division through Rescue Coordination Centre (RCC) Australia
Telex:	7162349
Telephone:	+61 (0)2 6230 6811
Freecall:	1800 641 792 (within Australia)
Facsimile:	+61 (0)2 6230 6868
AFTN:	YSARYCYX
E-mail:	rccaus@amsa.gov.au

(Note: If any of the following items of the vessel reporting format are inappropriate they should be omitted from the report. These items of the standard reporting format are referred to in IMO Resolution A.851(20)).

A. Name of vessel — Call sign — Flag

B. Date and time of event *(Note: Time must be expressed as Coordinated Universal Time (UTC))*

C. Position: latitude and longitude

or

D. Position: true bearing and distance

E. True course (as a three digit group)

F. Speed (in knots and tenths of a knot as a 3-digit group)

L. Route information – details of intended track

M. Full details of radio stations and frequencies being guarded

N. Time of next report *(Note: Time must be expressed as Coordinated Universal Time (UTC))*

P. Type and quantities of cargo and bunkers on board

Q. Brief details of defects, damage, deficiencies or other limitations.
These must include the condition of the vessel and the ability to transfer cargo, ballast or fuel

R. Brief details of actual pollution. These should include the type of oil, an estimate of the quantity discharged, whether
the discharge is continuing, the cause of the discharge and, if possible, an estimate of the movement of the slick

S. Weather and sea conditions, including wind force and direction and relevant tidal or current details

T. Name, address, telephone and facsimile numbers of the vessel's owner and representative *(manager or operator of the vessel, or their agents)*

Owner		Representative	
Telephone	Facsimile	Telephone	Facsimile

U. Type of vessel Length Breadth Tonnage

X. 1. Action being taken with regard to the discharge and to the movement of the vessel

2. Assistance or salvage efforts which have been requested or which have been provided by others

3. The master of an assisting or salvaging vessel should report the particulars of the action undertaken or planned

APPENDIX B PRELIMINIARY NET ENVIRONMENTAL BENEFIT ASSESSMENT (NEBA)

Definitions for scoring:

Scores	Potential LEVEL of impact	Likely SPATIAL SCALE of impact	Potential DURATION of impact
+3	**Major:** potential for full recovery	>3/4 of region or community or population to International	Potential for decrease in spill impact by **> 5 years**
+2	**Moderate:** partial recovery Likely to mitigate a significant impact to: - a single reproductive cycle for biological receptors; or - direct (e.g. loss of income) or indirect (e.g. via public perception) recoverable financial impact for socio-economic receptors.	>1/4 to 3/4 of region or community or population	Potential for decrease in spill impact by **1-5 years**
+1	**Minor:** limited recovery Likely to result in mitigation of behavioural impacts by biological or socio-economic receptors	Local (< 1/4 of region) or minor proportion of affected community or population	Potential for decrease in spill impact by **< 1 year**
0	**No discernable difference from an unmitigated spill impact**		
-1	**Minor:** limited additional losses	Local (< 1/4 of region); or minor proportion of affected community or population	Potential cumulative increase in impact by **< 1 year**
-2	**Moderate:** large additional losses	>1/4 to 3/4 of region or community or population	Potential cumulative increase in impact of **1-5 years**
-3	**Major:** unrecoverable loss	>3/4 of region or community or population to International	Potential cumulative increase in impact of **> 5 years**

Value Ranking: Guidance for classifying priority rank of resources (Source: https://www.transport.wa.gov.au/imarine/oil-spill-response-and-planning-tools.asp)

	Low (1)	Medium (2)	High (3)	Very High (4)
Plant and animal habitats	Important site for non-classified species (e.g. breeding colony) or known habitat for endemic species	Important sites for endemic species or known area for species in decline	Important sites for species in decline (but not listed) or known habitat for endangered or vulnerable species	Important sites for listed threatened species, or part of a known range for nationally critical species, or important sites for nationally critical species (e.g. breeding colony)
Protected sites	Identified sites of importance but no protected status	Scenic reserve or wildlife management reserves	Marine mammal sanctuary, nature reserve, wildlife refuge	Marine National Park, Sanctuary, Ramsar sites, World Heritage sites
Economic/commercial	Very low economic significance for the region (<$150k per km of coast)	Low economic significance for the region (<$150k-$500k per km of coast)	Some economic significance for the region, but not nationally ($500k-$1.5 million per 1 km of coast)	High regional or national significance (>$1.5 million per 1 km of coast)
Cultural and heritage	No special cultural importance	Some importance to local community	Important historical or cultural heritage site	High state or national historical or cultural heritage site
Social, amenity and recreation	Low to moderate local recreational use, community or amenity values	Regionally significant seasonal recreational use, community or amenity values	Regionally significant year-round recreational use, community or amenity values	Nationally significant seasonal and year-round recreational use, community or amenity values

**Adapted from the National Plan Guidance Draft Outline v6.05 and Maritime NZ NEBA Planning Process (Vorwerk 2012).*

Preliminary NEBA assessment:

This preliminary NEBA assessment is based on the modelling outcomes from 100 spills over a year. The information provided in summary tables of surface and shoreline exposure have been used to determine the potential maximum level of exposure, against which the potential efficacy and impacts of each spill response strategy have been assessed.

Value ranking: using scale aligned with WA DoT NEBA/SIMA process here: https://www.transport.wa.gov.au/imarine/oil-spill-response-and-planning-tools.asp

Senstivity/receptor	Value ranking	Monitor and Evaluate	Mechanical dispersion	Containment and recovery	Surface (vessel/aerial) dispersant application	Shoreline protection and clean-up	Oiled wildlife response
Intertidal reefs	3	0	0	+1	+1	-1	0
Lagoons	3	0	0	0	-1	-1	0
Sandy Beaches	4	0	+1	+1	+1	-2	0
Rocky shores	1	0	0	0	+1	+1	0
Shorebirds	4	0	0	0	+1	+1	+1
Seagrass	3	0	0	0	-1	-2	0
Macroalgae	3	0	0	0	-1	-1	0
Hard corals	3	0	0	0	-2	-2	0
Subtidal reefs, shoals and banks	3	0	0	0	-2	0	0
Benthic mixed algal/sessile epiobiota communities (shallow)	1	0	0	0	-2	-1	0
Benthic filter-feeding communities (deep water)	1	0	0	0	0	0	0
Benthic infaunal communities	1	0	0	0	-1	0	0
Plankton (inc. pelagic larval stages)	1	0	-1	0	-2	0	0
Pelagic fish	1	0	0	0	-1	0	0
Demersal fish	2	0	0	0	0	0	0
Sharks and rays	2	0	0	0	-1	0	0
Prawns	1	0	0	0	0	0	0
Rock lobster, lobster and Giant crab	2	0	0	0	0	0	0
Trinidad clam (*Tridacna crocea*)	2	0	0	0	-1	0	0
Oysters	1	0	0	0	-1	0	0
Other shellfish	1	0	0	0	-1	0	0
Threatened fish	3	0	0	0	-1	0	0
Humpack whale	3	0	0	0	+1	0	0
Other Cetaceans	3	0	0	0	+1	0	0
Marine Reptiles	3	0	+1	0	+1	+1	+1
Seabirds	2	0	+1	0	+2	0	+1
Threatened seabirds/shorebirds	4	0	0	0	+1	+1	+1
Commercial Fisheries	2	0	0	0	0	0	0
Recreational Fisheries	1	0	0	0	0	0	0
Protected areas	4	0	0	0	-1	-2	0
Shorebirds BIA	4	0	0	0	+1	-2	0
Sub-tidal Heritage sites	3	0	0	0	0	0	0
Shipping	1	0	0	0	0	0	0
Petroleum exploration and production	1	0	0	0	0	0	0
Tourism and recreation	2	0	0	0	-1	0	0
Research	2	0	0	0	-1	-1	0
Net environmental benefit?		No disbenefit	Low; Highly-localised	Negligible	No	Unlikely; Requires re-assessment based on nature and scale	Potentially
		The monitor and evaluate strategy has no direct effect on the spill itself (hence the zero scores), but provides critical situational awareness for effective spill response planning.	Mechanical dispersion is a highly localised strategy, with entrainment effects generally within the maximum extent of vessel fire hose range, and along the transit through the slick. The duration of entrainment is also unclear, as entrained droplets are limited to near-surface waters, and likely to rise back to the surface.	Assuming this strategy could be mobilised in time (modelling indicates that shoreline contact is within 16 hours), it is unlikely to be very effective due to prevailing offshore conditions, and as the equipment is not appropriate/efficient for recovery of light hydrocarbons such as MDO. Any benefit to shorelines is therefore likely to be low/minimal.	Assuming this strategy could be mobilised in time (modelling indicates that shoreline contact is within 16 hours), it is unlikely to be very effective due to the thickness and type of hydrocarbon. Dispersant is likely to 'punch through' the surface slick, resulting in minimal contact with spill hydrocarbons and input of chemical dispersants into the environment. The inherent toxicity of dispersants is likely to result in environmental impacts, especially if applied in close proximity (e.g. within 10 km) of shallow reefs/shorelines.	Shoreline protection booms require anchoring to the sea bed, which has the potential for impacts to benthic habitat such as seagrass and coral. Boom also do not collect oil, but redirect it onto a sacrificial beach. Due to the small size of the shorelines in the modelled exposure area, this approach is unlikely to benefit receptors. Similarly, modelling indicates that the level of accumulation on shorelines would be insufficient to automatically mobilise this response. The maximum levels - at Mermaid Reef/Seabirds BIA - would require assessment before any response is mobilised, to assess the risk to shoreline habitats and shorebirds. The decision on whether to mobilise shoreline response at Mermaid Reef would be made by AMSA as the CA for commonwealth waters, based on the nature and scale of the response.	Oiled wildlife response can be successful, with hazing likely to be the most effective response in this case. Collection of oiled seabirds offshore will be difficult/unfeasible, and the potential benefit of cleaning of any oiled shorebirds on shorelines would need to be made at the time, based on the nature and scale of the incident and a re-assessment of the potential benefit.

APPENDIX C AERIAL SURVEILLANCE OBSERVER LOG

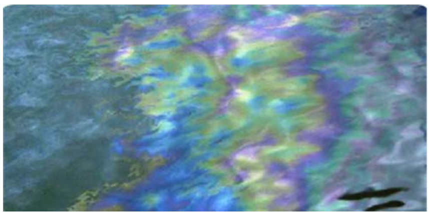
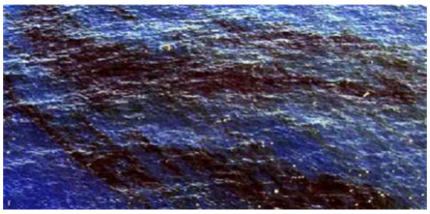
Survey Details									
Date:		Start time		End time		Observers:			
Incident:						Area of survey:			
Aircraft Type:		Call sign				Average altitude:		Remote sensing used	

Weather Conditions			
Wind speed (knots)		Wind direction	
Cloud base (feet)		Visibility (Nm)	
Time high water		Current direction	
Time low water		Current speed (Nm)	

Slick Details							
Slick grid parameters by lat/long				Slick grid parameters by air speed		Slick grid dimensions	
Length Axis		Width Axis		Length Axis	Width Axis	Length	Nm
Start Latitude		Start Latitude		Time (seconds)	Time (seconds)	Width	Nm
Start Longitude		Start Longitude				Length	km
End Latitude		End Latitude		Air Speed (Knots)	Air Speed (Knots)	Width	km
End Longitude		End Longitude				Total Grid Area	km^2

Code	Colour	%age cover observed		Total Grid Area	Area per oil code		Factor	Oil volume	
1	Silver		%			km^2	40 – 300 L/km^2		L
2	Rainbow		%			km^2	300 – 5,000 L/km^2		L
3	Metallic		%			km^2	5,000 – 50,000 L/km^2		L
4	Discontinuous true oil colour		%			km^2	50,000 – 200,000 L/km^2		L
5	Continuous true oil colour		%			km^2	>200,000 L/km^2		L
Non shaded areas to be completed on flight. Shaded areas completed on return.							TOTAL		l

APPENDIX D BONN AGREEMENT OIL APPEARNCE CODE (BAOAC)

Image	Description
	**CODE 1** - Oil Sheen Silvery (0.04 µm – 0.3 µm) Very thin films of oil reflect the incoming light better than the surrounding water and can be seen as a silvery or grey sheen. Above a certain height or angle of view the sheen may no longer be observed.
	**CODE 2** - Oil Sheen Rainbow (0.3 µm – 5.0 µm) Rainbow oil appearance is caused by an optical effect that is independent of oil type. Depending on angle of view and layer thickness, the distinctive colours will be diffuse to very bright. Bad light conditions may cause the colours to appear duller. A consistent layer of oil in the rainbow region will show different colours across the slick because of the change in angle of view. Therefore, if rainbow is present, a range of colours will be visible.
	**CODE 3** - Oil Sheen Metallic (5.0 µm – 50 µm) Although a range of colours can be observed (e.g. blue, purple, red and greenish) the colours will be distinctly different to a "rainbow". Metallic sheens will appear as a relatively homogeneous colour (blue, brown, purple or another colour). The "metallic" appearance – caused by a mirror effect - is the common factor, with the colour dependent on light and sky conditions. For example, blue can be observed in clear, blue-sky conditions.
	**CODE 4** - Discontinuous True Colour (50 µm – 200 µm) For oil slicks thicker than 50 µm, the true colour will gradually dominate. Brown oils will appear brown, black oils will appear black. Patchiness in colour due to thinner areas within the slick, results in a discontinuous appearance (though dominated by the true oil colour). The term "discontinuous" therefore should not be mistaken as necessarily describing the surface coverage of the oil.
	**CODE 5** - Continuous True Colour (>200 µm) The true colour of the specific oil is the dominant effect in this category. A more homogenous colour can be observed with no discontinuity as described in Code 4. This category is strongly oil type dependent and colours may be more diffuse in overcast conditions.

APPENDIX J Titleholder report on public comment

Please find attached the titleholder report on public comment for the Possum 3D Marine Seismic Survey Environment Plan (EP) submitted, as required, after completion of the public comment process.

The Possum 3D MSS EP was submitted to NOPSEMA for completeness check on 8 November 2021 and on acceptance entered a 30 day period of public comment where the EP was published on the NOPSEMA website from 15th November 2021 to 15th December 2021.

A total of 3 public submissions were received, consisting of 6015 additional interested parties who commented on the draft EP. The following pages detail the common issues or themes raised from the received comments. Searcher note that no new information relevant to impacts and risks in the EP were received. Where applicable Searcher has indicated the pertinent sections corresponding to the raised matters and where they have already been accounted for in the EP.

In the Environment Plan references to the 30 day public comment period and this "APPENDIX J: Titleholder report on public comment" have been highlighted in a different font (Times New Roman) and underlined for clarity.

Details for Searcher as both the Titleholder and nominated liaison person are as follows:

Name:	Searcher Seismic Pty Ltd
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Telephone:	+61 8 9327 0300
Contact:	Katrina Devlin
Email:	k.devlin@searcherseismic.com

ID#	**Comments received** (in general terms)	**Titleholder Response**
1	***Matter: Accountability and Compensation for damage*** ***Claim:*** Lack of accountability or compensation by oil and gas companies for damaging the environment.	Searcher thanks the stakeholders for their response. However, the issue raised by the stakeholders does not contain merits that pertain to the potential environmental impacts from the seismic survey. Searcher is unable to assess the merits of this claim. Searcher however notes that the EP contains relevant information at section 1.4 detailing that NOPSEMA require demonstration of Financial Assurance to cover the proposed activities, including environmental damage, prior to acceptance of the EP.
2	***Matter: Alternative Location*** ***Claim:*** Undertake the proposal in a different location.	Searcher thanks the stakeholders for their response. Offshore exploration permits for oil and gas are administered by NOPTA who release permits under the OPGGS Act 2006. Searcher does not decide or influence the permit release process or their location, this is decided by NOPTA. As such, Searcher is commercially and operationally constrained to acquire data relevant to required outcomes for NOPTA's exploration permits or special prospecting authority conditions and administration requirements for titleholders and are therefore unable to conduct this survey in a different location.
3	***Matter: Alternative Technologies*** ***Claim:*** Seismic blasting is a risky technology. Invent a safer method of detecting resources.	Searcher thanks the stakeholders for their response. The technology that will be used for this survey involves a series of sound sources that create acoustic emissions, within a specified frequency and amplitude, to detect geological formations. This technology is the only technology that is technically feasible for generating the required geophysical data and is commercially viable. All other seismic technology is still being developed and is not technically or commercially feasible for this survey. Searcher notes that a comprehensive assessment of the potential impacts and risks is provided in Section 6 of the EP. Furthermore, in accordance with the management controls set out in Section 9, the seismic activity will be managed so that the potential impacts and risks will be mitigated to ALARP and Acceptable levels in accordance with the environmental regulatory requirements for the Possum seismic survey.
4	***Matter: Biologically Important Areas (BIA)*** ***Claim:*** Keep seismic testing away from marine parks and biologically important areas (BIA). There are Biologically Important Areas (BIA) for three species that overlap the Rowley Shoals proposal area for the pygmy blue whale, the white-tailed tropicbird and the little tern.	Searcher thanks the stakeholders for their response. Concerns for the Marine Parks and Reef are addressed at Matter ID 24. Searcher notes that a comprehensive assessment of the potential impacts and risks to the Environment, including the species with Biologically Important Areas, is provided in Section 6 of the EP. A detailed assessment of potential impacts from anthropogenice sound is provided in section 6.4 of the EP. Pygmy blue whales are not expected to be displaced from their BIA. The acquisition area overlaps a very small portion of the white-tailed tropicbird breeding BIA and a very small portion of the little tern resting BIA. Only birds diving and foraging within the operational area would be exposed to anthropogenic sound while diving for small pelagic fishes near the sea surface, or be affected by changes in prey distribution. It is considered reasonable that birds may avoid the seismic sound and physical impact is considered not credible. Anthropogenic sound theoretically has the ability to affect the tropicbird foraging through avoidance of diving for prey or through disturbing their prey. Only the area around the seismic source (approximately 10 km) at any one time is expected to influence fish behaviour and therefore potentially influence the availability of their prey source. As such, at any moment in time the affects to potential foraging sources is extremely small. Further, the area of the BIA overlapped with the acquisition area (approximately 10-15%) is small, leaving most of the BIA available for foraging. The seismic activity will be managed so that potential impacts and risks to protected marine fauna including pygmy blue whale, the white-tailed tropicbird and the little tern are not inconsistent with the relevant management plans. Furthermore, in accordance with the management controls set out in Section 9, the seismic activity will be managed so that the potential impacts and risks to protected marine fauna including pygmy blue whale, the white-tailed tropicbird and the little tern will be

ID#	**Comments received** (in general terms)	**Titleholder Response**
		mitigated to ALARP and Acceptable levels in accordance with the environmental regulatory requirements for the Possum seismic survey.
5	***Matter: Chain Reactions and tipping points*** ***Claim:*** Until the proponent can prove that no harm comes to the marine life in the marine parks then they can't do blasting. Unknown chain reactions and tipping points are too great to risk.	Searcher thanks the stakeholders for their response. There is no seismic acquisition proposed in the Marine Parks. Under the OPGG Environment 2009 regulations, Searcher is required to demonstrate that changes to the marine environment in the vacinity of the Marine Parks due to the seismic activity are reduced to ALARP and Acceptable levels and are not inconsistent with other relevant legislation. Searcher notes that a comprehensive assessment of the potential impacts and risks is provided in Section 6 of the EP. Searcher has used the best and most contemporary scientific evidence with sound propagation modelling to predict the potential effects of anthropogenic sound on marine life. For example in Anthropogenic Sound section 6.4, peer-reviewed literature does not indicate any long-term abandonment of fishing grounds by commercial species due to seismic activity, with several studies indicating that catch levels returned to pre-survey levels after seismic activity had ceased. Furthermore, in accordance with the management controls set out in Section 9, the seismic activity will be managed so that the potential impacts and risks, to marine life and the marine parks, will be mitigated to ALARP and Acceptable levels in accordance with the environmental regulatory requirements for the Possum seismic survey. There is no residual or long-term impact expected from the routine operations.
6	***Matter: Chemicals from Explosives*** ***Claim:*** Chemicals from underwater explosives will kill fish.	Searcher thanks the stakeholders for their response. The seismic array that will be used in the seismic survey consists of a series of sound sources that discharge compressed air. Explosives will not be used during the survey therefore explosive related chemicals will not be released into the environment.
7	***Matter: Climate Change*** ***Claim:*** Oil and gas or fossil fuel activities contribute to climate change and global warming. Concerned that the environment is already stressed from climate change.	Searcher thanks the stakeholders for their response. However, the issue raised by the stakeholders does not contain merits that pertain to the potential environmental impacts from the seismic survey. Searcher is unable to assess the merits of this claim. Searcher notes however that a comprehensive assessment of the potential impacts and risks to the environment is provided in Section 6 of the EP. A detailed assessment of atmospheric emissions is provided in section 6.5 of the EP with control measures adopted to use more enviromentally friendly fuel in section 6.10.2. Furthermore, in accordance with the management controls set out in Section 9, the seismic activity will be managed so that the potential impacts and risks will be mitigated to ALARP and Acceptable levels in accordance with the environmental regulatory requirements for the Possum seismic survey.
8	***Matter: COP26 and Net zero by 2050*** ***Claim:*** Proposal in conflict with Australia's COP26 commitments, and achieving net zero by 2050.	Searcher thanks the stakeholders for their response. However, the issue raised by the stakeholders does not contain merits that pertain to the potential environmental impacts from the seismic survey. Searcher is unable to assess the merits of this claim. Searcher notes however that a comprehensive assessment of the potential impacts and risks to the environment is provided in Section 6 of the EP. A detailed assessment of atmospheric emissions is provided in section 6.5 of the EP with control measures adopted to use more enviromentally friendly fuel in section 6.10.2. Furthermore, in accordance accordance with the management controls set out in Section 9, the seismic activity will be managed so that the potential impacts and risks will be mitigated to ALARP and Acceptable levels in accordance with the environmental regulatory requirements for the Possum seismic survey.

ID#	**Comments received** (in general terms)	**Titleholder Response**
9	***Matter: Diving*** ***Claim:*** Impacts to diving spots, people/divers and local economy.	Searcher thanks the stakeholders for their response. Searcher notes that a comprehensive assessment of the potential impacts and risks to divers is provided in Section 6.4.10 of the EP with management measures detailed in Section 6.4.12. The 40 m depth contour at Mermaid Reef nearest the acquisition area has been identified as the nearest potential dive location and is considered representative of the greatest underwater sound impacts on divers. When the seismic vessel is at its closest point to the 40 m depth contour, the modelled sound level of 147.4 dB re 1 µPa (SPL; LP) at this location slightly exceeds the recommended safety threshold of 145 dB re 1 µPa (SPL; LP). Sound levels reaching the representative 40 m dive site from the two adjacent sites modelled (Sites 1 and 2) did not exceed the threshold, indicating it would be a transient exceedance. The acoustic modelling showed that as the sound reaches the steeply rising reef edge its energy decreases dramatically. The leeward sides of the reef are predicted to be exposed to significantly lower sound levels and most of the reef will be exposed to lower than the diver safety threshold value throughout the survey. The area on the north-west side of Mermaid Reef that is predicted to be exposed to sound above the recreational diver sound threshold is highly localised and would only be exposed to sound at this level for a short time. Prior consultation noted that identified diving operations only potentially run in October and November which is outside the proposed Possum seismic survey timing. Furthermore, in accordance with the management controls set out in Section 9, including the implementation of the DMAC 12 Safe Diving Distance from Seismic Surveying Operations Rev 2.1, there will be no impacts to diver health due to anthropogenic sound and the activity will be managed to ALARP and Acceptable levels in accordance with the environmental regulatory requirements for the Possum seismic survey.
10	***Matter: Drill Rigs following seismic survey*** ***Claim:*** Concerned about drill rigs following seismic blasting, the industrialisation of the Western Australian coast, and risk of oil spills.	Searcher thanks the stakeholders for their response. However, the issue raised by the stakeholders does not contain merits that pertain to the potential environmental impacts from the seismic survey. Searcher is unable to assess the merits of this claim.
11	***Matter: Earth's Crust weakened*** ***Claim:*** Seismic blasting weakens the Earth's crust, throws all marine life into chaos because they communicate via sounds and songs.	Searcher thanks the stakeholders for their response. Acoustic Modelling was conducted for the survey, demonstrating that as the signal reaches the seabed its energy decreases dramatically and is unlikely to weaken or damage the earth crust. The earth's crust issue raised by the stakeholder is more relevant to the concern raised about impact on seabed, which is addressed in ID 17. Searcher notes however that a comprehensive assessment of the potential impacts and risks to the environment is provided in Section 6 of the EP. A detailed assessment of potential impacts from anthropogenic sound is provided in section 6.4 of the EP. Furthermore, in accordance with the management controls set out in Section 9, the seismic activity will be managed so that the potential impacts and risks, to the marine parks, will be mitigated to ALARP and Acceptable levels in accordance with the environmental regulatory requirements for the Possum seismic survey. No effects on the seabed, seafloor features are predicted in section 6.4.8.2 and Table 6.15.

ID#	Comments received (in general terms)	Titleholder Response
12	***Matter: Financial Investment*** ***Claim:*** Object to financial investment in oil and gas projects and its profits. Call to invest in sustainable or clean energy projects.	Searcher thanks the stakeholders for their response. However, the issue raised by the stakeholders does not contain merits that pertain to the potential environmental impacts from the seismic survey. Searcher is unable to assess the merits of this claim.
13	***Matter: Fish and Commercial Fisheries*** ***Claim:*** Seismic blasting impacting fish species, fish stocks and fish catch rates (i.e. whiting and flathead).	Searcher thanks the stakeholders for their response. Searcher notes that a comprehensive description of the Biological Environment and the relevant Commercial Fisheries is provided, respectively, at section 4.6 and 4.7 of the EP. A detailed assessment of the potential effects of anthropogenic sound on fish and fisheries is proivded in sections 6.4.6 and 6.4.9 of the EP. Based on quantitative acoustic modelling and the best available science, the results show that serious injury and mortality are restricted to 144m from the seismic source. Behavioural and TTS effects are restricted to up to 10 km from the source which is not predicted to reach reef fish on the nearby reefs and shoals. Furthermore, the behavioural effects are likely to elicit an avoidance response that further reduce the potential for PTS/injury and TTS. This may result in some temporary displacement, particularly of mobile pelagic species within 10 km of the seismic source limited to the duration of the survey. The Mackerel Managed Fishery and North West Slope Trawl Fishery are the only historically active (recorded catch within the last 5 years) fisheries within or adjacent to (within 10 km of) the acquisition area. For the Mackerel Managed Fishery there is no overlap between the ensonified area capable of inducing behavioural changes and fished areas of the fishery. For the North West Slope Trawl Fishery there is a small overlap of 2.33% of the fishery and crustaceans on the seabed are unlikely to be exposed to lethal levels of anthropogenic sound. There is no known fishery for whiting or flathead in the area that overlaps with the ensonified area capable of inducing a behavioural response. Searcher is a member of the Collaborative Seismic Environment Plan (CSEP) consortium that underpins the National Energy Resources Australia (NERA) Commercial Fishing Industry Adjustment Protocol as negotiated with commercial fishing peak industry bodies, including AFMA, WAFIC and the Northern Territory Seafood Council. The CSEP Adjustment Protocol details an evidence-based process for commercial fishers to make a claim for loss of catch, displacement or gear damage within an Adjustment Area, a copy of which is available on the NERA website. Therefore, in accordance with the management controls set out in Section 9, the seismic activity will be managed so that potential impacts and risks to fish and fisheries are reduced to ALARP and Acceptable levels in accordance with the environmental regulatory requirements for the Possum seismic survey.
14	***Matter: Food and Food Chains*** ***Claim:*** Pollution or destruction of food and food chains.	Searcher thanks the stakeholders for their response. The EP contains a comprehensive assessment of the potential effects of seismic activitiy on marine life that constitute food and food chains in section 6. The seismic activity will be managed so that potential impacts and risks to protected marine life, fauna and fisheries are not inconsistent with the relevant management plans. Furthermore, in accordance with the management controls set out in Section 9, the seismic activity will be managed so that potential impacts and risks to protected marine life, fauna and fisheries are reduced to ALARP and Acceptable levels in accordance with the environmental regulatory requirements for the Possum seismic survey.

ID#	**Comments received** (in general terms)	**Titleholder Response**
15	***Matter: Future Generations*** ***Claim:*** Need to protect the ocean / environment for future generations.	Searcher thanks the stakeholders for their response. However, the issue raised by the stakeholders does not contain merits that pertain to the potential environmental impacts from the seismic survey. Searcher is unable to assess the merits of this claim. Searcher would like to note however that a comprehensive assessment of the potential impacts and risks to the environment is provided in Section 6 of the EP. In accordance with the management controls set out in Section 9, the seismic activity will be managed so that the potential impacts and risks will be mitigated to ALARP and Acceptable levels in accordance with the environmental regulatory requirements for the Possum seismic survey. In this manner Searcher supports protecting the ocean / environment for future generations
16	***Matter: Government and Politicians*** ***Claim:*** Call for government or politicians to oppose the proposal. Will not support any government or politicians who approve the proposal.	Searcher thanks the stakeholders for their response. However, the issue raised by the stakeholders does not contain merits that pertain to the potential environmental impacts from the seismic survey. Searcher is unable to assess the merits of this claim.
17	***Matter: Government Approval*** ***Claim:*** Concerned that seismic testing will devastate marine life, despite a government approval indicating it will have little impact to marine life.	Searcher thanks the stakeholders for their response. Searcher notes that a comprehensive assessment of the potential effects on marine life including threatened and protected marine life is provided in section 6 of the EP. A detailed assessment of potential impacts from anthropogenic sound is provided in section 6.4 of the EP. The seismic activity will be managed so that potential impacts and risks to protected marine fauna are not inconsistent with the relevant management plans. Furthermore, in accordance with the management controls set out in Section 9, the EP demonstrates that the seismic activity will be managed so that potential impacts and risks to protected marine fauna and fisheries are reduced to ALARP and Acceptable levels in accordance with the environmental regulatory requirements, therefore meeting the conditions requried for government approval. Searcher is confident that the Government has adequate and experienced resources in place to understand and appraise the EP which presents an assessment of potential impacts and risks backed up by scientific studies, sientific evidence and researches which will support the Government decision on whether to approve or reject the proposed survey.
18	***Matter: Healthy Oceans/Communities*** ***Claim:*** Healthy oceans mean healthy communities.	Searcher thanks the stakeholders for their response. However, the issue raised by the stakeholders does not contain merits that pertain to the potential environmental impacts from the seismic survey. Searcher is unable to assess the merits of this claim. Searcher would like to note however that a comprehensive assessment of the potential risks and impacts on the marine environment is provided in Section 6 of the EP. Furthermore, in accordance with the management controls set out in Section 9, the seismic activity will be managed so that the potential impacts and risks will be mitigated to ALARP and Acceptable levels in accordance with the environmental regulatory requirements for the Possum seismic survey. In this manner Searcher supports the health of oceans and communities.

ID#	**Comments received** (in general terms)	**Titleholder Response**
19	***Matter: Heritage Values*** ***Claim:*** Protect heritage values.	Searcher thanks the stakeholders for their response. Searcher noteas that a comprehensive assessment of the potential effects of the seismic activity on heritage values is provided in section 6.4.8 of the EP. The seismic activity will be managed so that potential impacts and risks to heritage values are not inconsistent with the relevant IUCN principles. Furthermore, in accordance with the management controls set out in Section 9, the seismic activity will be managed so that the potential impacts and risks, to heritage values, will be mitigated to ALARP and Acceptable levels in accordance with the environmental regulatory requirements for the Possum seismic survey.
20	***Matter: Irreparable damage*** ***Claim:*** The proposal will destroy / wreck / vandalise the ocean, the environment, and marine species, causing irreparable damage. Need to prioritise their protection instead, and leave it untouched / pristine. Opposed to seismic blasting.	Searcher thanks the stakeholders for their response. Searcher notes that a comprehensive assessment of the potential effects, impacts and risks on the ocean, the environment and marine species are provided in section 6 of the EP. The seismic activity will be managed so that potential impacts and risks are not inconsistent with the relevant plans of management. Furthermore, in accordance with the management controls set out in Section 9, the seismic activity will be managed so that the potential impacts and risks; to the ocean, environment, and marine species, will be mitigated to ALARP and Acceptable levels in accordance with the environmental regulatory requirements for the Possum seismic survey. There is no irrepairable damage expected from the routine operations.
21	***Matter: Loss of Macological species*** ***Claim:*** Concern that seismic exploration will result in loss of many Malacological species.	Searcher thanks the stakeholders for their response. Searcher notes that a comprehensive assessment of the potential effects of anthropogenic sound on molluscs is provided in section 6.4.3 of the EP. Based on quantitative acoustic modelling and the best available science, mobile molluscs such as squid are likely to respond behaviourally and avoid the seismic sound. For more sessile molluscs such as scallops, the research shows there may be slightly increased rates of mortality above background levels. However, this effect would be likely to be restricted to close proximity of the seismic survey and will have little effect across the population within the broader bioregion, there are also no scallop fisheries in or near the survey area. Furthermore, in accordance with the management controls set out in Section 9, the seismic activity will be managed so that potential impacts and risks to Macological species are reduced to ALARP and Acceptable levels in accordance with the environmental regulatory requirements for the Possum seismic survey.
22	***Matter: Marine life*** ***Claim:*** Seismic exploration should not be permitted in areas important for our protected marine life and fisheries.	Searcher thanks the stakeholders for their response. Searcher notes that a comprehensive assessment of the potential effects on protected marine life and fisheries in the vicinity of the survey is provided in section 6 of the EP. A detailed assessment of potential impacts from anthropogenic sound is contained within sections 6.4 of the EP. The seismic activity will be managed so that potential impacts and risks to protected marine life and fisheries are not inconsistent with the relevant plans for management. Furthermore, in accordance with the management controls set out in Section 9, the seismic activity will be managed so that the potential impacts and risks to protected marine life and fisheries will be mitigated to ALARP and Acceptable levels in accordance with the environmental regulatory requirements for the Possum seismic survey.
23	***Matter: Marine Park Extension*** ***Claim:*** Balance every blasting licence with commensurate extension of marine park area.	Searcher thanks the stakeholders for their response. However, the issue raised by the stakeholders does not contain merits that pertain to the potential environmental impacts from the seismic survey. Searcher is unable to assess the merits of this claim.

ID#	Comments received (in general terms)	Titleholder Response
24	***Matter: Marine Parks, Reefs and Shoals - vicinity to survey*** ***Claim:*** Seismic blasting is too close to the pristine Rowley Shoals, in the Rowley Shoals Marine Park and Mermaid Reef Marine Park. Marine Parks must be protected.	Searcher thanks the stakeholders for their response. The survey area is in close proximity to, but has been designed to avoid, the Mermaid Reef Commonwealth Marine Reserve (MRCMR) boundary (4.4 km to Operational Area; 7.2km to Active Source area) and the Rowley Shoals Marine Park boundary at Imperieuse Reef (11.9km to Operational Area; 21.65km to Active Source area). The operational area also avoids the ancient coastline. Searcher notes that a comprehensive assessment of the potential impacts on the marine parks in the vicinity of the survey is provided in section 6.4.8.2 of the EP and all other biological receptors that may occur in the marine park are assessed in their respective sub-headings in section 6 of the EP. The seismic activity will be managed so that potential impacts and risks to the marine parks are not inconsistent with the requirements of the relevant marine park management plans. Furthermore, in accordance with the management controls set out in Section 9, the seismic activity will be managed so that the potential impacts and risks, to the marine parks, will be mitigated to ALARP and Acceptable levels in accordance with the environmental regulatory requirements for the Possum seismic survey.
25	***Matter: Marine Parks, Reefs and Shoals*** ***Claim:*** Concern for the pristine coral reefs and crystal-clear waters that provide food, shelter and passage to hundreds of marine animals, many of which are protected and threatened species.	Searcher thanks the stakeholders for their response. Concerns for the Marine Parks and Reef are addressed at Matter ID 24. Searcher notes that a comprehensive assessment of the potential impacts to the environmental values and key biological receptors of the marine parks in the vicinity of the survey is provided in section 6.4.8.2 of the EP and all other biological receptors that may occur in the marine parks are assessed in their respective sub-headings in section 6 of the EP. The seismic activity will be managed so that potential impacts and risks to the environmental and biological receptors that may occur in the marine parks are not inconsistent with the requirements of the marine park management plans. Furthermore, in accordance with the management controls set out in Section 9, the seismic activity will be managed so that the potential impacts and risks to environmental and biological receptors in the marine parks are reduced to ALARP and Acceptable levels in accordance with the environmental regulatory requirements for the Possum seismic survey.
26	***Matter: Oil & Gas Obsolete*** ***Claim:*** Oil and gas / fossil fuels are obsolete and no longer needed. Move towards renewable / sustainable energy instead.	Searcher thanks the stakeholders for their response. However, the issue raised by the stakeholders does not contain merits that pertain to the potential environmental impacts from the seismic survey. Searcher is unable to assess the merits of this claim.
27	***Matter: Opposed to Recreational fishing*** ***Claim:*** Opposed to recreational fishing industry.	Searcher thanks the stakeholders for their response. However, the issue raised by the stakeholders does not contain merits that pertain to the potential environmental impacts from the seismic survey. Searcher is unable to assess the merits of this claim.
28	***Matter: Overseas markets*** ***Claim:*** Oil and gas companies are diverting gas resources to overseas markets, causing local manufacturing to collapse.	Searcher thanks the stakeholders for their response. However, the issue raised by the stakeholders does not contain merits that pertain to the potential environmental impacts from the seismic survey. Searcher is unable to assess the merits of this claim.

ID#	Comments received (in general terms)	Titleholder Response
29	***Matter: Protected Species*** ***Claim:*** 96 protected marine species (18 threatened) are likely to occur within the proposed seismic operational area including whales, sea turtles, sea snakes, sharks, rays, 31 different types of fish and 13 seabirds. All of these marine animals rely on underwater sound to communicate, navigate, mate, feed and detect predators. If seismic blasting went ahead it would interfere with these natural processes, potentially harming wildlife we should be protecting.	Searcher thanks the stakeholders for their response. Searcher notes that a comprehensive assessment of the potential effects of anthropogenic sound on protected and threatened marine species is provided in section 6.4 of the EP. The seismic activity will be managed so that potential impacts and risks to protected marine species are not inconsistent with the relevant management plans. Furthermore, in accordance with the management controls set out in Section 9, the seismic activity will be managed so that the potential impacts and risks, to protected marine fauna, cetaceans, marine reptiles, fish and avifauna, will be mitigated to ALARP and Acceptable levels in accordance with the environmental regulatory requirements for the Possum seismic survey.
30	***Matter: Regional economy*** ***Claim:*** Impacts to regional economy through local tourism and recreational and commercial fishing.	Searcher thanks the stakeholders for their response. Concerns for Tourism, Recreation and Commercial Fishing related to the Marine Parks and Reef are addressed at Matter ID 24, Divers at Matter ID 9 and Fisheries at Matter ID 13. The regional economy is detailed in the socio-economic environment in section 4 of the EP. Searcher notes that a comprehensive assessment of the potential impacts and risks to the regional economy is provided in section 6 of the EP. Furthermore, in accordance with the management controls set out in Section 9, the seismic activity will be managed so that the potential impacts and risks will be mitigated to ALARP and Acceptable levels in accordance with the environmental regulatory requirements for the Possum seismic survey.
31	***Matter: Risk to the Planet*** ***Claim:*** Future of the planet at risk. Need to protect and look after the planet	Searcher thanks the stakeholders for their response. However, the issue raised by the stakeholders does not contain merits that pertain to the potential environmental impacts from the seismic survey. Searcher is unable to assess the merits of this claim. Searcher notes however that a comprehensive assessment of the potential impacts and risks to the environment is provided in Section 6 of the EP. Furthermore, in accordance with the management controls set out in Section 9, the seismic activity will be managed so that the potential impacts and risks will be mitigated to ALARP and Acceptable levels in accordance with the environmental regulatory requirements for the Possum seismic survey. In this manner Searcher supports protecting and looking after the planet.

ID#	**Comments received** (in general terms)	**Titleholder Response**
32	***Matter: Risks don't end with seismic survey*** ***Claim:*** The risks to our protected marine species don't end with seismic surveys. Modelling suggests the potential impact zone of an oil spill in this location would encompass some of our most iconic marine parks and reefs including Scott Reef, the Kimberley Marine Park, Argo-Rowley Terrace Marine Park, and the Eighty Mile Beach Marine Park. This would devastate a near-pristine marine environment, the marine life that call it home and local communities, fishing and tourism businesses.	Searcher thanks the stakeholders for their response. Searcher notes that the seismic survey does not involve drilling or oil production, so an oil spill from a reservoir is not possible. In relation to the Argo-Rowley Terrace Marine Park and other Marine Parks or reefs within the survey area, a comprehensive assessment of the potential effects of a worst case credible Marine Hydrocarbon spill from the seismic vessel is provided in section 6.10 of the EP. The risks of a fuel spill from the seismic vessel are of a similar likelihood and consequence to the risks of a spill from one of the many commercial vessels that transit the area. The seismic activity will be managed so that potential impacts and risks to the marine parks and reefs are not inconsistent with the relevant management plans. Furthermore, in accordance with the management controls set out in Section 9, the seismic activity will be managed so that the potential impacts and risks, from a marine hydrocarbon spill, will be mitigated to ALARP and Acceptable levels in accordance with the environmental regulatory requirements for the Possum seismic survey.
33	***Matter: Scallop/zooplankton mortality*** ***Claim:*** Seismic blasting can kill scallops and tiny zooplankton more than a kilometre away.	Searcher thanks the stakeholders for their response. Searher notes that a comprehensive assessment of the potential effects of anthropogenic sound on zooplankton and scallops is provided in sections 6.4.2 and 6.4.3 of the EP. Based on quantitative acoustic modelling and the best available science, the predicted maximum distance that plankton could suffer mortality is 120 m from the seismic source. Scallops may suffer some mortality at levels slightly higher than natural rates of mortality close to the seismic source. There are no scallop fisheries in or near the survey area. Furthermore, in accordance with the management controls set out in Section 9, the seismic activity will be managed so that potential impacts and risks to zooplankton and scallops are reduced to ALARP and Acceptable levels in accordance with the environmental regulatory requirements for the Possum seismic survey.
34	***Matter: Seabed damage*** ***Claim:*** Seismic exploration is damaging to the seabed.	Searcher thanks the stakeholders for their response. Searcher notes that a comprehensive assessment of the potential impacts and risks from the seismic activity is provided in Section 6 of the EP. Furthermore, in accordance with the management controls set out in Section 9, the seismic activity will be managed so that the potential impacts and risks will be mitigated to ALARP and Acceptable levels in accordance with the environmental regulatory requirements for the Possum seismic survey. No effects on the seabed, seafloor features are predicted in section 6.4.8.2 and Table 6.15.
35	***Matter: Seismic Banned*** ***Claim:*** Seismic exploration should be banned.	Searcher thanks the stakeholders for their response. However, the issue raised by the stakeholders does not contain merits that pertain to the potential environmental impacts from the seismic survey. Searcher is unable to assess the merits of this claim.

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36	***Matter: Seismic blasting*** ***Claim:*** Seismic blasting can confuse, harm and potentially kill precious marine fauna (i.e. scallops, zooplankton, fish species and whales). Seismic blasting could be devastating for these incredible Australian marine icons	Searcher thanks the stakeholders for their response. The seismic array that will be used in the seismic survey consists of a series of sound sources that discharge compressed air. Searcher notes that a comprehensive assessment of the potential impacts and risks from the acoustic source and anthropogenic sound during the survey is provided in section 6.4 of the EP. The seismic activity will be managed so that potential impacts and risks are not inconsistent with the relevant plans of management. Furthermore, in accordance with the management controls set out in Section 9, the seismic activity will be managed so that the potential impacts and risks, to the marine parks, will be mitigated to ALARP and Acceptable levels in accordance with the environmental regulatory requirements for the Possum seismic survey.
37	***Matter: Seismic impact zones*** ***Claim:*** Under sea surface blasts have disastrous effects at distances far outside the zones of immediate impact.	Searcher thanks the stakeholder for their response. The seismic array that will be used in the seismic survey consists of a series of sound sources that discharge compressed air. Searcher has undertaken an Acoustic Modelling Report to inform a comprehensive assessment of the potential effects on marine species including threatened and protected marine life at all relevant distances from the seismic source. A detailed assessment of potential impacts and risks from anthropogenic sound is contained within sections 6.4 of the EP. Futhermore, in accordance with the management controls set out in Section 9, the seismic activity will be managed so that potential impacts and risks are reduced to ALARP and Acceptable levels in accordance with the environmental regulatory requirements for the Possum seismic survey.
38	***Matter: Stakeholder Concerns*** ***Claim:*** Deep concern from Australian public, coastal communities, scientists, recreational fishers and commercial fishers on impacts to marine life and local fisheries.	Searcher thanks the stakeholders for their response. Searcher conducted comprehensive Stakeholder Consultation (see EP section 8) prior to the NOPSEMA 30 day public review with all concerns from relevant stakeholders addressed within the EP including impacts to marine life and local fisheries. Further following consultation the EP adopted a number of management controls as detailed in section 9 to mitigate against potential effects of anthropogenic sound on marine life and local fisheries in sections 6.4.6 and 6.4.9 of the EP as addressed in Matter ID 13 - Fish and Fisheries.
39	***Matter: Survey Parameters*** ***Claim:*** Seismic blasting involves loud explosions into the seabed every 10-15 seconds, 24 hours a day, 7 days a week.	Searcher thanks the stakeholders for their response. Searcher notes that a comprehensive assessment of the potential impacts and risks of anthropogenic sound is provided in Section 6.4 of the EP with the survey parameters detailed in section 3.3.1. Furthermore, in accordance with the management controls set out in Section 9, the seismic activity will be managed so that the potential impacts and risks will be mitigated to ALARP and Acceptable levels in accordance with the environmental regulatory requirements for the Possum seismic survey. No effects on the seabed, seafloor features are predicted in section 6.4.8.2 and Table 6.15.
40	***Matter: Survey Timing*** ***Claim:*** Put off the seismic exploration for a few more years to gauge how we progress away from fossil fuels.	Searcher thanks the stakeholders for their response. However, the issue raised by the stakeholders does not contain merits that pertain to the potential environmental impacts from the seismic survey. Searcher is unable to assess the merits of this claim. Searcher notes however that a comprehensive assessment of the potential impacts and risks to of the timing of the survey is provided in section 6.1 of the EP. Furthermore, in accordance with the management controls set out in Section 9, the seismic activity will be managed so that the potential impacts and risks will be mitigated to ALARP and Acceptable levels in accordance with the environmental regulatory requirements for the Possum seismic survey.

ID#	**Comments received** (in general terms)	**Titleholder Response**
41	***Matter: Whales*** ***Claim:*** Seismic blasting can damage whales hearing, cause displacement from key feeding and breeding grounds and cause fatalities.	Searcher thanks the stakeholders for their response. Searcher notes that a comprehensive assessment of the potential effects of anthropogenic sound on whales (cetaceans) is provided in section 6.4.4 of the EP. Based on quantitative acoustic modelling and the best available science, anthropogenic sound will be managed so as not to cause instantaneous PTS and TTS. Cumulative PTS is not considered credible due to the amount of time a whale would need to spend in very close proximity to the seismic source to elicit this response. The speed at which the vessel and whales move, along with the likelihood of whales responding behaviourally to avoid close proximity to the source, makes PTS highly unlikely, particularly given the management controls that will be implemented (see section 9 of EP). For the same reasons, cumulative TTS is theoretically possible but also highly unlikely. In addition, TTS is a temporary hearing injury response and is recoverable in 24 hrs. There are no known feeding or breeding grounds in the vicinity of the seismic survey. The seismic activity will be managed so that potential impacts and risks to protected marine fauna including specifically cetaceans are not inconsistent with the relevant management plans. Furthermore, in accordance with the management controls set out in Section 9, the seismic activity will be managed so that the potential impacts and risks, to protected marine fauna including specifically cetaceans, will be mitigated to ALARP and Acceptable levels in accordance with the environmental regulatory requirements for the Possum seismic survey.
42	***Matter: Blank public comments***	No additional comments or concerns have been raised. Searcher is unable to assess the merits of this claim.