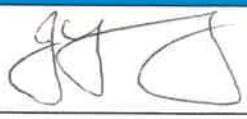
Santos

Stairway-1 Vessel Based Activity Environment Plan

PROJECT/FACILITY	Stairway-1
REVIEW INTERVAL (MONTHS)	60 Months
SAFETY CRITICAL DOCUMENT	NO

Rev	Owner	Reviewer/s *Managerial/Technical/Site*	Approver
	Drilling Superintendent	HSE Team Lead – Offshore Drilling and Completions	Manager – Offshore Drilling and Completions
1			

Rev	Rev Date	Author/Editor	Amendment
A	08/06/21	Advisian and MCC	Issued to Santos for internal review
B	24/06/21	Advisian and MCC	Issued to Santos for final review
0	29/06/21	Advisian and MCC	Issued for Use
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1	07/08/21	Santos	Issued for Use

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List of Acronyms

Abbreviation	Description
AFMA	Australian Fisheries Management Authority
AHO	Australian Hydrographic Office
AIS	automatic identification system
ALARP	as low as reasonably practicable
AMOSC	Australian Marine Oil Spill Centre Pty Ltd
AMP	Australian Marine Park
AMSA	Australian Maritime Safety Authority
APASA	Asia-Pacific Applied Science Associates
APPEA	Australian Petroleum Production & Exploration Association
ASBTIA	Australian Southern Bluefin Tuna Industry Association
AUV	autonomous underwater vehicle
BIA	biologically important area
CAMBA	China Australia Migratory Bird Agreement
CCWA	Conservation Council of Western Australia
CEO	Chief Executive Officer
CFA	Commonwealth Fisheries Association
CHARM	chemical hazard assessment and risk management
CM	control measure
CO2	carbon dioxide
COLREGS	International Rules for Preventing Collisions at Sea
CPT	cone penetration test
DAH	dissolved aromatic hydrocarbons
DAWE	(Australian) Department of Agriculture, Water and Environment
DBCA	Department of Biodiversity, Conservation and Attractions
DEWHA	Department of Environment, Water, Heritage and the Arts
DoE	(Australian) Department of the Environment (now DoEE)
DoEE	(Australian) Department of the Environment and Energy (now DAWE)
DMIRS	Department of Mines, Industry Regulation and Safety
DNP	Director of National Parks
DoF	Department of Fisheries
DoT	Department of Transport
DP	dynamic positioning
DPaW	Department of Parks and Wildlife (now DBCA)

Abbreviation	Description
DPIF	Department of Primary Industry and Fisheries
DPIRD	Department of Primary Industries and Regional Development
DWER	Department of Water and Environment Regulation
EE	existing environment
EEZ	exclusive economic zone
EMBA	environment that may be affected
ENVID	environmental hazard identification workshop
EP	Environment Plan
EPA	Western Australian (WA) Environmental Protection Authority
EPBC Act	Environmental Protection and Biodiversity Conservation Act 1999
EPO	environmental performance outcome/objective
EPS	environmental performance standard
ESD	ecologically sustainable development
GHG	greenhouse gases
GHS	Globally Harmonized System of Classification and Labelling of Chemicals
HEV	high environmental value
HOCNF	harmonised offshore chemical notification format
HSE	health, safety and environment
IAPP	international air pollution prevention
IBCs	intermediate bulk containers
IMCRA	integrated marine and coastal regionalisation of Australia
IMS	invasive marine species
IMSMP	Invasive Marine Species Management Plan
IMT	incident management team
ISPP	international sewage pollution prevention
JAMBA	Japan Australia Migratory Bird Agreement
JRCC	Joint Rescue Coordination Centre
KEF	key ecological feature
KLC	Kimberley Land Council
LMS	listed migratory species
LTS	listed threatened species
MARPOL	International Convention for the Prevention of Pollution from Ships 1973, as modified by the Protocol of 1978
MBES	multi-beam echo sounding
MC	measurement criteria

Abbreviation	Description
MDO	marine diesel oil
MFO	marine fauna observer
MMO	marine mammal observer
MNES	matters of national environmental significance
MoC	management of change
MODU	mobile offshore drilling unit
MOU	Memorandum of Understanding
MP	Marine Park
MTWA	Marine Tourism Western Australia
N2O	nitrous oxide
NEBA	net environmental benefit analysis
NMFS	National Marine Fisheries Service
NOPSEMA	National Offshore Petroleum Safety and Environment Management Authority
NOx	oxides of nitrogen
NSF	National Science Foundation
NWS	Western Australia's North West Shelf
OCNS	Offshore Chemical Notification Scheme (United Kingdom)
ODS	ozone-depleting substances
OPEP	Oil Pollution Emergency Plan
OPGGS(E)R	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009
OWM	oil weathering model
PAM	passive acoustic monitoring
PK	peak sound levels
PLONOR	pose little or no risk to the environment
PMST	Protected Matters Search Tool
PPA	Pearl Producers Association
ROV	remotely operated vehicle
PSZ	Petroleum Safety Zone
PTS	permanent threshold shift
SBES	single beam echosounder
SBP	sub-bottom profiling
SDS	Safety Data Sheet
SEL	sound exposure level
SMPEP	Shipboard Marine Pollution Emergency Plan

Abbreviation	Description
SOLAS	safety of life at sea
SOPEP	Shipboard Oil Pollution Emergency Plan
SOx	sulphur oxides
SPL	sound pressure level
SSS	side-scan sonar
TTS	temporary threshold shift
UNCLOS	United Nations Convention on the Law of the Sea
USBL	ultra-short baseline
VBA	vessel-based activities
VI	Varanus Island
WAFIC	Western Australian Fishing Industry Council
WDCS	Whale and Dolphin Conservation Society
WHP	wellhead platform
WQ	water quality

1. Introduction

1.1 EP summary

OPGGS(E)R 2009 Requirements
Regulation 11(3)
Within 10 days after receiving notice that the Regulator has accepted an environment plan (whether in full, in part or subject to limitations or conditions), the titleholder must submit a summary of the accepted plan to the Regulator for public disclosure.
Regulation 11(4)
The summary: (a) must include the following material from the environment plan: (i) the location of the activity; (ii) a description of the receiving environment; (iii) a description of the activity; (iv) details of environmental impacts and risks; (v) a summary of the control measures (CM) for the activity; (vi) a summary of the arrangements for ongoing monitoring of the titleholder's environmental performance; (vii) a summary of the response arrangements in the oil pollution emergency plan; (viii) details of consultation already undertaken, and plans for ongoing consultation; and (ix) details of the titleholder's nominated liaison person for the activity. (b) must be to the satisfaction of the Regulator.

Environment Plan (EP) Summary material requirement	Relevant section of EP containing EP Summary material
The location of the activity	**Section 2**
A description of the receiving environment	**Section 3** and **Regulatory Framework of Relevant Legislation**
A description of the activity	**Section 2**
Details of the environmental impacts and risks	**Sections 6** and **7**
The control measures for the activity	**Sections 6** and **7** and **Table 8-2**
The arrangements for ongoing monitoring of the titleholder's environmental performance	**Section 8**
The response arrangements in the oil pollution emergency plan (OPEP)	**Section 6.7** and OPEP
Details of consultation already undertaken and plans for ongoing consultation	**Section 4**
Details of the titleholder's nominated liaison person for the activity	**Section 1.5**

1.2 Activity overview

Santos proposes to conduct a vessel-based survey in permit area AC/P50 located in Commonwealth waters. The survey activities will help to inform future drilling activities (subject to separate EPs) and will involve geophysical and geotechnical survey techniques, including:

+ geophysical surveys;
+ hydrographic surveys;
+ geotechnical surveys; and
+ autonomous underwater vehicle (AUV) and remotely operated vehicle (ROV) surveys.

These activities are collectively referred to as vessel-based activities (VBA) throughout this EP, which will be undertaken within the operational area as shown in **Figure 1-1**.

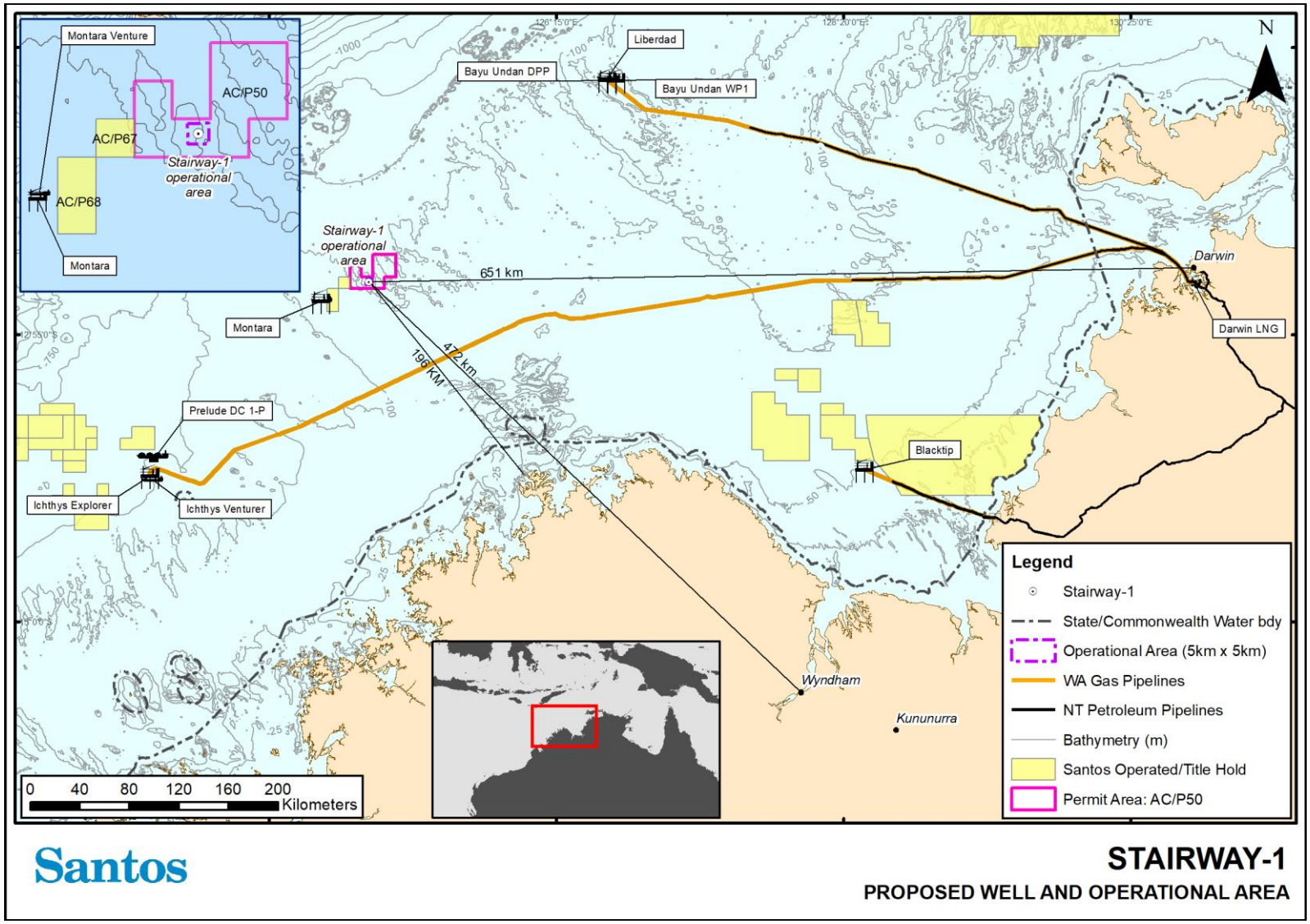

Figure 1-1: Location of Stairway-1 vessel-based activity

1.3 Purpose of the Environment Plan

This EP has been prepared to address the environmental requirements of activities undertaken in accordance with *Commonwealth Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (OPGGS(E)R), for acceptance by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA).

In accordance with the OPGGS(E)R, this EP details the environmental impacts and risks associated with the activity and demonstrates how these will be reduced to as low as reasonably practicable (ALARP) and to an acceptable level. The EP provides an implementation strategy that will be used to measure and report on environmental performance during planned activities and unplanned events to ensure impacts and risks are continuously reduced to ALARP and are at an acceptable level. The environmental management of the activity described in the EP complies with the Santos Environment, Health and Safety Policy (**Santos Environment, Health and Safety Policy**

) and with all relevant legislation (Regulatory Framework of Relevant Legislation

). This EP documents and considers all relevant stakeholder consultation performed during the development of the EP.

1.4 Environment Plan validity

This EP remains valid from NOPSEMA acceptance until the end of 2022, or until NOPSEMA has accepted an end-of-activity notification under Regulation 25A, or until Santos revises this EP in the event a significant change to the activity or level of impact or risk occurs as required under Sub-regulations 17(10), 17(5), 17(6) and 17(7).

Santos may revise the EP, using the Management of Change (MoC) Process described in **Section 8.10**. Any changes made under this process will not affect the validity of this EP.

1.5 Operator and titleholder details

OPGGS(E)R 2009 Requirements
Regulation 15(1)
The environment plan must include the following details for the titleholder: (a) name; (b) business address; (c) telephone number (if any); (d) fax number (if any); (e) email address (if any); (f) if the titleholder is a body corporate that has an ACN (within the meaning of the *Corporations Act 2001*)—ACN.
Regulation 15(2)
The environment plan must also include the following details for the titleholder's nominated liaison person: (a) name; (b) business address; (c) telephone number (if any); (d) fax number (if any); (e) email address (if any).

Santos Offshore Pty Ltd is the titleholder undertaking the activity within Permit AC/P50. Titleholder details are provided in **Table 1-1**.

Table 1-1: Titleholder details

Titleholder	ACN / ABN	Permit % Interest	Address
Santos Offshore Pty Ltd	38 005 475 589 (ACN: 005 475 589)	60%	Business Address: Level 7, 100 St Georges Terrace, Perth, Western Australia 6000 Telephone number: (08) 6218 7100 Fax number: (08) 6218 7200 Email address: offshore.environment.admin@santos.com
SapuraOMV Upstream (Western Australia) Pty Ltd	37 629 043 518 (ACN: 629 043 518)	40%	Business Address: Level 2, 251 St Georges Terrace Perth, WA 6000 Telephone number: +61 8 6118 4990 Email address: zamina@sapura-OMV.com

1.5.1 Details of nominated liaison person

Details for Santos' Nominated Liaison Person for the activity are as follows:

Name: Aileen Stewart (Senior Stakeholder Adviser)

Business address: Level 7, 100 St Georges Terrace, Perth, WA 6000

Telephone number: (08) 6218 7100

Email address: offshore.environment.admin@santos.com

Additional information about Santos and its operations can be obtained from the website at: www.santos.com.

1.5.2 Notification procedure in the event of changed details

If there is a change in the nominated operator, the operator's nominated liaison person, or a change in the contact details for the operator or liaison person, Santos will notify NOPSEMA and provide the updated details.

1.6 Environmental management framework

OPGGS(E)R 2009 Requirements
Regulation 13. Environmental assessment
Description of the activity 13(4) The environment plan must: (a) describe the requirements, including legislative requirements, that apply to the activity and are relevant to the environmental management of the activity; and (b) demonstrate how those requirements will be met.
Regulation 16(a). Other information in the environment plan
The environment plan must contain the following: (a) a statement of the titleholder's corporate environmental policy.

1.6.1 Santos Environment, Health and Safety Policy

The activity will be conducted in accordance with the Santos Environment, Health and Safety Policy presented in **APPENDIX A** and relevant legislative requirements presented in **APPENDIX B**, inclusive of the relevant EP sections where the legislation may prescribe or control how an activity is undertaken.

Sections 6, **7** and **8** of this EP reflect the Environment, Health and Safety Policy, detailing and evaluating impacts and risks from planned and unplanned events and providing control measures with set performance outcomes, standards and measurement criteria to ensure environmental performance is achieved.

1.6.2 Relevant environmental legislation

Australia is a signatory to numerous international conventions and agreements that obligate the Commonwealth government to prevent pollution and protect specified habitats, flora and fauna. Those that are relevant to the VBA are detailed in **APPENDIX B**.

2. Activity Description

OPGGS(E)R 2009 Requirements
Regulation 13 (1)
The environment plan must contain a comprehensive description of the activity, including the following: (a) the location or locations of the activity; (b) general details of the construction and layout of any facility; (c) an outline of the operational details of the activity (for example, seismic surveys, exploration drilling or production) and proposed timetables; and (d) any additional information relevant to consideration of environmental impacts and risks of the activity.

2.1 Activity overview

To support the drilling of the Stairway-1 well, geotechnical and/or geophysical surveys may be required at the location to inform the positioning of a mobile offshore drilling unit (MODU) and well location.

VBA may involve:

+ geophysical and hydrographic surveys such as:
  - acquisition of multi-beam echo sounding (MBES) and side-scan sonar (SSS) data to define the bathymetry/seafloor morphology (for example, depth, bedform character) and confirm the absence of debris or other anomalous seabed features
  - identification of any hazards that may impact the location of a MODU or equipment through sub-bottom profiling (SBP).
+ geotechnical surveys such as seabed sampling/coring for ground-truthing the surficial geophysics and to support MODU spud-can penetration assessments
+ AUV and ROV surveys, with various equipment attached, to provide information about buried objects and the existing environment (water and seabed parameters).

The range of survey equipment and deployment methods described are summarised in **Table 2-1**.

Table 2-1: Summary of survey equipment that may be used and typical deployment methods

Activity	Equipment Used	Typical Deployment Method
SSS survey	Side scan transducer	Mounted on a AUV or towed behind a vessel using a towfish
SBP survey	Chirps and pingers	Towed behind a vessel, AUV mounted on a surface or deep towfish
	Boomer and sparker	Mounted on surface tow or deep tow system depending on water depth
	Small streamer/hydrophone	Small streamer/hydrophone towed behind vessel on surface or 1 m below surface
MBES surveys	MBES	Vessel-mounted or mounted on an AUV
SBES surveys	Single beam echosounder (SBES)	Vessel-mounted or mounted on an AUV
Subsea geotechnical drilling	Remotely Operated Seafloor Drill system	Dynamically positioned vessel using an A-frame, crane or Launch and Recovery System
	Dedicated geotechnical drill ship	Dynamically positioned vessel with geotechnical drilling derrick
Vibrocoring	Vibrocoring unit	Vessel or rig with a suitable A-frame or tower
Coring	Piston corer	Vessel winch
	Drop corer	Vessel winch
Cone penetration test (CPT)	CPT	Deployed as part of the remotely operated drill system or through the drill string
AUV survey	AUV with Sub Bottom Profiler, side scan sonar, MBES, video payloads	Deployed from a vessel using a crane or an A-frame, recovered using a winch
ROV surveys	Observation class ROV	Deployed from vessel

2.2 Operational area

The activity will be conducted entirely within Commonwealth waters in Santos permit area AC/P50 within an operational area of 5 km x 5 km centred around the proposed well location; the co-ordinates are shown in **Table 2-2**. The operational area is shown in **Figure 1-1**. Water depths in the operational area are approximately 80 m to 110 m.

Table 2-2: Co-ordinates of Stairway-1 operational area

Corner	Latitude	Longitude
NW	-12.507938	124.867605
NE	-12.507614	124.913599
SE	-12.552804	124.913932
SW	-12.553129	124.867931

2.3 Timing and duration

The activity will occur anytime between Q4 2021 and end of Q3 2022. Allowing for potential down time, such as due to weather or vessel operability issues, the activity may extend to up to ten days.

Activities will be undertaken up to 24 hours per day.

2.4 Vessels and helicopters

Typically, different vessels will be used to undertake each activity. The actual vessel will be determined in later planning stages. For environmental assessment purposes, the *Fugro Mariner* has been considered as a proxy, noting that the actual vessels to be used are expected to be smaller, the intent being to assess impacts and risks of the largest typical vessel so the assessment is conservative and allows for flexibility.

The Fugro Mariner (see **Figure 2-1**) is a 76 m long, 4750-tonne DP2 geotechnical and scientific drilling vessel with accommodation for up to 58 people.

For the geophysical, hydrographic and/or AUV/ROV surveys, the vessel speeds will be approximately four knots during surveying and the vessel will be temporarily stationary when taking seabed samples. For geotechnical drilling, the vessel will be stationary on DP2. No anchoring will occur unless in an emergency (such as loss of power).

Figure 2-1: Indicative vessel – the Fugro Mariner

2.4.1 Vessel anchoring

Vessel anchoring will not occur.

2.4.2 Vessel refuelling and transfers

Vessel-to-vessel refuelling is not normally required for VBA, due to the limited duration and scope. Similarly, equipment transfers are rarely required. However, depending on the nature and scale of the finalised activity, a material or fuel transfer may be needed in rare instances. Therefore, the impacts and risks associated with

these activities are included in this EP. While this activity generally refers to transfers between offshore support vessels, a helicopter may also be used to transport materials or personnel to a remote VBA.

2.4.3 Vessel discharges and emissions

Aqueous discharges from the vessel may include treated sewage, greywater, cooling water, oily water (bilge), deck run-off and desalination brine (if a reverse osmosis system is used). Atmospheric emissions will include exhaust gases from fuel combustion. Other environmental emissions include light emissions from vessel decks, accommodation, navigation and safety systems; and noise emissions from above and below the water (for example, engine noise, survey equipment).

Discharges that occur during geotechnical drilling (if required) are described in **Section 2.7**.

2.5 Geophysical surveys

Geophysical surveys are typically conducted to investigate pre-identified key areas of interest. A geophysical survey may be undertaken to delineate seabed features at the proposed drilling site (within the 5 km by 5 km operational area). The types of surveys that may be undertaken are described in the following subsections.

2.5.1 Side-scan sonar

SSS identifies any sea floor debris that may cause damage to MODU support legs or other equipment. SSS involves towing a set of transducers mounted on either side of a 'tow fish' approximately 10 to 20 m above the seabed, producing pulses at high frequencies.

2.5.2 Sub-bottom profiling

SBP allows the near-seabed stratigraphy to be evaluated for hazards (including shallow gas, lateral variability in layer properties, adverse near-seabed stratigraphy, anomalous layers of hard/soft formations, localised/regional outcrops or sub-crops, mobile bedforms) and to confirm it will be providing adequate foundations for supporting a MODU when it is elevated above the water; or anchors and other equipment. SBP uses an acoustic source typically towed just behind the vessel, with a hydrophone streamer towed approximately 25 m behind the vessel below the water surface or at depth to record the reflected sound waves.

2.6 Hydrographic surveys

Hydrographic surveys are conducted to measure the physical features underwater. Types of surveys that may be conducted are provided in the next subsections.

2.6.1 Multibeam echo sounder

MBES surveys will enable the collection of bathymetry data and the correlation of depth information. This type of survey uses a sonar system to transmit short pulses of sound energy, analysing the return signal from the seafloor or other objects.

2.6.2 Single beam echo sounder

SBESs provide water depths by measuring the two-way travel time of a high-frequency pulse emitted by a transducer. The systems are calibrated to allow for errors introduced by temperature and salinity and other factors that affect sound velocity. The choice of echosounder depends on many factors, including accuracy requirements, depth of water and resolution.

2.7 Geotechnical surveys (seabed sampling)

The main objective of the geotechnical survey is to obtain adequate soil data to assess the performance of the jack-up drilling platform spud-can footing penetration and seabed punch-through analyses. The survey will assure safe installation of a jack-up MODU. A survey may include locations for sample collection and CPTs (see **Section 2.7.1.1**) for the potential MODU site selection. Examples of the equipment used to undertake sampling are provided in the next subsections.

2.7.1 Geotechnical drilling rig

Geotechnical site surveys are conducted to establish the geotechnical properties of the shallow soils to approximately 40 m below seabed. The disturbance footprint is limited to the equipment used and a small volume of cuttings left on the seabed. Drill cuttings will be comprised primarily of rock, sediment or soil from the seabed, with a small amount of residual drilling fluids. Approximately 2.5 m^3 of drill cuttings is expected at each borehole location. The drilling fluid used to drill the borehole is expected to be seawater. However, specific drilling muds or additives may be used where the borehole requires stabilisation during borehole progression to avoid collapse. Only approved drilling muds or additives will be used (**Section 2.9**).

The drilling process can either occur on the seabed by a remotely operated drill rig, or from the vessel from a dedicated geotechnical drill rig. The primary coring methods used for sampling are either push sampling or rotary coring.

Push sampling is generally undertaken wherever possible in un-cemented sediments. The drill string and coring barrels are returned to the magazine before recovery.

Rotary coring is generally undertaken in consolidated sediments where the push sampling cannot penetrate the substrate. The rotary coring process is much the same as the push sampling process, except that the mechanical motion is a rotary motion.

2.7.1.1 Cone penetration tests

CPTs are used to provide in-situ detail on the geotechnical characteristics of the soil. CPTs can be deployed through the drill string and are used to gather down-hole information during geotechnical drilling. The CPT is hydraulically pushed into the ground at a constant rate. The tip of the rod is fitted with a sensitive cone to measure soil resistance and pore pressure.

2.7.2 Geotechnical ground truthing

To correlate the geophysical data, it is common to ground-truth by taking shallow samples from the seabed that are typically limited to a few metres.

2.7.2.1 Piston/drop coring

Piston or drop coring is undertaken by lowering the equipment to just above the seabed, where the equipment is either dropped or released to allow it to penetrate the seabed. The equipment is then raised back to deck where the sample can be taken out of the corer for logging and testing.

2.7.2.2 Vibrocoring

Vibrocoring is undertaken where information about the shallow soils is required, down to a maximum depth of 6 m. The vibrocoring unit is lowered to the seabed on a lifting line. An umbilical is also lowered with the vibrocore. Once on the seabed, electrical power is supplied to the vibrating head through the umbilical. The head then vibrates the core down through the sediment layers. The equipment is then raised back to the deck where the sample can be taken out of the corer for logging and testing.

2.7.2.3 Geotechnical grab sampling

Sediment/grab samples are used to provide detailed geotechnical data for very shallow surface sediments only. A Van Veen system or similar is typically used for shallow water operations. The Van Veen system consists of a clamshell bucket made from stainless steel. The Van Veen is set up on deck before being lowered to the seafloor, where it is triggered and a sediment sample collected. It is then recovered to the deck where the sample is sub-sampled as appropriate.

Some operations may require a larger grab sample, such as a box corer. Large grab samples may be deployed by a hydraulic winch or a crane system; smaller samples may be deployed by hand or by a capstan.

2.8 Other surveys

2.8.1 Autonomous underwater vehicle surveys

AUVs travel underwater on pre-defined 'flight paths' without requiring navigation from an operator and are fitted with various payloads for survey acquisition.

AUVs are battery-powered systems capable of hosting several geophysical and inspection payloads. Examples of payloads include SBP, MBES, cameras, SSS and conductivity, temperature and depth (CTD) instruments. The survey speed is often determined by the payload and survey objective but is generally around four knots. The actual size of the AUV depends on the size of the payload and duration required for the survey.

2.8.2 Remotely operated vehicle surveys

ROVs are linked to the vessel by either a neutrally buoyant tether or often, when working in rough conditions or in deeper water, a load-carrying umbilical cable is used along with a tether management system.

Equipment such as torque tools and manipulator arms are typically powered by hydraulic though battery-powered tools. Most ROVs are equipped with at least a video camera and lights. Additional equipment can include sonars, MBES, magnetometers, a still camera, a manipulator or cutting arm and water samplers. The class and size of the ROV used will depend on the operational objectives of the survey.

Examples of ROV application include routine inspections of pipeline bundles, subsea valves, pipeline alignment surveys, subsea infrastructure and platform substructure inspections. They can also be used for environmental habitat mapping, baseline surveys and site survey validation work.

2.9 Chemicals

On the rare occasion when hard rock is encountered, a lubricant may be used in cutting through the section to be sampled during geotechnical surveys. Only water-based muds (such as bentonite or guar gum) will be required, given the shallow drilling depth. The chemical assessment procedure is outlined below.

2.9.1 Chemical assessment

A risk-based approach to select chemical products ranked under the Offshore Chemical Notification Scheme (OCNS) is applied for those chemicals used and discharged to the marine environment. This scheme lists and ranks all chemicals used in the exploration, exploitation and associated offshore processing of petroleum on the United Kingdom Continental Shelf.

Chemicals are ranked according to their calculated Hazard Quotients (HQ) by the CHARM (Chemical Hazard Assessment and Risk Management) mathematical model, which uses aquatic toxicity, biodegradation and bioaccumulation data. The HQ is converted to a colour banding, with Gold and Silver colour bands representing the least environmentally hazardous chemicals. Chemicals not amenable to the CHARM model (in other words, inorganic substances, hydraulic fluids or chemicals used only in pipelines) are assigned an

OCNS grouping based on the worst-case ecotoxicity data, with Group E and D representing the least hazard potential.

The Santos *Offshore Division Drilling Chemical Selection and Approval Process (EA-91-II-00007*) accepts CHARM-ranked Gold/Silver, or non-CHARM-ranked E/D chemicals for use and discharge without a detailed environmental risk assessment. The same applies to chemicals that are on the OSPAR Pose Little or No Risk to the Environment (PLONOR) List. The PLONOR Listed, agreed upon by the OSPAR Convention (Convention for the Protection of the Marine Environment of the North-East Atlantic), contains a list of substances that will pose little or no risk to the environment in offshore waters. If chemicals are ranked lower than Gold, Silver, E or D (in other words, CHARM-ranked purple, orange, blue or white, or non-CHARM A, B or C ranked chemicals) and no alternatives are available, a risk assessment is conducted to provide technical justification for their use, and show that their use and associated risk is acceptable and ALARP.

As described above, investigation of potential alternative chemicals is completed when chemicals are ranked lower than CHARM Gold, Silver, E or D (in other words, CHARM-ranked purple, orange, blue or white, or non-CHARM A, B or C ranked chemicals). There is a preference for chemical options that are CHARM-ranked Gold/Silver, or non-CHARM-ranked E/D chemicals, or chemicals that have a low aquatic toxicity (such as EC50/LC50 greater than 100 mg/L), low bioaccumulation potential (such as Log Pow <3) and readily biodegradable (such as more than 60 in 28 days OECD 306) (discussed below).

Any chemicals that may be discharged to the marine environment and not OCNS CHARM or non-CHARM-ranked are risk-assessed using the OCNS CHARM or non-CHARM models. The chemical is assigned a pseudo-ranking based on the available aquatic toxicity, biodegradation and bioaccumulation data (discussed below), and assessed for environmental acceptability for discharge to the marine environment.

Ecotoxicity Assessment

Table 2-3 and **Table 2-4** act as guidance in assessing the ecotoxicity of chemicals during the investigation of potential alternatives. **Table 2-3** is used by Cefas to group a chemical based on ecotoxicity results, 'A' representing highest toxicity/risk to environment and 'E' lowest. **Table 2-4** shows classifications/categories of toxicity against aquatic toxicity results.

Table 2-3: Initial Offshore Chemical Notification Scheme grouping

Initial grouping	A	B	C	D	E
Result for aquatic-toxicity data (ppm)	<1	≥1-10	>10-100	>100-1,000	>1,000
Result for sediment-toxicity data (ppm)	<10	≥10-100	>100-1,000	>1,000-10,000	>10,000

Note: Aquatic toxicity refers to the Skeletonema costatum EC_{50}, Acartia tonsa LC_{50}, and Scophthalmus maximus (juvenile turbot) LC_{50} toxicity tests. Sediment toxicity refers to the Corophium volutator LC_{50} test.
Source: Cefas Standard Procedure 2019, OCNS 011 NL Protocol PART 1: Core Elements

Table 2-4: Aquatic species toxicity grouping

Category	Species	LC_{50} and EC_{50} criteria
Category Acute 1: Hazard statement – Very toxic to aquatic life	Fish	LC_{50} (96 hrs) of ≤1 mg/L
	Crustacea	EC_{50} (48 hrs) of ≤1 mg/L
	Algae/other aquatic plant species	ErC_{50} (72 or 96 hrs) of ≤1 mg/L
Category Acute 2: Hazard statement – Toxic to aquatic life	Fish	LC_{50} (96 hrs) of >1 mg/L to ≤10 mg/L
	Crustacea	EC_{50} (48 hrs) of >1 mg/L to ≤10 mg/L
	Algae/other aquatic plant species	ErC_{50} (72 or 96 hrs) of >1 mg/L to ≤10 mg/L
Category Acute 3: Hazard statement – Harmful to aquatic life	Fish	LC_{50} (96 hrs) of >10 mg/L to ≤100 mg/L
	Crustacea	EC_{50} (48 hrs) of >10 mg/L to ≤100 mg/L
	Algae/other aquatic plant species	ErC_{50} (72 or 96 hrs) of >10 mg/L to ≤100 mg/L

Source: United Nations (2019) Globally Harmonized System of Classification and Labelling of Chemicals (GHS), Eighth Revised Edition

Biodegradation Assessment

The biodegradation of chemicals is assessed using the Cefas biodegradation criteria, which aligns with the categorisation outlined in the United Nations GHS Annex 9 Guidance on Hazards to the Aquatic Environment (2019). The below is used as a guide when investigating potential chemical alternatives. Preference is to select readily biodegradable chemicals.

Cefas categorises biodegradation into the three groups of:

+ readily biodegradable: results of less than X% biodegradation in 28 days to an OSPAR harmonised offshore chemical notification format (HOCNF) accepted ready biodegradation protocol;
+ moderately biodegradable: results more than 20% and less than X% to an OSPAR HOCNF accepted ready biodegradation protocol; and
+ poorly biodegradable: results from OSPAR HOCNF accepted ready biodegradation protocol.

Where X is equal to:

+ 60% in 28 days in OECD 306, marine biodegradability of insoluble substances or any other acceptable marine protocols, or in the absence of valid results for such tests;
+ 60% in 28 days (OECD 301B, 301C, 301D, 301F, Freshwater biodegradability of insoluble substances); OR
+ 70% in 28 days (OECD 301A, 301E).

Bioaccumulation Assessment

The bioaccumulation of chemicals is assessed using the Cefas bioaccumulation criteria, which aligns with the categorisation outlined in the United Nations GHS Annex 9 Guidance on Hazards to the Aquatic Environment (2019). Preference is to select non-bioaccumulative chemicals.

The following guidance is used by Cefas:

+ Non-bioaccumulative/non-bioaccumulating: Log P_{ow} <3, or results from a bioaccumulation test (preferably using *Mytilus edulis*) demonstrates a satisfactory rate of uptake and depuration, and the molecular mass is more than or equal to 700; and
+ Bioaccumulative/bioaccumulating: Log P_{ow} ≥3, or results from a bioaccumulation test (preferably using *Mytilus edulis*) demonstrates an unsatisfactory rate of uptake and depuration, and the molecular mass is less than 700.

All operational chemicals will be selected in accordance with the Santos *Offshore Division Drilling Chemical Selection and Approval Process (EA-91-II-00007*).

3. Description of the Environment

OPGGS(E)R 2009 Requirements
Regulation 13(1)(2)
The environment plan must: (a) describe the existing environment that may be affected by the petroleum activity; and (b) include details of the particular relevant values and sensitivities (if any) of that environment. Without limiting paragraph (1)(b), particular relevant values and sensitivities may include the following: (a) the world heritage values of a declared World Heritage property within the meaning of the EPBC Act; (b) the national heritage values of a National Heritage place within the meaning of that Act; (c) the ecological character of a declared Ramsar wetland within the meaning of that Act; (d) threatened; (e) migratory; (f) any values and sensitivities that exist in, or in relation to, part or all of: (i) a Commonwealth marine area within the meaning of that Act; or (ii) Commonwealth land within the meaning of that Act.

3.1 Environment that may be affected

This section describes the key physical, biological, socio-economic and cultural characteristics of the existing environment that may be affected by the activity, from both planned and unplanned events associated with the activity. The description of the environment applies to the operational area (the area within which planned activities will occur), and the environment that may be affected (EMBA) by unplanned events within the operational area. These are shown in **Figure 3-1**.

The potential area impacted by planned activities is expected to be within the defined operational area of 5km x 5km centred around the proposed well location as described in **Section 2.2**, with the exception of the following:,

+ an area of up to 20 km from the boundary of the operational area associated with noise emissions from the VBA equipment (Refer **Section 6.1**),
+ an area of up to 20 km from the operational area associated with light emissions from the vessel (refer **Section 6.2**).

No activity will occur within this 20km boundary. It is described purely for environmental impact assessment purposes only in the relevant impact sections**.**

The EMBA encompasses the full range of environmental receptors that might be contacted by hydrocarbons in the highly unlikely event of a worst-case hydrocarbon spill. Most planned and unplanned events associated with the activity may affect the environment up to a few kilometres from the operational area; for example, from noise and light impacts (as identified in **Section 6**). A large unplanned hydrocarbon spill would extend substantially beyond this (**Section 7.6**).

3.1.1 Protected Matters Search Tool reports

Protected Matters Search Tool (PMST) searches were undertaken on the operational area and the EMBA. The PMST searches were completed using the exact coordinates that are used to produce the figures throughout **Section 3**, ensuring the EMBA encompasses the full range of environmental receptors that might

be contacted by surface and subsurface hydrocarbons at the low exposure level, in the highly unlikely event of a worst-case oil spill.

On the first page of the PMST report is a coarse graphic showing the area over which the search has been conducted. However, the granularity of this can make the output look different to the spatial area represented on figures within the EP.

The co-ordinates are also provided within the PMST report to allow for duplication of the search and verification if required. Santos does not have control over the PMST output, but instead has provided the reports and co-ordinates to ensure transparency.

3.1.2 Determining the environment that may be affected

Stochastic hydrocarbon dispersion and fate modelling, applied to the worst-case spill scenario for the operational area identified as relevant to the activity (**Section 7.6**), was undertaken to inform the EMBA. Stochastic modelling is created by overlaying hundreds of individual hypothetical oil spill simulations from an oil spill into a single map, with each simulation subject to a different set of metocean conditions drawn from historical records. Stochastic modelling is completed to reduce uncertainty in risk assessment and spill response planning.

The modelling considered four key physical or chemical phases of hydrocarbons that pose differing environmental and socio-economic risks: surface, entrained, dissolved aromatic and shoreline-accumulated hydrocarbons. The modelling used defined hydrocarbon exposure values, as relevant, to identify an area that might be contacted by hydrocarbons, environment risk assessment and oil spill response planning, for the various hydrocarbon phases. Refer to **Table 3-1** for the exposure values used and to **Section 7.6** for more information about why these exposure values have been selected and how they relate to the risk assessment.

3.1.2.1 Hydrocarbon exposure values

The EMBA is based on stochastic modelling using the low exposure values (**Table 3-1**). The EMBA encompasses the outermost boundary of the overlaid worst-case spatial extent of the four hydrocarbon phases listed above for the credible spill scenario for the operational area.

The low exposure values are used as a predictive tool to set the outer boundaries of the EMBA and may not necessarily result in ecologically significant impacts. To inform the evaluation of potential environmental consequences of a hydrocarbon release (impact assessment), modelling is undertaken using higher exposure values (in other words, the concentrations at which environmental consequences may result). The higher exposure values are known as ‘moderate’ and ‘high’ and are further explained in **Section 7.6**.

A low exposure threshold, which represents a visible oil (rainbow) sheen, has been used to provide an indication of the extent to which stakeholders may visually observe oil on the sea surface. This is considered to provide a conservative extent of potential impacts to visual amenity. Biological impacts are expected to occur within the moderate and high exposure values which represent a subset of the EMBA. Refer to **Section 7.6** for more information about the spill trajectory modelling thresholds that have been selected.

Table 3-1: Environment that may be affected – hydrocarbon exposure values

Hydrocarbon phase	Exposure Value		
	Low	Moderate	High
Floating (g/m²)	1	10	50
Shoreline accumulation (g/m²)	10	100	1,000
Dissolved aromatics (ppb)	10	50	400
Entrained (ppb)	10	-	100

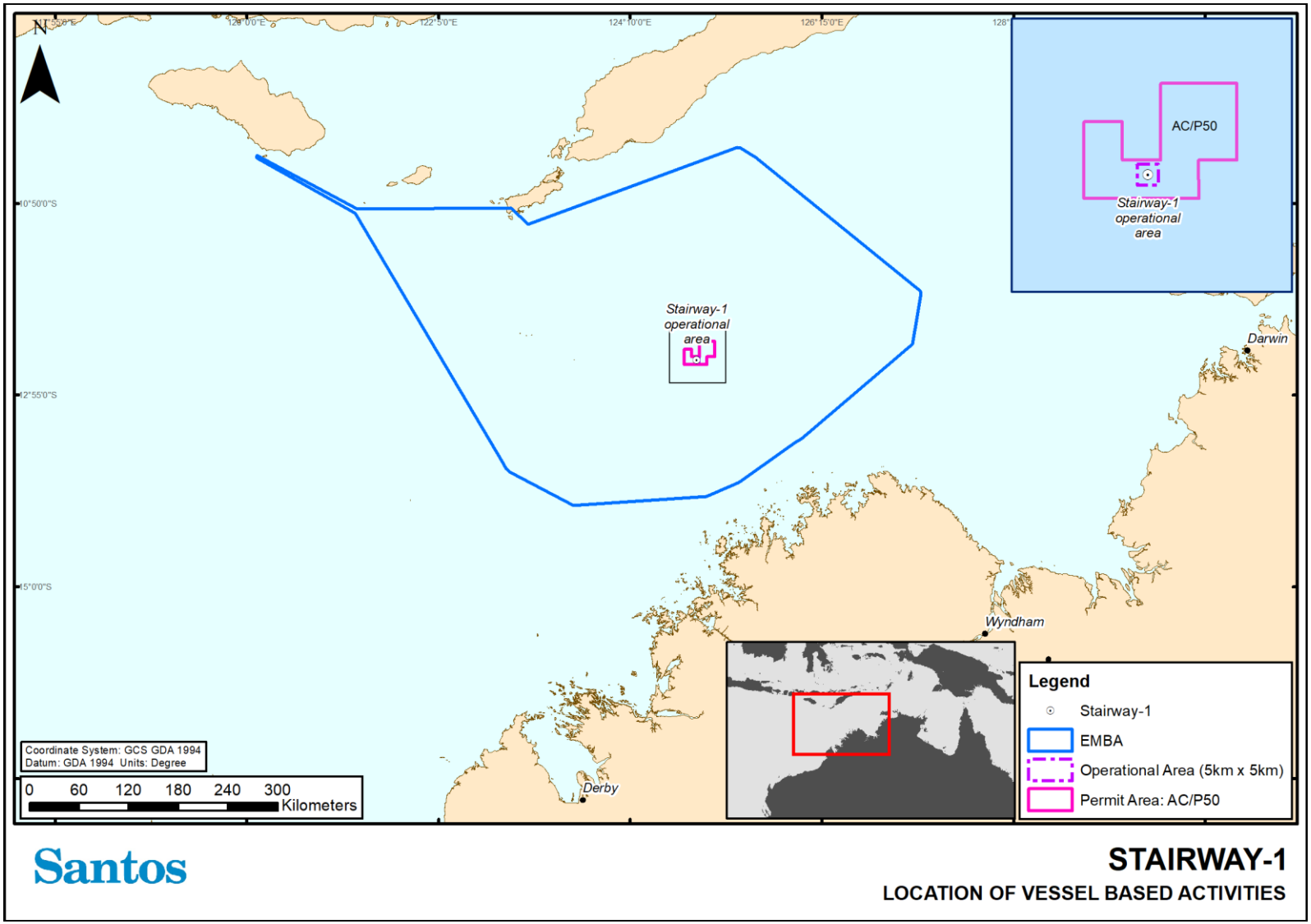

Figure 3-1: Environment that may be affected and operational area

3.2 Environmental values and sensitivities

This section summarises environmental values and sensitivities, including physical, biological, social, economic and cultural features within the marine and coastal environment that is relevant to the operational area and EMBA.

A summary of the information derived from the Department of Agriculture, Water and Environment (DAWE) PMST, Bioregional Plans and Fauna Recovery Plans relevant to the operational area and the EMBA is provided in this section. A detailed and comprehensive description of the environment (in accordance with Regulation 13(1)(2) of the OPGGS(E)R) is available in **APPENDIX C**– Description of the Existing Environment.

This draws upon existing knowledge and a comprehensive review of information about the marine environmental values and sensitivities in the region.

Copies of the DAWE PMST outputs for the operational area and the EMBA are also available in **APPENDIX C**.

The figures presented in this section of the EP have been zoomed to the extent of the data boundaries within the EMBA, to show all relevant data layers in a legible manner. Some data layers that sit within the map area but are not present within the EMBA are not displayed.

3.2.1 Physical environment

3.2.1.1 Bioregions

Based on the Integrated Marine and Coastal Regionalisation of Australia (IMCRA) Version 4.0, the bioregions overlapped by the operational area and EMBA are provided in **Table 3-2** and **Figure 3-2**.

Table 3-2: IMCRA 4.0 provincial bioregions relevant to the activity

Bioregion	Operational Area	EMBA
Northwest Shelf Transition	✓	✓
Northwest Shelf Province	✗	✓
Timor Province	✗	✓
International Waters	✗	✓

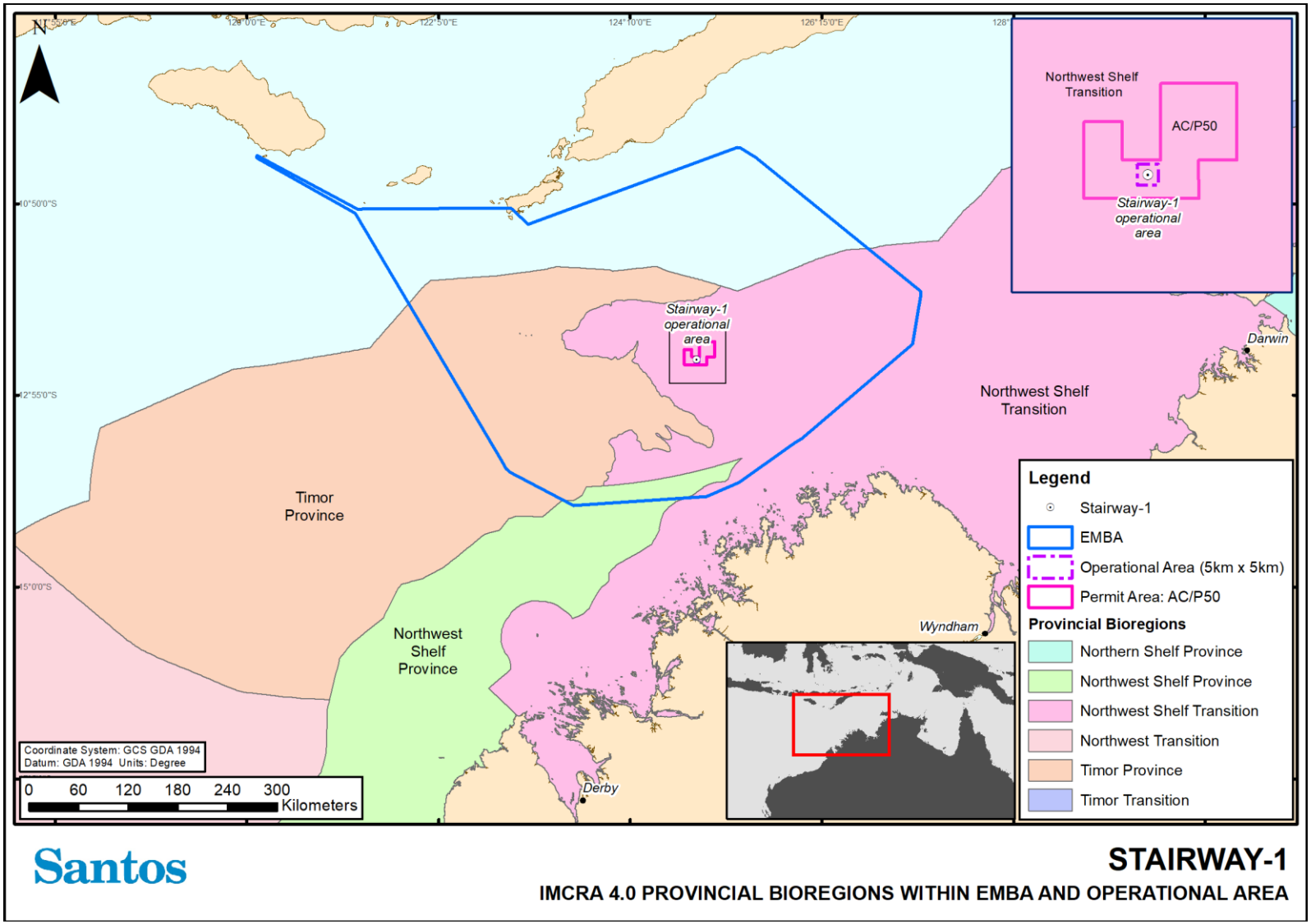

Figure 3-2: IMCRA 4.0 provincial bioregions within the environment that may be affected and operational area

3.2.1.2 Benthic habitats

The presence of marine, coastal and terrestrial habitats within the operational area and EMBA are shown in **Figure 3-3**, listed in **Table 3-3**, and a detailed description of these habitats with reference to the IMCRA provincial bioregions is provided in Appendix C.

More detailed description of the benthic habitats within the EMBA is not provided, as the potential impacts from a hydrocarbon spill (from vessel collision) are limited to the surface waters only.

3.2.1.2.1 Operational area

In adjacent permit areas around the Montara field, surveyed benthic habitats were characterised by homogenous, flat, featureless soft sediment, predominantly comprised of sand with small rubble and shell fragments (Jadestone Energy, 2019). Sparse patches of epifauna were recorded and included hydroids, octocorals, black corals and ascidians. Macrobenthic faunal assemblages surveyed generally had a low, highly patchy abundance of individuals. Polychaete bristleworms (Phylum Annelida) contributed the highest relative abundance of microbenthic assemblages, followed by Malacostracan crustaceans (such as shrimps and crabs). It is assumed the Stairway-1 operational area will be similar, given the proximity of the surveyed area.

3.2.1.2.2 Environment that may be affected

Deep-water soft sediment habitats are expected to be broadly similar in the wider EMBA to the surveyed locations in the Montara field and surrounding areas. In a study of benthic habitats on the continental shelf near the Big Bank Shoals (Heyward *et al*., 1997), the predominant benthic infaunal species were polychaetes and crustaceans (such as prawns, shrimp and crabs). These two groups made up 84% of the total species in sediment samples with a high diversity of species but a low abundance of each individual species. Epibenthic communities were sparse and species commonly associated with soft sediment habitats: sponges, gorgonians and sea fans, ascidians, echinoderms, crustaceans and bryozoans.

There are around 150 shoal/bank features across the Sahul Shelf and a high level of interconnectivity exists between them. The larval development rates of the species present, current speeds and the relatively short distance between the shoals, banks and reefs maintain this connectivity. The associated fish fauna is highly diverse but variable between shoals and banks, but sharing many species, which is influenced by depth, substrate and exposure to prevailing weather. There are a number of shoals within the EMBA, the nearest to the operational area being the Vulcan Shoals, Eugene McDermott Shoal and Barracouta Shoals.

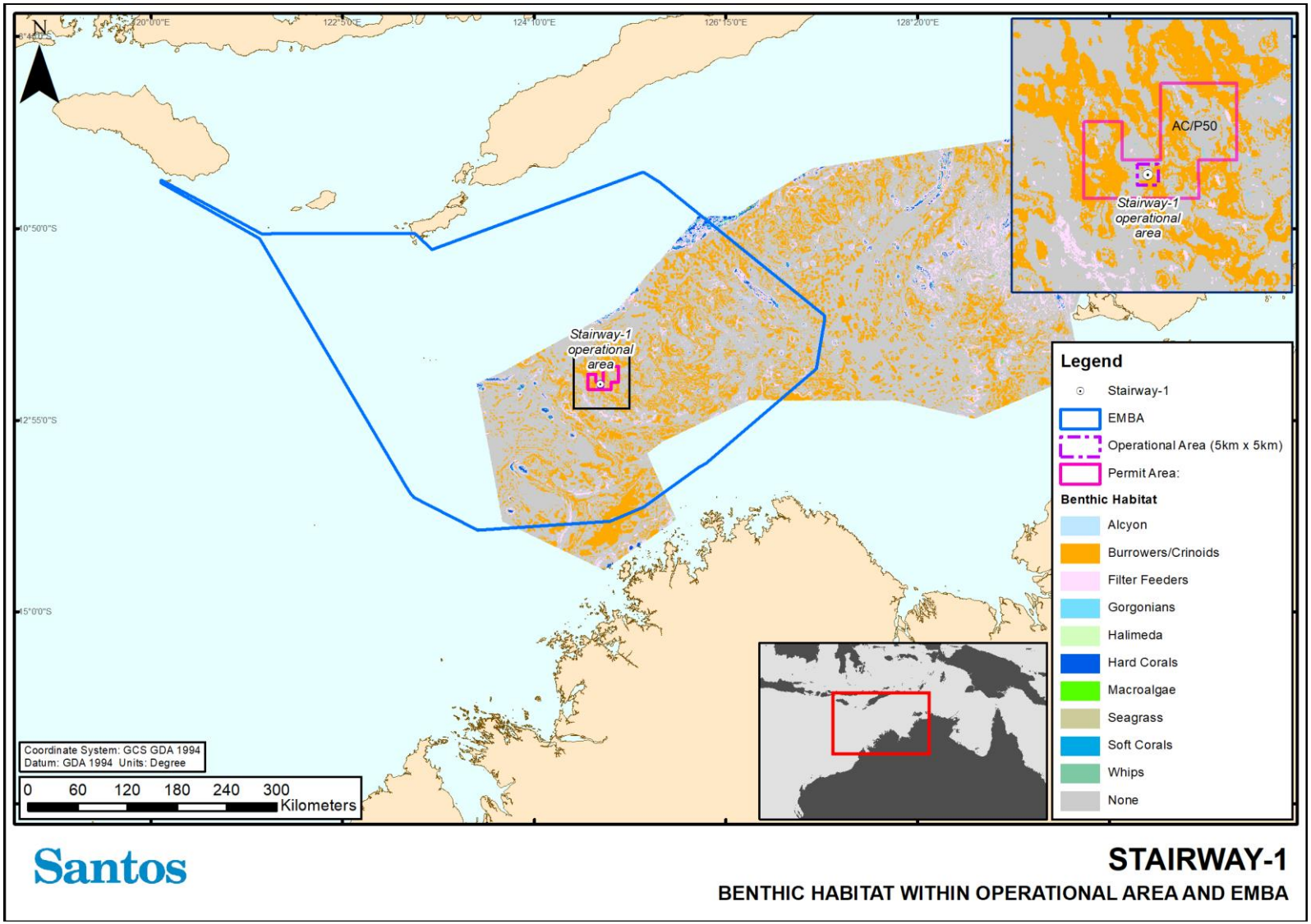

Figure 3-3: Benthic habitat within operational area and environment that may be affected

Table 3-3: Habitats within the environment that may be affected, listed according to presence within the operational area and IMCRA Provincial Bioregions of Australia

Category	Receptor	Operational Area presence	EMBA Presence				Relevant events that may impact on the receptors
			Northwest Shelf Transition	Northwest Shelf Province	Timor Province	International Waters	
Benthic habitats	Coral reefs	✗	✓	✓	✓	✓	Unplanned: Release of hydrocarbons
	Seagrass	✗	✓	✓	✓	✓	Unplanned: Release of hydrocarbons
	Macroalgae	✗	✓	✓	✓	✓	Unplanned: Release of hydrocarbons
	Non-coral benthic invertebrates	✓	✓	✓	✓	✓	Planned: Seabed disturbance Planned operational discharges Unplanned: Introduction of IMS Release of hydrocarbons
Shoreline habitats	Mangroves	✗	✓	✓	✓	✓	Unplanned: Release of hydrocarbons
	Intertidal platforms	✗	✓	✓	✗	✓	
	Sandy beaches	✗	✓	✓	✓	✓	
	Rocky shorelines	✗	✓	✓	✗	✓	
	Saline mudflats	✗	✓	✓	✓	✓	

3.2.2 Protected/significant areas

Protected/significant areas identified in the operational area and EMBA are detailed in **Table 3-4** and shown in **Figure 3-4** and **Figure 3-5**. These areas are further discussed in Appendix C.

The management zones, associated with the Australian Marine Parks (AMPs) identified in the EMBA, and the relevant objectives are detailed in **Table 3-5**. Distances shown are from the closest point of the operational area to the nearest feature.

Table 3-4: Distance from respective operational area boundaries to protected areas within the environment that may be affected

Value/sensitivity	Name	Within operational area	Within EMBA	Distance to operational area	Protection classification/zone
Australian Marine Parks	Ashmore Reef Marine Park	✗	✓	176 km NW	Recreational Use Zone (IUCN IV) Sanctuary Zone (IUCN Ia)
	Cartier Island Marine Park	✗	✓	135 km W	Sanctuary Zone (IUCN Ia)
	Kimberley Marine Park	✗	✓	93 km S	Multiple Use Zone (IUCN VI)
	Oceanic Shoals Marine Park	✗	✓	125 km E	Multiple Use Zone (IUCN VI)
State Marine Parks and Marine Management Areas	Browse Island Marine Park	✗	✓	224 km SW	Sanctuary Zone (IUCN Ia) Class 'C' Nature Reserve
Key Ecological Features	Ancient Coastline at 125 m Depth Contour	✗	✓	83 km SW	-
	Ashmore Reef and Cartier Island and surrounding Commonwealth waters	✗	✓	135 km W	-
	Carbonate Bank and Terrace System of the Sahul Shelf	✗	✓	9 km E	-
	Continental Slope Demersal Fish Communities	✗	✓	126 km SW	-
	Pinnacles of the Bonaparte Basin	✗	✓	243 km NE	-
Ramsar Wetlands	Ashmore Reef National Nature Reserve	✗	✓	176 km NW	-

Table 3-5: Management zones for the Australian and State Marine Parks found within the environment that may be affected and the associated objectives

Management zones	Objective
Australian Marine Parks	
Multiple Use (IUCN VI)	Managed to allow ecologically sustainable use while conserving ecosystems, habitats and native species. The zone allows for a range of sustainable uses, including commercial fishing and mining where they are consistent with park values.
Recreational Use (IUCN IV)	Managed to allow recreational use while conserving ecosystems, habitats and native species in as natural a state as possible. The zone allows for recreational fishing, but not commercial fishing.
Sanctuary Zone (IUCN Ia)	Managed to conserve ecosystems, habitats and native species in as natural and undisturbed a state as possible. The zone allows only authorised scientific research and monitoring.
State Marine Park	
Sanctuary Zone	The primary purpose of sanctuary zones is to protect and conserve marine biodiversity. Sanctuary zones are 'no-take' areas managed solely for nature conservation and low-impact recreation and tourism.

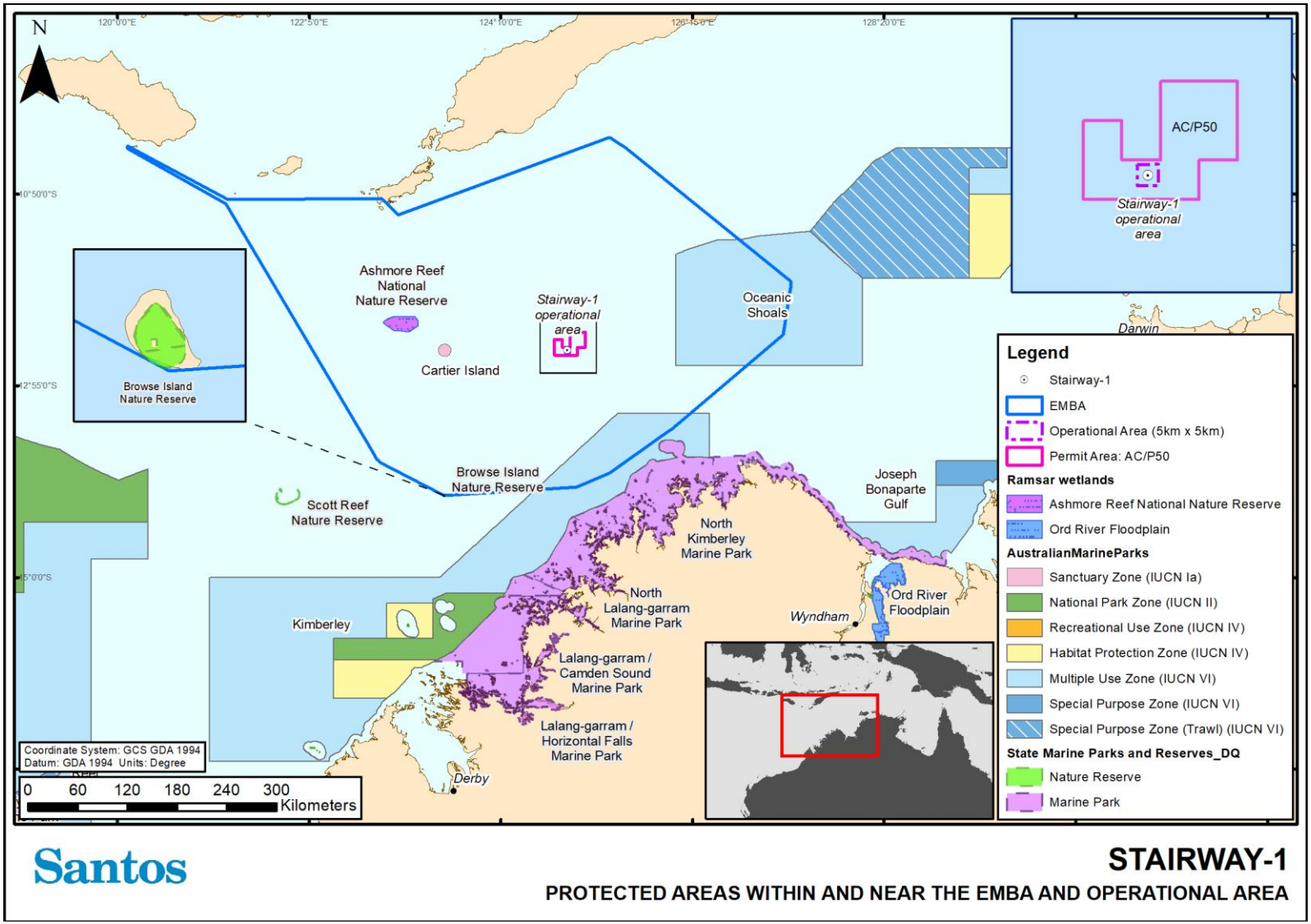

Figure 3-4: Protected areas within and near the environment that may be affected and operational area

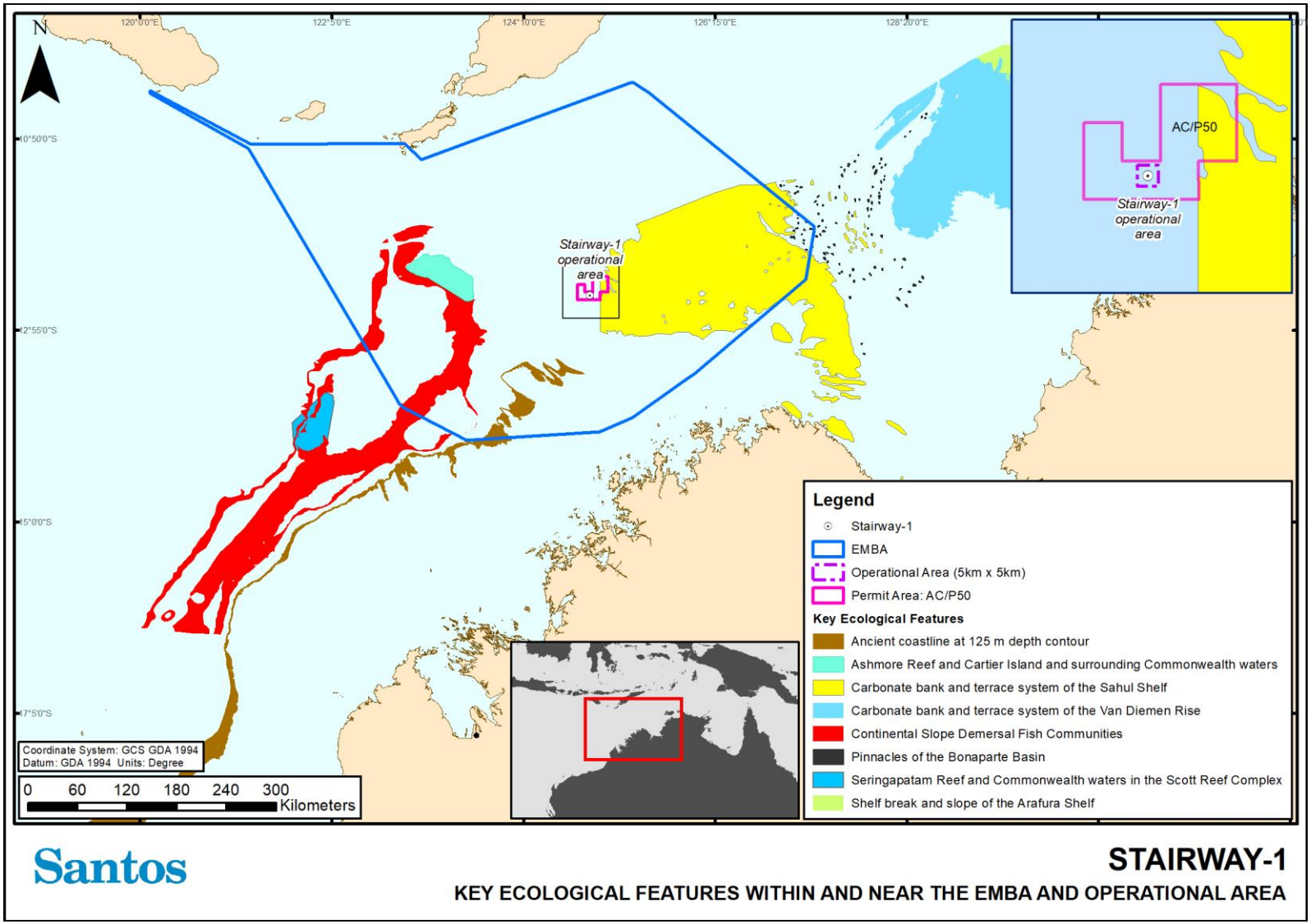

Figure 3-5: Key ecological features within and near the environment that may be affected and operational area

3.2.3 Threatened and migratory fauna

A summary of the Listed Threatened Species (LTS) and Listed Migratory Species (LMS) identified by the PMST for both the operational area and EMBA is shown in **Table 3-6**.

The combined spill trajectory area for the worst-case unplanned diesel release during VBA does not contact Australian shorelines but does contact Indonesian shorelines in International waters.

Table 3-6: Summary of the listed threatened and listed migratory species identified by the Protected Matters Search Tool

	Operational Area	EMBA
LTS	19	25
LMS	31	53
Total	**52**	**78**

*NOTE: EMBA species' totals *include* those of the operational area.

Those listed as threatened or migratory species groups and which have been identified as potentially being present within the operational area or EMBA, and the relevant planned and unplanned events that may impact them, are listed in **Table 3-7**. Threatened and migratory species within these species groups are further described in Appendix C.

Biologically important areas (BIAs) such as an aggregation, breeding, resting, nesting or feeding area, or known migratory routes for these species within the operational area and EMBA, are shown in **Figure 3-6** to **Figure 3-13** and are also described in Appendix C. The relevant BIAs that occur within the operational area are identified in **Table 3-8**.

Table 3-7: Environmental values and sensitivities within the operational area and environment that may be affected – threatened and migratory marine fauna

Value/sensitivity		EPBC Act Status	Operational Area		EMBA		Relevant events
Common name	Scientific name		Presence	Particular values or sensitivities	Presence	Particular values or sensitivities	
Fish and Sharks							
Whale shark	*Rhincodon typus*	Vulnerable, Migratory	✓	Foraging, feeding or related behaviour known to occur within area.	✓	Foraging, feeding or related behaviour known to occur within area. Overlap with foraging BIA.	<u>Planned</u> + Acoustic disturbance to marine fauna + Light emissions + Seabed and benthic habitat disturbance + Operational discharges + Spill response operations <u>Unplanned</u> + Release of solid objects + Introduction of invasive marine species (IMS) + Marine fauna interaction + Hazardous liquid releases + Release of hydrocarbons
Great white shark	*Carcharodon carcharias*	Vulnerable, Migratory	✓	Species or species habitat may occur within area.	✓	Species or species habitat may occur within area.	
Northern river shark	*Glyphis garricki*	Endangered	✓	Species or species habitat may occur within area.	✓	Species or species habitat may occur within area.	
Oceanic whitetip shark	*Carcharhinus longimanus*	Migratory	✓	Species or species habitat may occur within area.	✓	Species or species habitat may occur within area.	
Freshwater sawfish	*Pristis pristis*	Vulnerable, Migratory	✓	Species or species habitat known to occur within area.	✓	Species or species habitat known to occur within area.	
Green sawfish	*Pristis zijsron*	Vulnerable, Migratory	✓	Species or species habitat known to occur within area.	✓	Species or species habitat known to occur within area.	
Narrow sawfish	*Anoxypristis cuspidata*	Migratory	✓	Species or species habitat may occur within area.	✓	Species or species habitat may occur within area.	
Reef manta ray	*Manta alfredi*	Migratory	✓	Species or species habitat likely to occur within area.	✓	Species or species habitat likely to occur within area.	
Giant manta ray	*Manta birostris*	Migratory	✓	Species or species habitat likely to occur within area.	✓	Species or species habitat likely to occur within area.	
Shortfin mako	*Isurus oxyrinchus*	Migratory	✓	Species or species habitat likely to occur within area.	✓	Species or species habitat likely to occur within area.	
Longfin mako	*Isurus paucus*	Migratory	✓	Species or species habitat likely to occur within area.	✓	Species or species habitat likely to occur within area.	
Dwarf sawfish	*Pristis clavata*	Vulnerable, Migratory	✗	N/A.	✓	Species or species habitat known to occur within area.	<u>Unplanned</u> + Release of hydrocarbons
Marine Mammals							
Humpback whale	*Megaptera novaeangliae*	Vulnerable, Migratory	✓	Species or species habitat likely to occur within area.	✓	Species or species habitat known to occur within area.	<u>Planned</u> + Acoustic disturbance to marine fauna + Light emissions + Operational discharges + Spill response operations <u>Unplanned</u> + Marine fauna interaction + Hazardous liquid releases + Release of hydrocarbons
Blue whale	*Balaenoptera musculus*	Endangered, Migratory	✓	Species or species habitat likely to occur within area.	✓	Migration route known to occur within area. Overlap with migration BIA.	
Bryde's whale	*Balaenoptera edeni*	Migratory	✓	Species or species habitat may occur within area.	✓	Species or species habitat likely to occur within area.	
Orca, killer whale	*Orcinus orca*	Migratory	✓	Species or species habitat may occur within area.	✓	Species or species habitat may occur within area.	
Spotted bottlenose dolphin	*Tursiops aduncus* (Arafura/ Timor Sea populations)	Migratory	✓	Species or species habitat may occur within area.	✓	Species or species habitat may occur within area.	
Sei whale	*Balaenoptera borealis*	Vulnerable, Migratory	✓	Species or species habitat may occur within area.	✓	Species or species habitat likely to occur within area.	
Fin whale	*Balaenoptera physalusk*	Vulnerable, Migratory	✓	Species or species habitat may occur within area.	✓	Species or species habitat likely to occur within area.	
Australian snubfin dolphin	*Orcaella heinsohni*	Migratory	✗	N/A	✓	Species or species habitat may occur within area.	<u>Unplanned</u> + Release of hydrocarbons
Dugong	*Dugong dugon*	Migratory	✗	N/A	✓	Breeding known to occur within area. Overlap with foraging, nursing, calving and breeding BIAs.	
Sperm whale	*Physeter macrocephalus*	Migratory	✗	N/A	✓	Species or species habitat may occur within area.	

Value/sensitivity		EPBC Act Status	Operational Area		EMBA		Relevant events
Common name	Scientific name		Presence	Particular values or sensitivities	Presence	Particular values or sensitivities	
Marine Reptiles							
Loggerhead turtle	*Caretta caretta*	Endangered, Migratory	✓	Species or species habitat likely to occur within area.	✓	Foraging, feeding or related behaviour known to occur within area.	Planned + Acoustic disturbance to marine fauna + Light emissions + Seabed and benthic habitat disturbance + Operational discharges + Spill response operations Unplanned + Introduction of IMS + Marine fauna interaction + Hazardous liquid releases + Release of hydrocarbons
Green turtle	*Chelonia mydas*	Vulnerable, Migratory	✓	Species or species habitat likely to occur within area.	✓	Foraging, feeding or related behaviour known to occur within area. Overlap with foraging, internesting, internesting buffer and mating BIAs.	
Leatherback turtle	*Dermochelys coriacea*	Endangered, Migratory	✓	Species or species habitat likely to occur within area.	✓	Foraging, feeding or related behaviour likely to occur within area.	
Hawksbill turtle	*Eretmochelys imbricata*	Vulnerable, Migratory	✓	Species or species habitat likely to occur within area.	✓	Foraging, feeding or related behaviour known to occur within area. Overlap with foraging, internesting and internesting buffer BIAs.	
Olive Ridley turtle	*Lepidochelys olivacea*	Endangered, Migratory	✓	Species or species habitat likely to occur within area.	✓	Foraging, feeding or related behaviour known to occur within area. Overlap with foraging BIA.	
Flatback turtle	*Natator depressus*	Vulnerable, Migratory	✓	Species or species habitat likely to occur within area.	✓	Foraging, feeding or related behaviour known to occur within area. Overlap with foraging BIA.	
Short-nosed seasnake	*Aipysurus apraefrontalis*	Critically Endangered	✗	N/A	✓	Species or species habitat known to occur within area.	Unplanned Release of hydrocarbons
Leaf-scaled seasnake	*Aipysurus foliosquama*	Critically Endangered	✗	N/A	✓	Species or species habitat known to occur within area.	
Saltwater crocodile	*Crocodylus porosus*	Migratory	✗	N/A	✓	Species or species habitat likely to occur within area.	
Birds							
Australian lesser noddy	*Anous tenuirostris melanops*	Vulnerable	✓	Species or species habitat may occur within area.	✓	Breeding known to occur within area.	Planned + Light emissions + Atmospheric emissions + Operational discharges + Spill response operations Unplanned + Release of hydrocarbons
Curlew sandpiper	*Calidris ferruginea*	Critically Endangered, Migratory	✓	Species or species habitat may occur within area.	✓	Species or species habitat known to occur within area.	
Red knot	*Calidris canutus*	Endangered, Migratory	✓	Species or species habitat may occur within area.	✓	Species or species habitat known to occur within area.	
Eastern curlew	*Numenius madagascariensis*	Critically Endangered, Migratory	✓	Species or species habitat may occur within area.	✓	Species or species habitat known to occur within area.	
Common noddy	*Anous stolidus*	Migratory	✓	Species or species habitat may occur within area.	✓	Breeding known to occur within area.	
Streaked shearwater	*Calonectris leucomelas*	Migratory	✓	Species or species habitat may occur within area.	✓	Species or species habitat known to occur within area.	
Lesser frigatebird	*Fregata ariel*	Migratory	✓	Species or species habitat likely to occur within area.	✓	Breeding known to occur within area.	
Common sandpiper	*Actitis hypoleucos*	Migratory	✓	Species or species habitat may occur within area.	✓	Species or species habitat known to occur within area.	

Value/sensitivity		EPBC Act Status	Operational Area		EMBA		Relevant events
Common name	Scientific name		Presence	Particular values or sensitivities	Presence	Particular values or sensitivities	
Sharp-tailed sandpiper	*Calidris acuminata*	Migratory	✓	Species or species habitat may occur within area.	✓	Species or species habitat known to occur within area.	
Pectoral sandpiper	*Calidris melanotos*	Migratory	✓	Species or species habitat may occur within area.	✓	Species or species habitat may occur within area.	
Greater frigatebird	*Fregata minor*	Migratory	✓	Species or species habitat may occur within area.	✓	Breeding known to occur within area.	
Roseate tern	*Stern dougallii*	Migratory	✗	N/A	✓	Breeding known to occur within area.	Unplanned + Release of hydrocarbons
Abbott's booby	*Papasula abbotti*	Endangered	✗	N/A	✓	Species or species habitat may occur within area.	
Osprey	*Pandion haliaetus*	Migratory	✗	N/A	✓	Species or species habitat may occur within area.	
Brown booby	*Sula leucogaster*	Migratory	✗	N/A	✓	Breeding known to occur within area.	
Bar-tailed godwit	*Limosa lapponica*	Migratory	✗	N/A	✓	Species or species habitat known to occur within area.	
Northern Siberian bar-tailed godwit	*Limosa lapponica menzbieri*	Critically Endangered	✗	N/A	✓	Species or species habitat known to occur within area.	
Australian painted snipe	*Rostratula australis*	Endangered	✗	N/A	✓	Species or species habitat may occur within area.	
Masked booby	*Sula dactylatra*	Migratory	✗	N/A	✓	Breeding known to occur within area.	
Red-footed booby	*Sula sula*	Migratory	✗	N/A	✓	Breeding known to occur within area.	
White-tailed tropicbird	*Phaethon lepturus*	Migratory	✗	N/A	✓	Breeding known to occur within area.	
Red-tailed tropicbird	*Phaethon rubricauda*	Migratory	✗	N/A	✓	Breeding known to occur within area.	
Little tern	*Sternula albifrons*	Migratory	✗	N/A	✓	Congregation or aggregation known to occur within area	
Wedge-tailed shearwater	*Ardenna pacifica*	Migratory	✗	N/A	✓	Breeding known to occur within area.	
Caspian tern	*Hydroprogne caspia*	Migratory	✗	N/A	✓	Breeding known to occur within area.	
Bridled tern	*Onychoprion anaethetus*	Migratory	✗	N/A	✓	Breeding known to occur within area.	
Oriental reed-warbler	*Acrocephalus orientalis*	Migratory	✗	N/A	✓	Species or species habitat known to occur within area.	
Greater crested tern	*Thalasseus bergii*	Migratory	✗	N/A	✓	Breeding known to occur within this area.	

Table 3-8: Biologically important areas identified in operational area and environment that may be affected

Species	BIA Area	Presence in Operational Area	Presence in EMBA
Whale shark	Foraging	✓	✓
Dugong	Breeding	✗	✓
	Calving	✗	✓
	Nursing	✗	✓
	Foraging	✗	✓
Blue whale	Migration	✗	✓
Green turtle	Foraging	✗	✓
	Nesting/internesting	✗	✓
	Mating	✗	✓
Hawksbill turtle	Foraging	✗	✓
	Nesting/internesting	✗	✓
Olive Ridley turtle	Foraging	✗	✓
Flatback turtle	Foraging	✗	✓
Seabirds	Resting	✗	✓
	Breeding	✗	✓

Relevant conservation advice, recovery plans and management plans for marine fauna identified in the PMST are provided in **Section 3.2.3.1**.

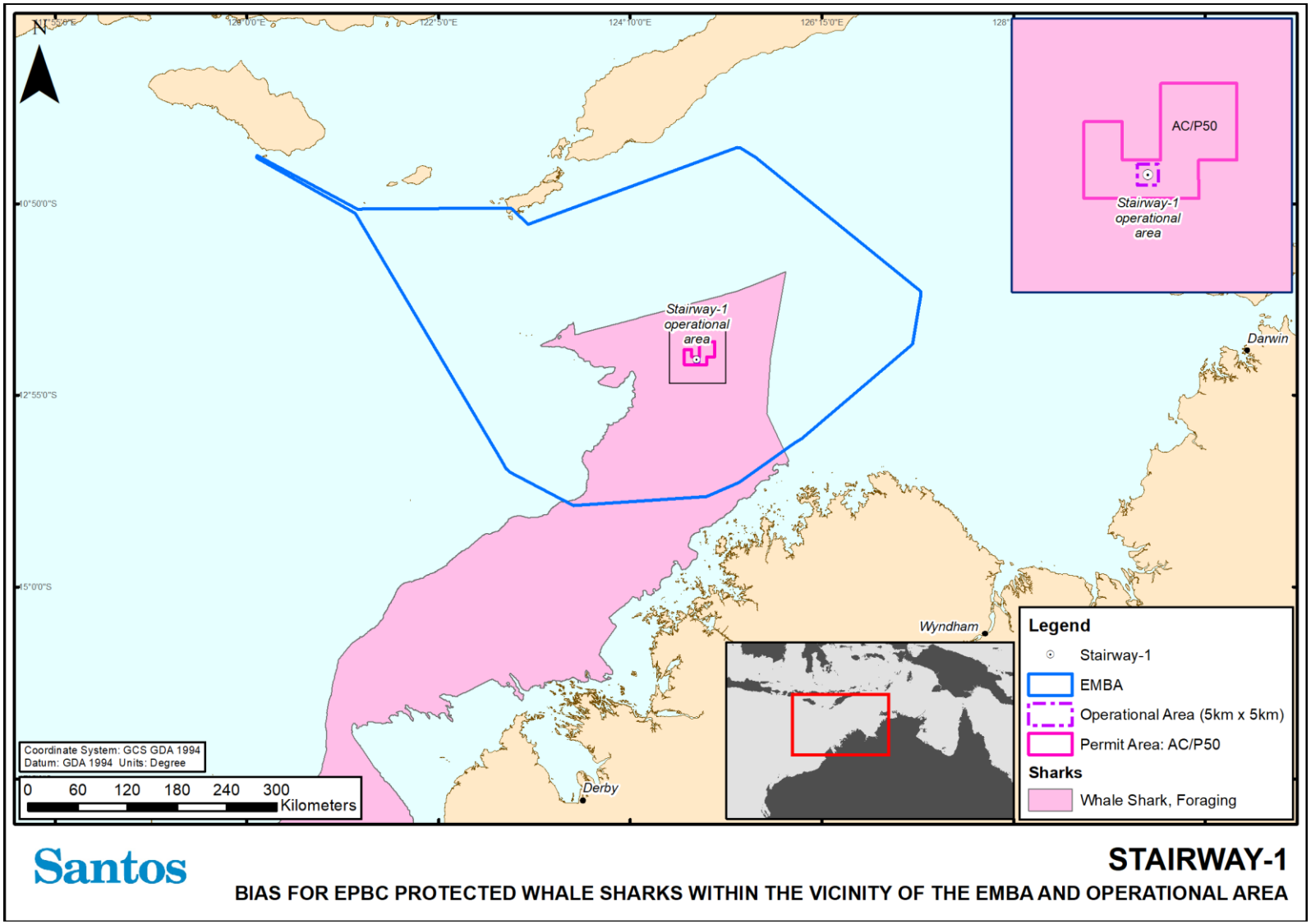

Figure 3-6: Biologically important areas for Environmental Protection and Biodiversity Conservation Protected whale sharks within the vicinity of the environment that may be affected and operational area

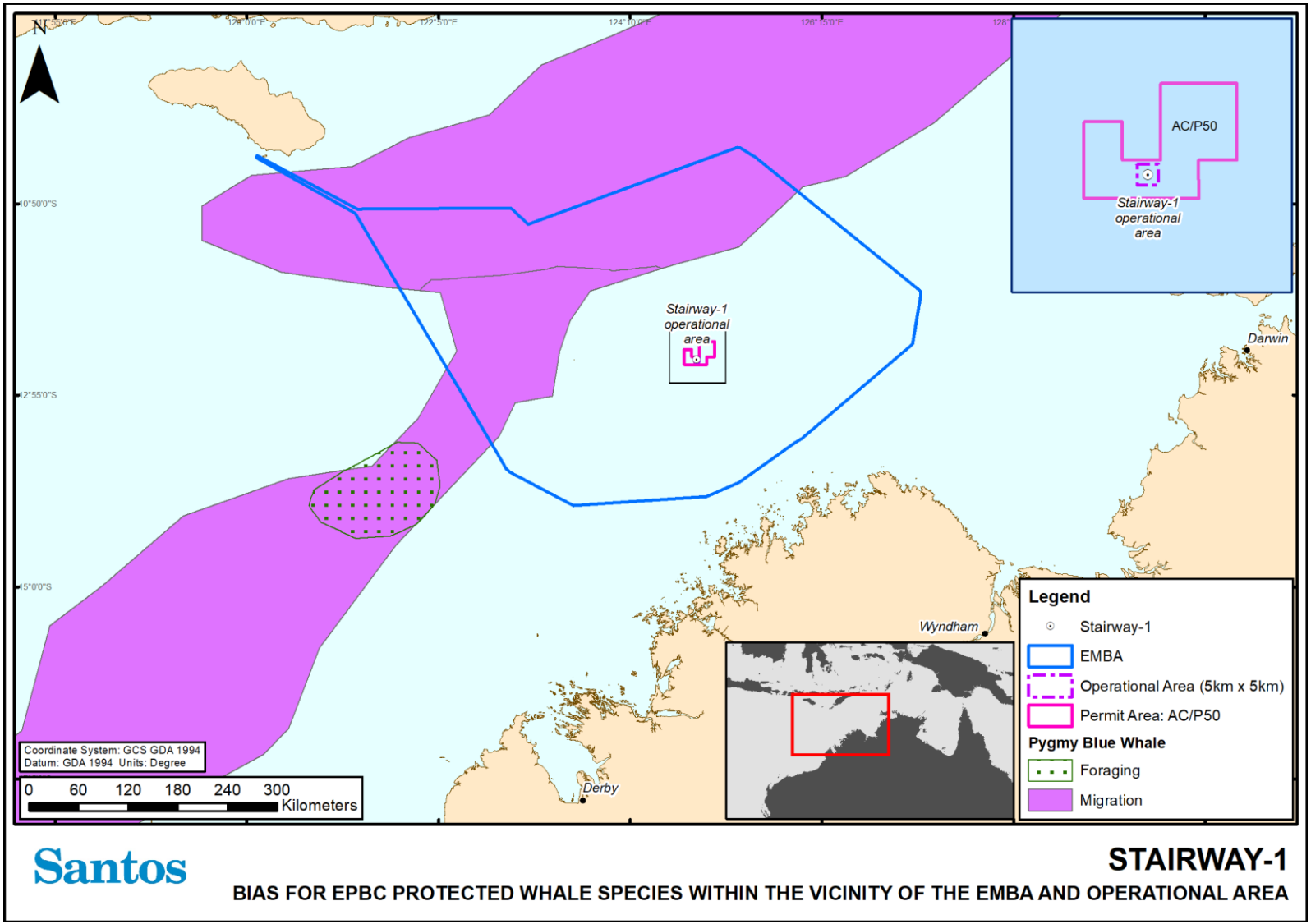

Figure 3-7: Biologically important areas for Environmental Protection and Biodiversity Conservation Protected whale species within the vicinity of the environment that may be affected and operational area

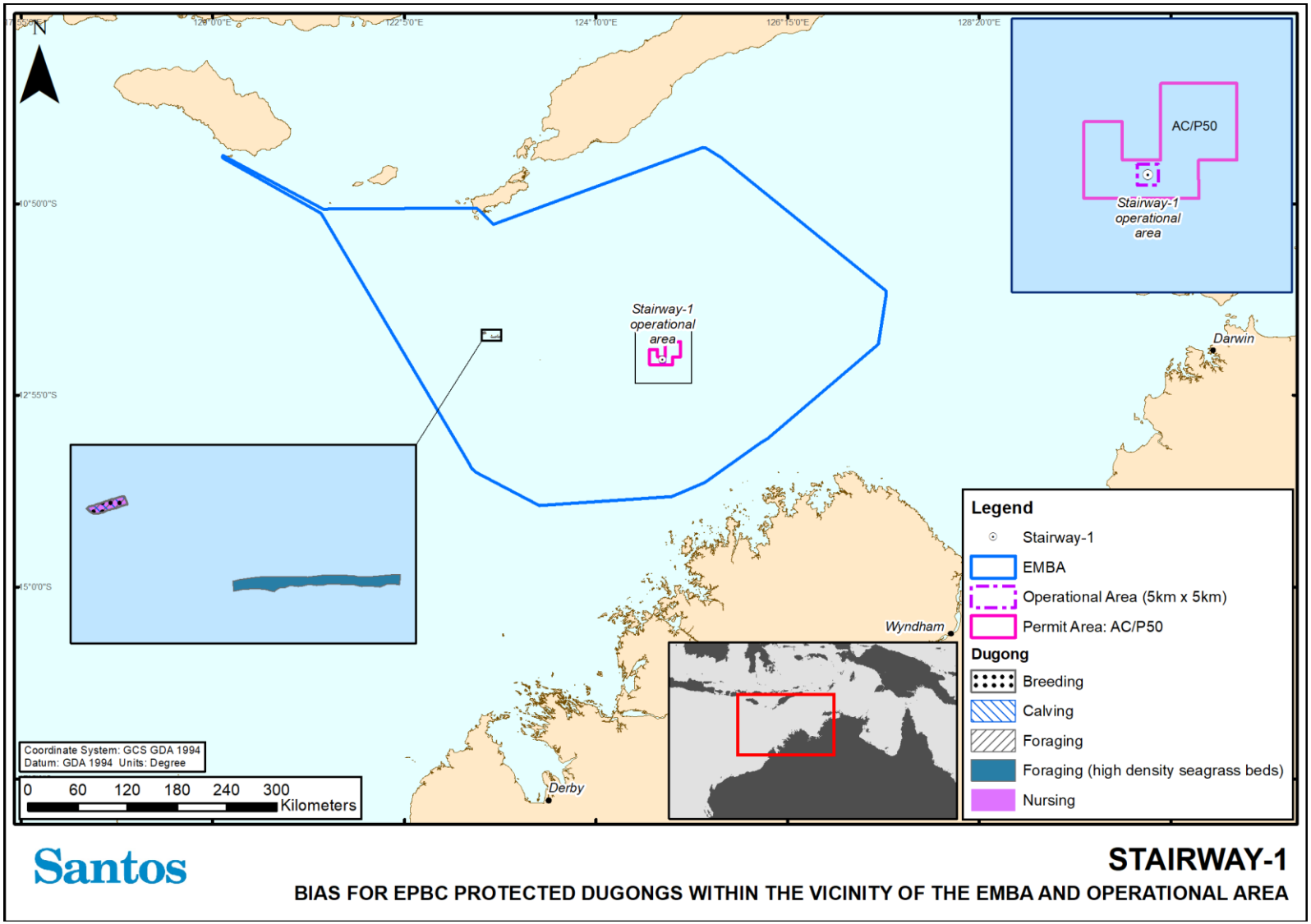

Figure 3-8: Biologically important areas for Environmental Protection and Biodiversity Conservation Protected dugongs within the vicinity of the environment that may be affected and operational area

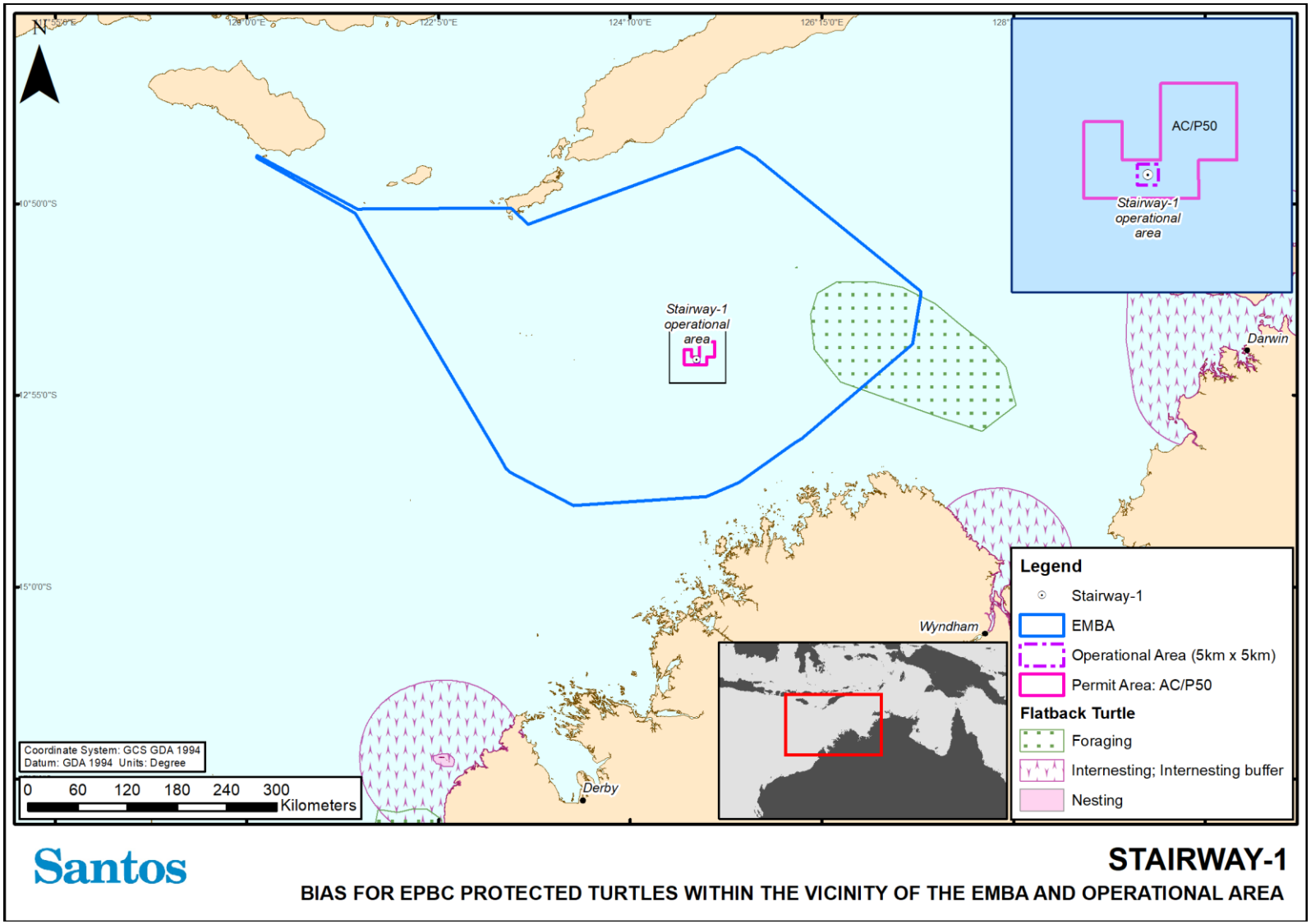

Figure 3-9: Biologically important areas for Environmental Protection and Biodiversity Conservation Protected flatback turtles within the vicinity of the environment that may be affected and operational area

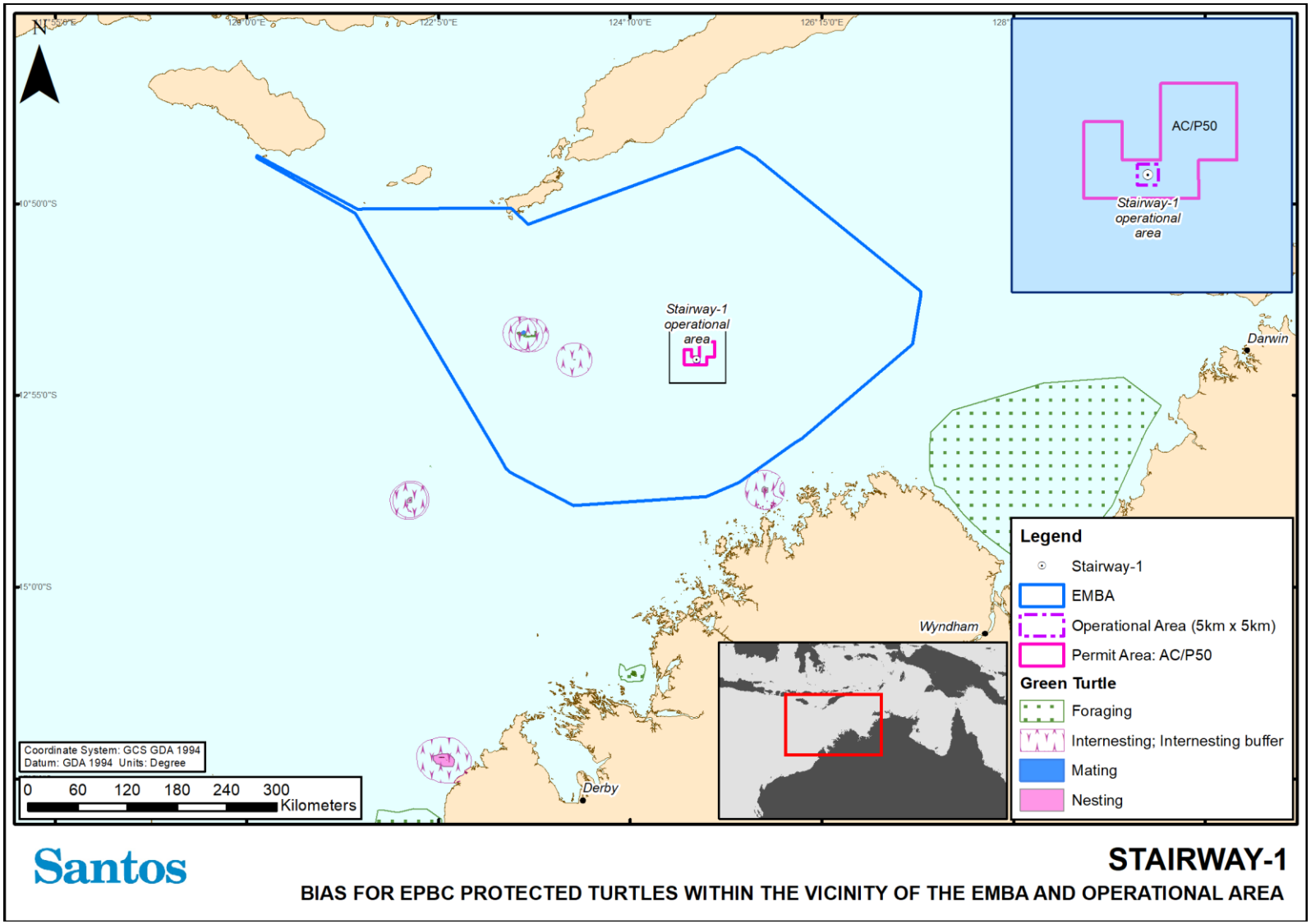

Figure 3-10: Biologically important areas for Environmental Protection and Biodiversity Conservation Protected green turtles within the vicinity of the environment that may be affected and operational area

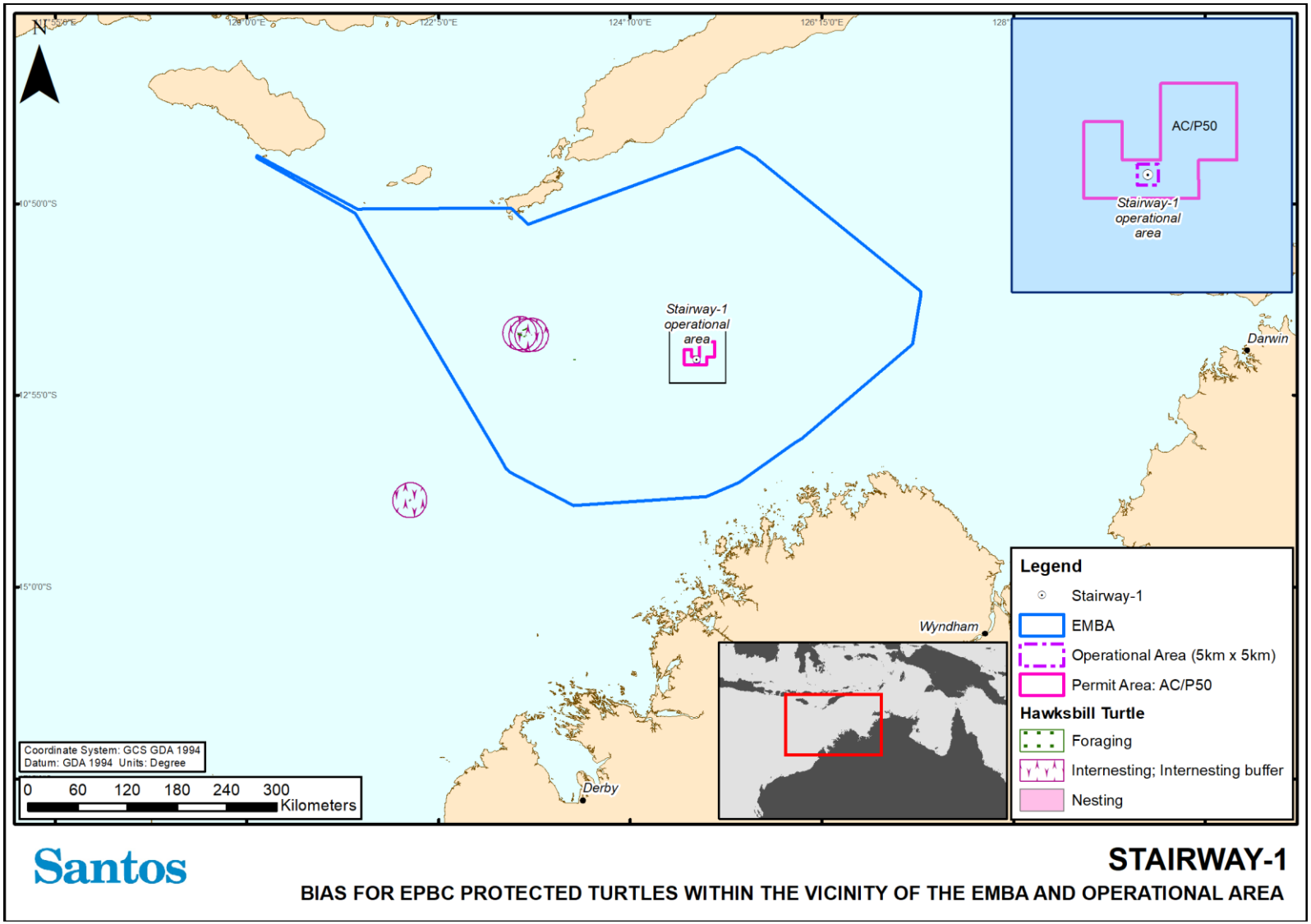

Figure 3-11: Biologically important areas for Environmental Protection and Biodiversity Conservation Protected hawksbill turtles within the vicinity of the environment that may be affected and operational area

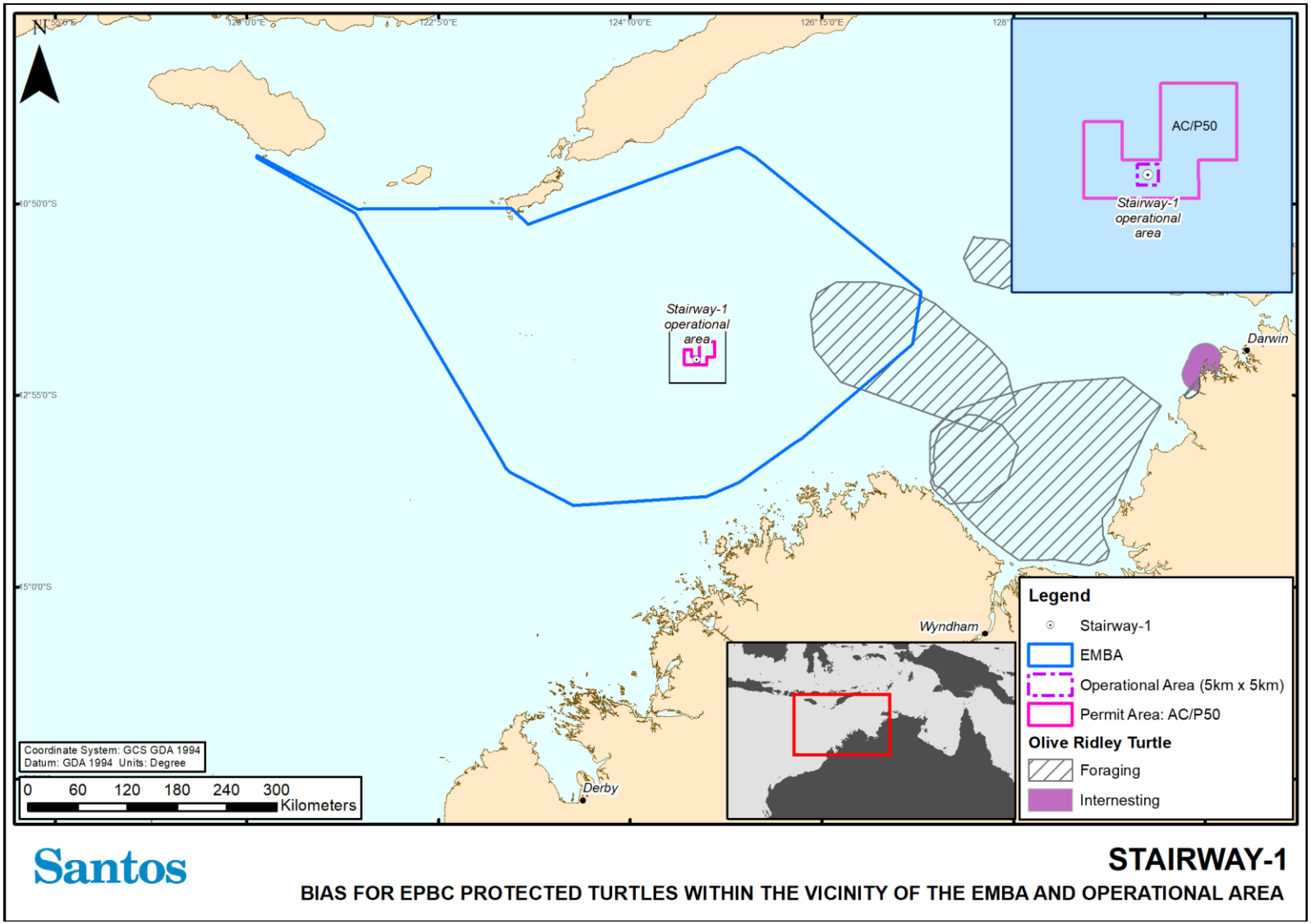

Figure 3-12: Biologically important areas for Environmental Protection and Biodiversity Conservation Protected Olive Ridley turtles within the vicinity of the environment that may be affected and operational area

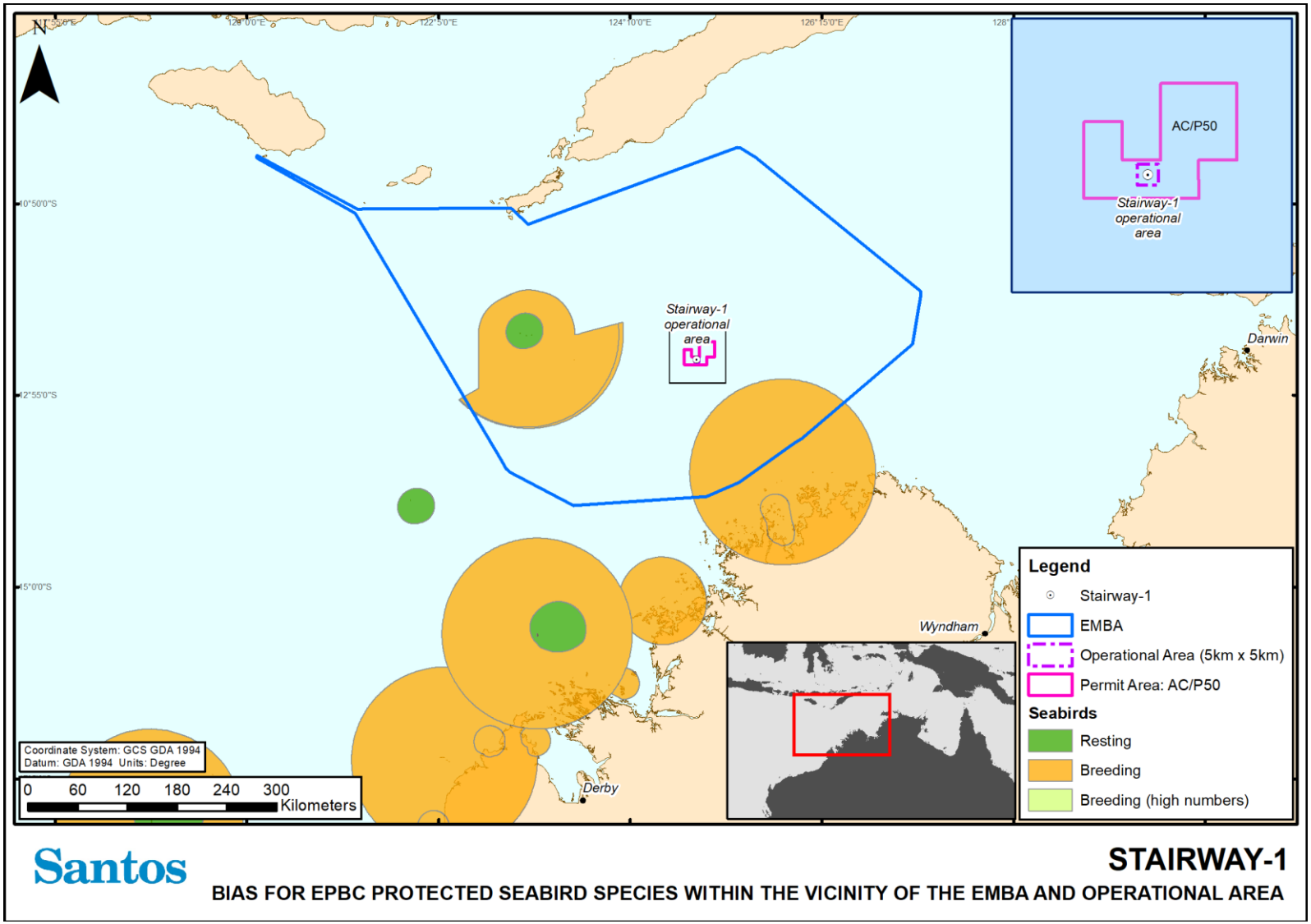

Figure 3-13: Biologically important areas for Environmental Protection and Biodiversity Conservation Protected seabird species within the vicinity of the environment that may be affected and operational area

3.2.3.1 Recovery Plans

Recovery Plans set out the research and management actions necessary to stop the decline of and support the recovery of LTS. **Table 3-9** summarises the actions relevant to the activity, with more information about the specific requirements of the relevant plans of management (including Conservation Advices and Conservation Management Plans) that would be applicable to the activity, and demonstrates where current management requirements have been considered.

Table 3-9: Threats and strategies from recovery plans, conservation advice and management plans relevant to the activity

Receptor	Name	Recovery Plan/Conservation Advice/Management Plan	Threats/strategies identified as relevant to the activity	Addressed (where relevant) in EP Section
All	All vertebrate fauna	Threat Abatement Plan for Impacts of Marine Debris on Vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018)	Marine debris	**7.1** and **7.3**
Fish and Sharks	Dwarf sawfish	Sawfish and River Sharks Multispecies Recovery Plan (2015a)	Habitat degradation and modification	**7.1, 7.2**, **7.4**, **7.6**
	Green sawfish	Commonwealth Conservation Advice on *Pristis zijsron* (green sawfish) (2008)	Habitat degradation and modification	**7.1, 7.2**, **7.4**, **7.6**
		Sawfish and River Sharks Multispecies Recovery Plan (2015a)		
	Narrow sawfish	Sawfish and River Sharks Multispecies Recovery Plan (2015a)	Habitat degradation and modification	**7.1, 7.2, 7.4, 7.6**
	Great white shark	Recovery plan for the White Shark (*Carcharodon carcharias*) (2013)	Ecosystem effects as a result of habitat modification and climate change	**7.1, 7.2, 7.6**
	Whale shark	Approved Conservation Advice for *Rhincodon typus* (whale shark) (2015)	Boat strike from large vessels	**7.3**
			Habitat disruption from mineral exploration, production and transportation	**7.1** to **7.6**
Mammals	Blue whale	Blue Whale Conservation Management Plan 2015–2025 (2015b)	Noise interference	**6.1**
			Habitat modification	**7.4**, **7.6**
			Vessel disturbance	**7.3**
	Fin whale	Approved Conservation Advice for *Balaenoptera physalus* (fin whale) (2015)	Habitat degradation including pollution (increasing port expansion and coastal development)	**7.1**, **7.2**, **7.4**, **7.6**
			Pollution (persistent toxic pollutants)	**7.4**, **7.6**
			Noise interference	**6.1**
			Vessel strike	**7.3**

Receptor	Name	Recovery Plan/Conservation Advice/Management Plan	Threats/strategies identified as relevant to the activity	Addressed (where relevant) in EP Section
	Sei whale	Approved Conservation Advice for *Balaenoptera borealis* (sei whale) (2015)	Habitat degradation including pollution (increasing port expansion and coastal development)	**7.1, 7.2**, **7.4**, **7.6**
			Pollution (persistent toxic pollutants)	**7.4**, **7.6**
			Vessel strike	**7.3**
	Humpback whale	Approved Conservation Advice for *Megaptera novaeangliae* (humpback whale) (2015)	Noise interference	**6.1**
			Habitat degradation including coastal development and port expansion	**7.1, 7.2**, **7.4**, **7.6**
Reptiles	All marine turtles	National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds (DoEE, 2020)	Light pollution	**6.2**
	Loggerhead turtle	Recovery plan for marine turtles in Australia 2017–2027 (Commonwealth of Australia, 2017)	Marine debris	**7.1**
			Vessel disturbance	**6.1** and **7.3**
			Light pollution	**6.2**
	Green turtle	Recovery plan for marine turtles in Australia 2017–2027 (Commonwealth of Australia, 2017)	Deteriorating water quality	**6.6, 7.4**, **7.6**
			Marine debris	**7.1**
			Vessel disturbance	**6.1** and **7.3**
			Light pollution	**6.2**
	Leatherback turtle	Commonwealth Conservation Advice on *Dermochelys coriacea* (2008)	Boat strike	**7.3**
			Changes to breeding sites	**7.6**
		Recovery plan for marine turtles in Australia (Commonwealth of Australia, 2017)	Deteriorating water quality	**6.6, 7.4**, **7.6**
			Marine debris	**7.1**
			Loss of habitat	**7.6**

Receptor	Name	Recovery Plan/Conservation Advice/Management Plan	Threats/strategies identified as relevant to the activity	Addressed (where relevant) in EP Section
			Vessel disturbance	**6.1** and **7.3**
			Light pollution	**6.2**
	Hawksbill turtle	Recovery plan for marine turtles in Australia 2017–2027 (Commonwealth of Australia, 2017)	Deteriorating water quality	**6.6**, **7.4**, **7.6**
			Marine debris	**7.1**
			Loss of habitat	**7.6**
			Vessel disturbance	**6.1** and **7.3**
			Light pollution	**6.2**
	Flatback turtle	Recovery plan for marine turtles in Australia 2017–2027 (Commonwealth of Australia, 2017)	Deteriorating water quality	**6.6**, **7.4**, **7.6**
			Marine debris	**7.1**
			Loss of habitat	**7.6**
			Vessel disturbance	**6.1** and **7.3**
			Light pollution	**6.2**
Birds	All seabirds and shorebirds	National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds (DoEE, 2020)	Light pollution	**6.2**
	Bar-tailed godwit Common sandpiper Sharp-tailed sandpiper Pectoral sandpiper Red knot	Wildlife Conservation Plan for Migratory Shorebirds (2015)	Pollution and contaminants	**7.4**, **7.6**
			Habitat loss and degradation	**7.6**
	Curlew sandpiper	Approved Conservation Advice for *Calidris ferruginea* (Curlew Sandpiper) (2015c)	Habitat loss and degradation from pollution	**7.4**, **7.6**

Receptor	Name	Recovery Plan/Conservation Advice/Management Plan	Threats/strategies identified as relevant to the activity	Addressed (where relevant) in EP Section
	Eastern curlew	Approved Conservation Advice for *Numenius madagascariensis* (Eastern Curlew) (2015d)	Habitat loss and degradation from pollution	**7.4**, **7.6**
	Red knot	Approved Conservation Advice for *Calidris canutus* (Red knot) (2016)	Pollution/contamination impacts	**7.4**, **7.6**
			Habitat loss and degradation	**7.4**, **7.6**
	Northern Siberian bar-tailed godwit	Conservation Advice *Limosa lapponica menzbieri* (Bar-tailed godwit (northern Siberian)) (2016b)	Habitat loss disturbance and modifications	**7.4**, **7.6**
	Australian painted snipe	Approved Conservation Advice for *Rostratula australis* (Australian Painted Snipe) (2013)	Habitat loss disturbance and modifications	**7.4**, **7.6**

3.2.4 Socio-economic receptors

Socio-economic activities that may occur within the operational area and EMBA include commercial fishing, oil and gas exploration and production, and to a lesser extent, recreational fishing and tourism, as summarised in **Table 3-10**.

More detailed descriptions of socio-economic considerations are provided in **APPENDIX C**.

Table 3-10: Summary of socio-economic activities that may occur within the operational area

Value/sensitivity	Description	Operational area presence	Relevant events within operational area	Relevant events within EMBA
Commercial fisheries – Commonwealth	Three Commonwealth fisheries overlap the operational area: the Southern Bluefin Tuna Fishery, Western Skipjack Fishery and Western Tuna and Billfish Fishery (**Table 3-12**). Southern Bluefin Tuna Fishery is only active in waters offshore South and South Eastern Australia, confirmed in consultation with the Australia Southern Bluefin Tuna Association for previous company offshore activities (ABARES Fishery Status Reports, 2018). There has been no fishing effort in the Skipjack Tuna Fishery since the 2009 season, and in that season, activity concentrated off South Australia (ABARES Fishery Status Reports, 2018). Since 2005, there have been fewer than five vessels active in the Western Tuna and Billfish Fishery, down from 50 active vessels in 2000 (ABARES Fishery Status Reports, 2010).	✓	Planned Interaction with other marine users (**Section 6.5**)	Unplanned Unplanned hydrocarbon spills (**Section 7.6**)
Commercial fisheries – State	Two State fisheries intersect the operational area: the Mackerel Managed Fishery and the Northern Demersal Scalefish Fishery (**Table 3-12**).	✓	Planned Interaction with other marine users (**Section 6.5**)	Unplanned Unplanned hydrocarbon spills (**Section 7.6**)
Shipping	The operational area does not overlap any shipping fairways, though is adjacent to some increased vessel traffic following the charted Osborn Passage servicing the nearby Montara field (**Figure 3-17**).	✓	Planned Interaction with other marine users (**Section 6.5**)	Unplanned Unplanned hydrocarbon spills (**Section 7.6**)
Recreational fishing	Remoteness of operational area limits recreational fishing usage. Recreational fishing does occur within the EMBA, particularly around offshore reef systems such as Ashmore Reef and Cartier Island, and therefore could be impacted by a spill arising from a vessel collision.	✗	N/A	Unplanned Unplanned hydrocarbon spills (**Section 7.6**)

Value/sensitivity	Description	Operational area presence	Relevant events within operational area	Relevant events within EMBA
Traditional fishing	Traditional Australian indigenous fishing activities are generally concentrated within 3 nm of the Northern Territory (NT)/Western Australia (WA) coastline (DPIF, 2015). Indonesian/Timor-Leste indigenous fishing is concentrated in the vicinity of Sahul Bank, Echo Shoals and Memorandum of Understanding Box, and boats may pass through the operational area to reach these fishing grounds.	✗	N/A	Unplanned Unplanned hydrocarbon spills (**Section 7.6**)
Defence	The operational area and EMBA do not overlap with any defence training areas (**Figure 3-16**).	✗	N/A	N/A
Shipwrecks	No known sites of shipwrecks within the operational area.	✗	N/A	Unplanned Unplanned hydrocarbon spills (**Section 7.6**)
Oil and gas	Various petroleum exploration and production activities have been undertaken within the Timor Sea, including some close to the operational area. The nearest operating facility to the operational area is Jadestone's Montara facilities (**Figure 3-16**). Oil and gas facilities and permits are present within the EMBA, operated by other titleholders. As such, oil and gas activities could be impacted by unplanned events.	✗	Planned Interaction with other marine users (**Section 6.5**)	Unplanned Unplanned hydrocarbon spills (**Section 7.6**)
Tourism	There are limited recreational activities observed or expected to occur in the deep-water offshore environment of the operational area and majority of the EMBA, given the distance from shorelines. However, some occasional activity may be encountered around offshore reef systems such as Ashmore Reef and Cartier Island within the EMBA	✗	N/A	Unplanned Unplanned hydrocarbon spills (**Section 7.6**)
Cultural heritage	No known sites of Aboriginal Heritage significance occur within the operational area-	✗	N/A	N/A

3.2.4.1 Commercial fisheries

Commonwealth and State fisheries overlapping the operational area and the EMBA are illustrated in **Figure 3-14** and **Figure 3-15. Table 3-11** describes each of these fisheries and indicates which events associated with the activity may impact on these.

Consultation with WAFIC has identified commercial fishing interests that exist in, or in proximity to, proposed activities under this EP. This includes commercial fisheries identified within **Table 3-11**.

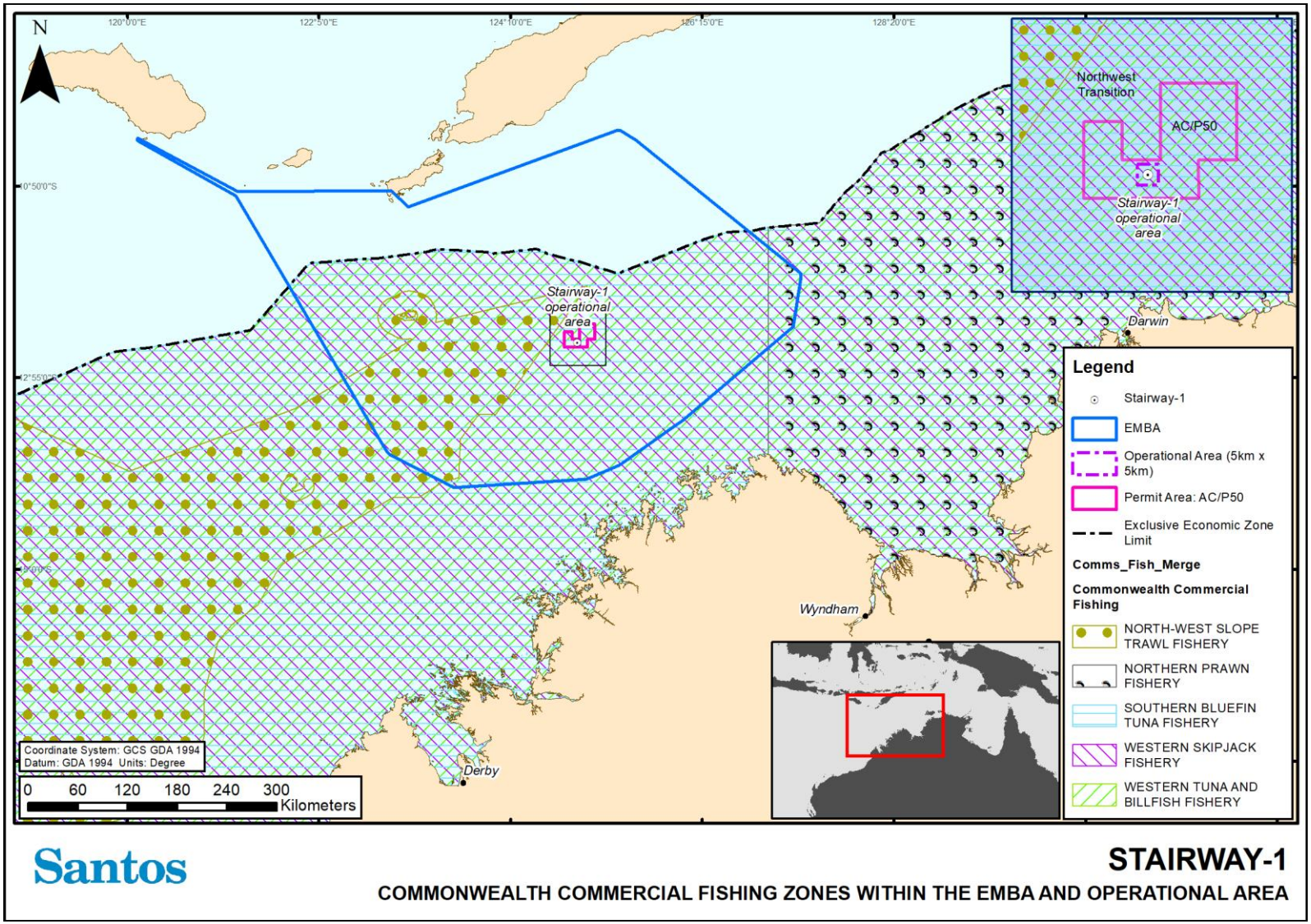

Figure 3-14: Commonwealth commercial fishing zones within the environment that may be affected and operational area

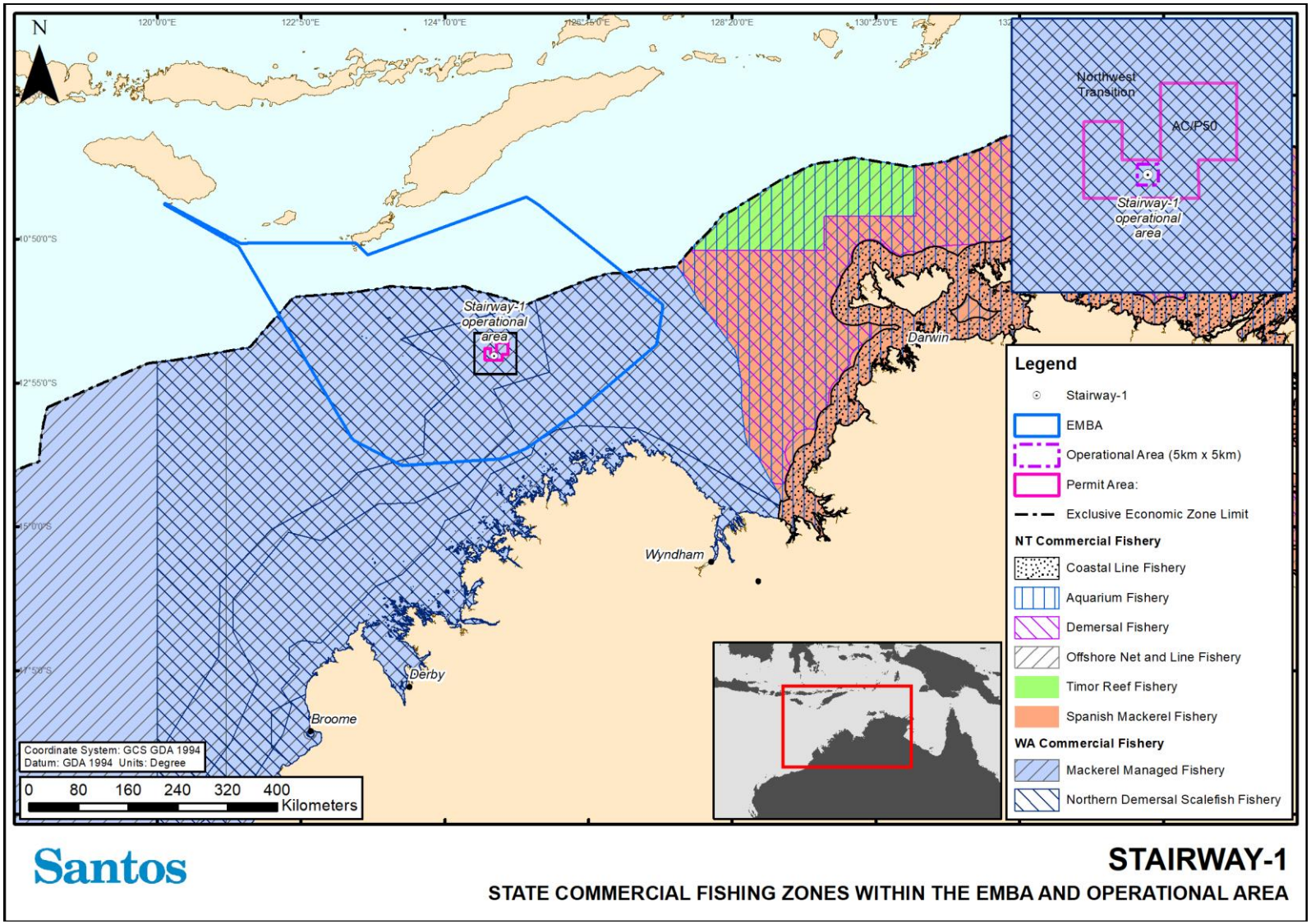

Figure 3-15: State commercial fishing zones within the environment that may be affected and operational area

Table 3-11: State and Commonwealth fisheries in the vicinity of the operational area and environment that may be affected

Value/ sensitivity	Description	Operational Area	EMBA	Likelihood of interaction with fishers
Commonwealth Managed Fisheries				
Western Tuna and Billfish Fishery	Extends westward from Cape York Peninsula (142°30' E) off Queensland to 34° S off the WA west coast. It also extends eastward from 34° S off the west coast of WA across the Great Australian Bight to 141° E at the South Australian–Victorian border. No current effort in operational area.	✓	✓	No active commercial fishing within the area in the past years. However, fishing vessels could be encountered in low density.
Western Skipjack Tuna Fishery	No current effort in operational area.	✓	✓	
Southern Bluefin Tuna Fishery	No current effort in operational area.	✓	✓	
North West Slope Trawl Fishery	Extends from 114° E to approximately 125° E off the WA coast between the 200 m isobath and the outer limit of the Australian Fishing Zone.	X	✓	Historical effort within the EMBA, targeting scampi and prawns.
Northern Prawn Fishery	Extends from Joseph Bonaparte Gulf across the top end to the Gulf of Carpentaria.	X	✓	Historical effort within the EMBA; however, mainly concentrated in shallower coastal waters.
State Managed Fisheries				
Mackerel Managed Fishery	Uses near-surface trolling gear from vessels in coastal areas around reefs, shoals and headlands to target Spanish mackerel, with the bulk of the total catch being taken in the Kimberley area.	✓	✓	Unplanned events which may occur in the operational area and EMBA could disrupt fishing activities, but the likelihood of these events is low.
Demersal Fishery	Operates off WA's coast in waters east of 120° E longitude. The permitted means of operation within the fishery include handline, dropline and fish traps, although the fishery	✓	✓	Unplanned events which may occur in the operational area and the EMBA could disrupt fishing activities, but the likelihood of these events is low.

Value/ sensitivity	Description	Operational Area	EMBA	Likelihood of interaction with fishers
	has essentially operated as trap-based since 2002.			
Northern shark fishery	Extends from NW Cape to Koolan Island.	X	X	Historical effort within the EMBA but no current fishing effort
State Managed Fisheries (Whole of State)				
Aquarium Fishery	All year. Effort within the operational area and EMBA is unknown but is unlikely, due to the depth and the dive-based method of collection.	✓	✓	Disruption to fishing activities unlikely, given water depths fisheries operate within. Unplanned events which may occur in the EMBA could disrupt fishing activities, but the likelihood of these events is low.
Spanish Mackerel Fishery	Trolling or handline. Near-surface trolling gear from vessels in coastal areas around reefs, shoals and headlands.	✓	✓	The majority of the catch is taken in the Kimberley Area and north of Port Hedland.
Coastal Line Fishery	Fishing occurs between high water marks and 15 nm from low water mark, targeting black jewfish and snapper using lines, nets and traps.	✓	✓	Unplanned events which may occur in the operational area and the EMBA could disrupt fishing activities, but the likelihood of these events is low.
Offshore Net and Line Fishery	Fishing occurs from low water mark to the boundary of the Australian Fishing Zone 200 nm offshore, targeting shark species and grey mackerel using lines and nets.	✓	✓	
Timor Reef Fishery	Limited number of active fishers using traps for snapper in water depths of 70 to 120 m.	✓	✓	

3.2.4.2 Recreational fisheries and tourism

The operational area is located in offshore waters that are not likely to be accessed for tourism activities, such as recreational fishing and boating and charter boat operations, which tend to be centred around nearshore waters, islands and coastal areas. There are shoals and banks within the EMBA, and some of these may be visited by small numbers of recreational fishers and charter vessels targeting fish inhabiting these shallower features.

A specimen shell collection enterprise occurs around Ashmore Reef and Cartier Island. Fishing and diving charter companies offer tours to diving spots off the WA coast, including Ashmore Reef, Cartier Island and

Hibernia Reef. These offshore areas are encompassed in the EMBA. Fishers may access the reefs of Cartier Island and visit Ashmore Reef for access to fresh water (DEWHA, 2008a).

3.2.4.3 Traditional Indonesian fishing

Indonesian and Timorese traditional fishers generally fish in the Timor Sea, typically at locations such as Hibernia Reef, Ashmore Reef and Scott Reef (more than 130 km of the operational area). Fishing occurs from April to December, with most activity occurring in September and October. The Big Bank shoals lie in the Indonesian Exclusive Economic Zone (EEZ) and Indonesian commercial vessels may fish in and around the shoals (Heyward *et al*., 1997). Species that are likely to be targeted by Indonesian fishers are shark, tuna, mackerel and reef fish such as snapper.

As the operational area is located in remote offshore waters with no geomorphic features such as shoals, banks or reefs, traditional Indonesian fishing is unlikely to occur within this area. As there are shoals in the EMBA, it is possible that Indonesian fishers may transit and fish in the EMBA.

3.2.4.4 Petroleum industry

The operational area and EMBA have several companies operating nearby. Vessels servicing oil and gas operations in the region may pass through the area en-route to facilities; however, vessel transit is not classed as a petroleum activity.

There are currently no existing facilities in the operational area.

In the EMBA, there are several exploration and production permits and leases throughout the WA, NT and Commonwealth waters, which include current exploration and production activities including platforms, floating, production, storage and offloading vessels, pipelines and drilling, as shown in **Figure 3-16**.

3.2.4.5 Defence

There are no defence operations within the vicinity of the operational area or the EMBA, as shown in **Figure 3-16**.

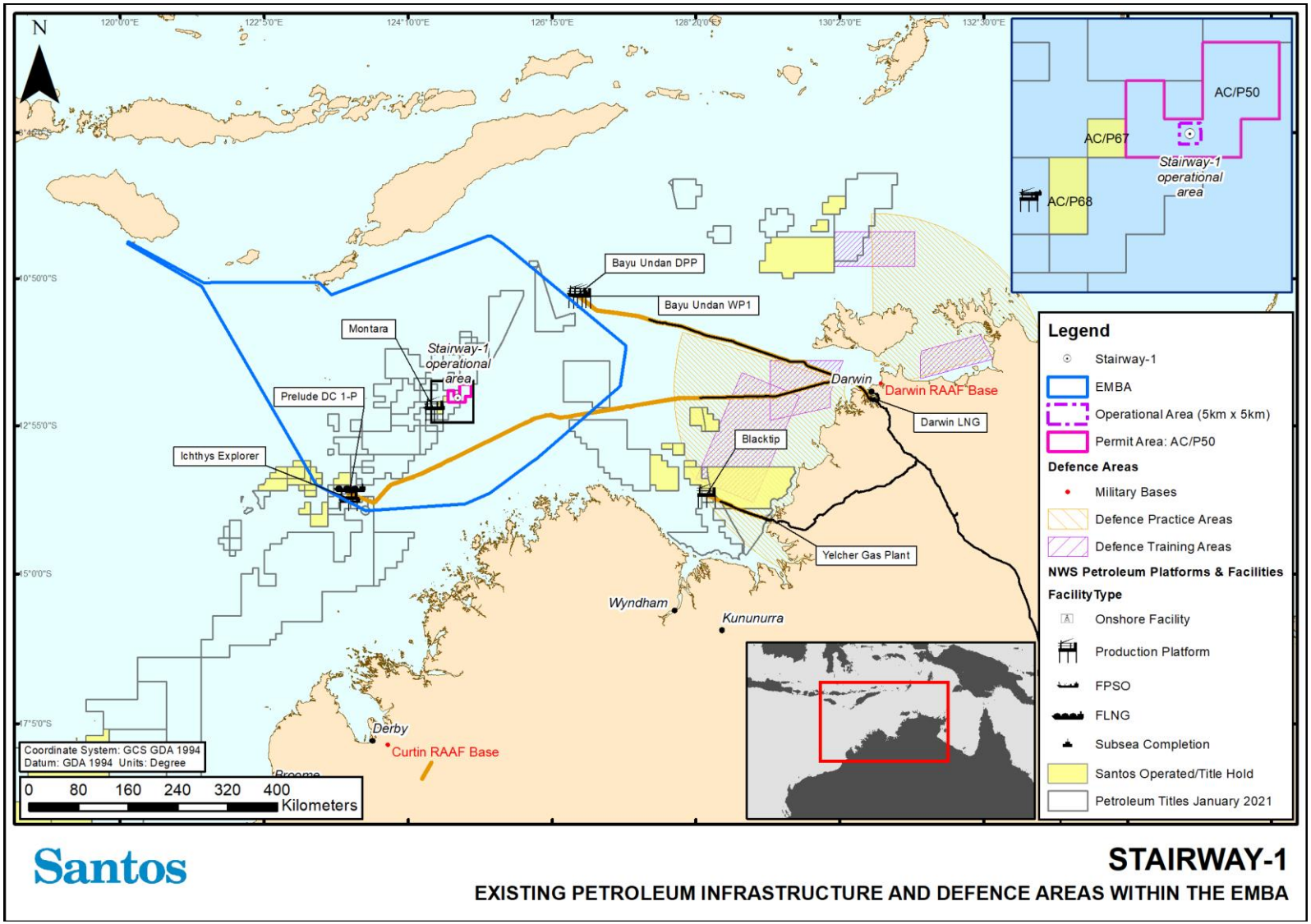

Figure 3-16: Existing petroleum infrastructure and defence areas within the environment that may be affected

3.2.4.6 Shipping

The closest major commercial port to the EMBA is Darwin. The Darwin Port Corporation serves multiple shipping and cargo markets, including cruise and naval vessels, livestock exports, dry bulk ore, offshore oil and gas rig services, and container and general cargo.

The Australian Maritime Safety Authority (AMSA) has established a network of shipping fairways to manage traffic patterns (AMSA, 2020). AMSA shipping routes close to the operational area and EMBA are shown in **Figure 3-17**.

Commercial shipping using the waters of the EMBA includes iron ore carriers, oil and liquefied natural gas tankers and other vessels proceeding to or from the ports of Darwin, Dampier, Port Walcott, Port Hedland, Barrow Island and Varanus Island (VI), and Onslow. Large cargo vessels carrying freight bound or departing from Fremantle also transit along the WA coastline, heading north and south in deeper water.

Large commercial vessels mostly associated with the oil and gas industry and major ports move through the EMBA in transit.

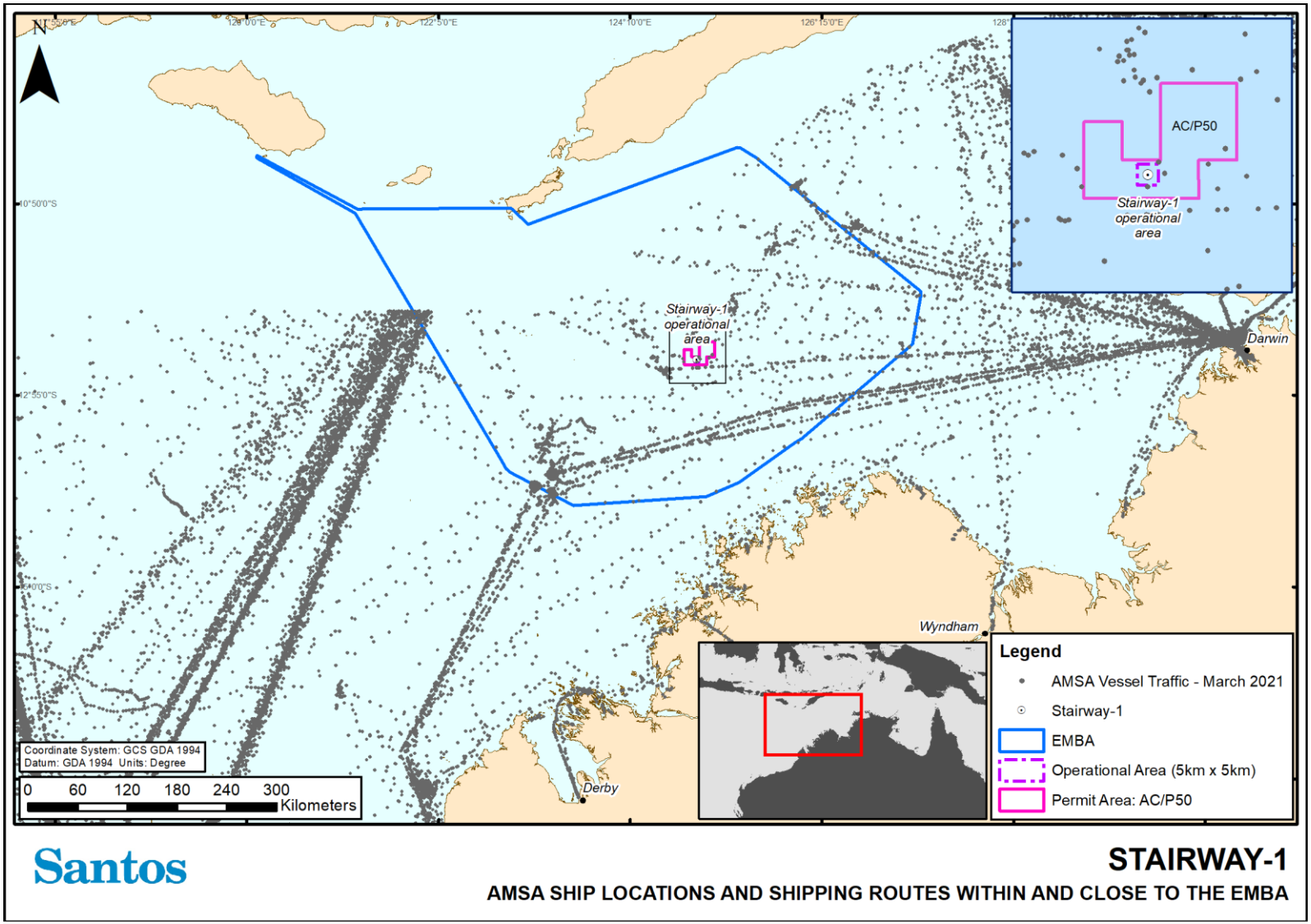

Figure 3-17: Australian Maritime Safety Authority ship locations and shipping routes within and close to the EMBA and operational area (March 2021)

3.2.5 Windows of sensitivity

Timing of peak activity for threatened species and other relevant, significant sensitivities is given in **Table 3-12**.

Table 3-12: Windows of sensitivity in the vicinity of the environment that may be affected

Receptors (critical lifecycle stages)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
All shoreline habitats												
Coral (spawning periods)												
Macroalgae	growing				shedding fronds				growing			
Other benthic and terrestrial habitats												
Fish/Sharks and Fisheries Species												
Whale sharks	Foraging											
Fisheries species spawning/aggregation times [1]												
Marine Mammals												
Dugong (breeding)	breeding								breeding			
Humpback whale (migration)						northern			southern			
Blue whale (migration)					northern						southern	
Marine Reptiles												
Hawksbill turtle (resident adult and juveniles[2])	Widespread throughout North Australian and North West Shelf (NWS) waters, highest density of adults and juveniles over hard bottom habitat (coral reef, rocky reef, pipelines, etcetera)											
Hawksbill turtle (mating aggregations[2])												
Hawksbill turtle (nesting and internesting[2])												
Hawksbill turtle (hatching[1])												
Flatback turtle (resident adult and juveniles[2])	Widespread throughout North Australian and NWS waters, increased density over soft bottom habitat 10 to 60 m deep, post-hatchling age classes and juveniles spread across shelf waters											
Flatback turtle (mating aggregations[2])												
Flatback turtle (nesting and internesting[2])												
Flatback turtle (hatching[2])												
Flatback turtle (nesting[2])												
Green turtle (resident adult and juveniles[2])	Widespread throughout North Australian and NWS waters, highest density associated with seagrass beds and macro algae communities, high-density juveniles in shallow waters off beaches, among mangroves and in creeks											

Receptors (critical lifecycle stages)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Green turtle (mating aggregations[2])												
Green turtle (nesting and internesting[2])												
Green turtle (hatching[2])												
Loggerhead turtle (resident adult and juveniles[2])	Widespread throughout the North Australian and NWS waters, increased density associated with soft bottom habitat supporting their bivalve food source, juveniles associated with nearshore reef habitat											
Loggerhead turtle (mating aggregations[2])												
Loggerhead turtle (nesting and internesting[2])												
Loggerhead turtle (hatching[2])												
Olive Ridley turtle	Can occur at low density year-round with a peak around April to June at the Tiwi Islands during nesting, and hatchling emergence June to August											
Leatherback turtle	Can occur at low density year-round											
Short-nosed seasnake	Can occur at low density year-round											
Seabirds and migratory wetland birds												
Nesting, migrating, foraging												
Socio-economic												
Commercial managed fisheries												
Oil and gas												
Shipping												
Tourism/recreational												

KEY/NOTES	
Peak activity, presence reliable and predictable	[1] Information provided from Department of Fisheries (DoF) consultation
Lower level of abundance/activity/presence	[2] Information provided by K. Pendoley (2011)
Very low activity/presence	
Activity can occur throughout year	
Proposed timing of activity	

4. Stakeholder Consultation

OPGGS(E)R 2009 Requirements
Regulation 9AB
If the Regulator's provisional decision under Regulation 9AA is that the environment plan includes material apparently addressing all the provisions of Division 2.3 (Contents of an environment plan), the Regulator must publish on the Regulator's website as soon as practicable: (a) the plan with the sensitive information part removed; and (b) the name of the titleholder who submitted the plan; and (c) a description of the activity or stage of the activity to which the plan relates; and (d) the location of the activity; and (e) a link or other reference to the place where the accepted offshore project proposal (if any) is published; and (f) details of the titleholder's nominated liaison person for the activity.
Regulation 14(9)
The implementation strategy must provide for appropriate consultation with: (a) relevant authorities of the Commonwealth, a State or Territory; and (b) other relevant interested persons or organisations.
Regulation 16
The environment plan must contain the following: (b) report on all consultations between the operator and any relevant person, for Regulation 11A, that contains: (i) a summary of each response made by a relevant person; and (ii) an assessment of the merits of any objection or claim about the adverse impact of each activity to which the environment plan relates; and (iii) a statement of the operator's response, or proposed response, if any, to each objection or claim; and (iv) a copy of the full text of any response by a relevant person.

4.1 Summary

Stakeholders (**Table 4-1**) were informed of activities covered in this EP via several channels of engagement commencing in June 2021, including:

- Stairway-1 Exploration Drilling and Site Survey Program Consultation package, distributed to identified stakeholders on 2 June 2021;
- Stairway-1 Exploration Drilling and Site Survey Program Consultation package for Commercial Fishers, distributed to identified fishing licence holders on 3 June 2021;
- subsequent email and consultation material to identified stakeholders on 21 June 2021;
- Santos' Quarterly Consultation Update, issued in July 2021; and
- Stairway-1 Exploration Drilling and Site Survey Program Consultation Update, distributed to identified stakeholders on 5 August 2021

Based on Santos' experience with previous vessel-based survey EPs and from subsequent stakeholder feedback and regulator discussions, the primary stakeholder issue of concern for this activity is:

+ interaction with other marine users and commercial fishers (addressed in **Section 6.5**).

Santos has considered all stakeholder responses and assessed the merits of all objections and claims about the potential impact of the proposed activity. The process adopted to assess these claims is outlined in **Section 4.4**. A summary of Santos' response statements to the objections and claims is provided in **Table 4-2**; any specific commitments made as a result of stakeholder consultation are listed in **Table 8-4**.

Santos considers that consultation with relevant stakeholders has been adequate to inform the development of this EP. Notwithstanding this, Santos recognises the importance of ongoing stakeholder consultation, which is described in **Section 4.5**.

4.2 Stakeholder identification

Santos understands retaining a broad licence to operate depends on the development and maintenance of positive and constructive relationships with a comprehensive group of stakeholders in the community, government, non-government, other business sectors and other users of the marine environment. Fostering effective consultation between Santos and relevant stakeholders is an important part of this process.

Santos began the stakeholder identification process for this EP with a review of its stakeholder database, including stakeholders consulted for other recent activities in the area. The list of stakeholders was then reviewed and refined based on the defined operational area (refer to **Section**) and the relevance of the stakeholder according to Regulation 11A of OPGGS(E)R and NOPSEMA Bulletin #2, clarifying statutory requirements and good practice consultation (November 2019). More specifically, stakeholders for this EP were identified through:

+ regular review of legislation applicable to petroleum and marine activities;
+ identification of marine user groups and interest groups active in the area, such as commercial fisheries, other oil and gas producers and merchant shipping;
+ a review of the most recent DPIRD FishCube data as required;
+ updated fishing licence holder contact details as provided by DPIRD;
+ use of the Western Australian Fishing Industry Council (WAFIC) Oil and Gas consultation services to advise on 'relevant' commercial fisheries and fishers;
+ discussions with identified stakeholders to identify other potentially impacted persons;
+ active participation in industry bodies and collaborations (such as Australian Petroleum Production & Exploration Association [APPEA], Australian Marine Oil Spill Centre [AMOSC], National Energy Resources Australia); and
+ records from previous consultation activities in the area.

Currently identified stakeholders and an assessment of their relevance under the OPGGS(E)R for the purposes of consultation for this activity are listed in **Table 4-1**.

Table 4-1: Assessment of relevance of identified stakeholders for the proposed activity

Stakeholder	Relevant to Activity	Relevance/Reason for Engagement
Commonwealth Government Departments/Agencies		
Australian Hydrographic Office (AHO)	Considered relevant persons under Regulation 11A(1) (a)	AHO is the part of the Commonwealth Department of Defence responsible for maintaining and disseminating nautical charts, including the distribution of Notices to Mariners. The operational area is in Commonwealth waters.
Australian Maritime Safety Authority	Considered relevant persons under Regulation 11A(1) (a)	AMSA is the statutory and control agency for maritime safety and vessel emergencies in Commonwealth waters. AMSA is a relevant agency when proposed offshore activities may impact on the safe navigation of commercial shipping in Australian waters. The operational area is in Commonwealth waters.
Department of Defence (Defence)	Considered relevant persons under Regulation 11A(1) (a)	Defence is a relevant agency where the proposed activity may impact on operational requirements; encroach on known training areas and restricted airspace, or when nautical products or other maritime safety information is required to be updated. The operational area is in Commonwealth waters.
Australian Fisheries Management Authority	Considered relevant persons under Regulation 11A(1) (a)	AFMA is responsible for managing Commonwealth fisheries and is a relevant agency where the activity has the potential to impact on resources in AFMA-managed fisheries. The operational area intersects with Commonwealth managed fisheries.
Department of Agriculture, Water and the Environment – Biosecurity (marine pests)	Considered relevant persons under Regulation 11A(1) (a)	DAWE (marine pests) has primary policy and regulatory responsibility for managing biosecurity for incoming goods and conveyances, including biosecurity for marine pests. The department is the relevant agency where an offshore activity has the potential to transfer marine pests between installations and mainland Australia. The operational area is in Commonwealth waters.
Department of Agriculture, Water and the Environment – Fisheries	Considered relevant persons under Regulation 11A(1) (a)	DAWE (fisheries) has primary policy responsibility for promoting the biological, economic and social sustainability of Australian fisheries. The department is the relevant agency where the activity has the potential to negatively impact fishing operations and/or fishing habitats in Commonwealth waters. The operational area intersects Commonwealth-managed fisheries.

Stakeholder	Relevant to Activity	Relevance/Reason for Engagement
Department of Agriculture, Water and the Environment –Biosecurity (vessels, aircraft and personnel)	Considered relevant persons under Regulation 11A(1) (a)	DAWE (vessels and aircraft) has inspection and reporting requirements to ensure all conveyances (vessels, installations and aircraft) arriving in Australian territory comply with international health regulations and that any biosecurity risk is managed. The department is the relevant agency where the titleholder's activity involves: + the movement of aircraft or vessels between Australia and offshore petroleum activities, either inside or outside Australian territory + the exposure of an aircraft or vessel (which leaves Australian territory not subject to biosecurity control) to offshore petroleum activities.
Director of National Parks (DNP)	Considered relevant persons under Regulation 11A(1) (a)	DNP is the statutory authority responsible for administering, managing and controlling Commonwealth marine reserves. DNP is a relevant person for consultation where: + the activity or part of the activity is within the boundaries of a proclaimed Commonwealth marine reserve + activities proposed to occur outside a reserve may impact on the values within a Commonwealth marine reserve, or + an environmental incident occurs in Commonwealth waters surrounding a Commonwealth marine reserve and may impact on the values within the reserve.
Department of Foreign Affairs and Trade	Considered relevant persons under Regulation 11A(1) (a)	Department of Foreign Affairs and Trade may be consulted when: + a proposed activity may cross into or impact on waters outside of Australia's maritime jurisdiction + a proposed activity poses any oil spill or other environmental risk that could result in impacts to other international jurisdictions + relevant persons that may be impacted by a proposed activity include foreign individuals or governments.
State Government Departments/Agencies		
Department of Transport (DoT)	Considered relevant persons under Regulation 11A(1) (b)	DoT is the control agency for marine pollution emergencies in State waters.
Department of Primary Industries and Regional Development	Considered relevant persons under Regulation 11A(1) (b)	DPIRD is responsible for managed WA State fisheries. The operational area intersects with State-managed fisheries.

Stakeholder	Relevant to Activity	Relevance/Reason for Engagement
Department of Biodiversity, Conservation and Attractions (DBCA)	Considered relevant persons under Regulation 11A(1) (b)	DBCA is a relevant State agency responsible for managing State marine parks and reserves and protected marine fauna and flora.
Department of Mines, Industry Regulation and Safety (DMIRS)	Considered relevant persons under Regulation 11A(1) (c)	DMIRS is responsible for managing offshore petroleum in adjacent State waters.
Industry Bodies		
Western Australian Fishing Industry Council	Considered relevant persons under Regulation 11A(1) (e)	WAFIC is the peak industry body representing the interests of the WA commercial fishing, pearling and aquaculture sector. The operational area intersects with several State-managed fisheries.
Commonwealth Fisheries Association (CFA)	Considered relevant persons under Regulation 11A(1) (e)	CFA was engaged as a representative body for Commonwealth fisheries. The operational area intersects with several Commonwealth-managed fisheries. CFA is also listed on AFMA's website as a contact for petroleum operators to use when consultation with fishing operators is required.
Pearl Producers Association (PPA)	Considered relevant persons under Regulation 11A(1) (e)	The PPA is the peak representative organisation of The Australian South Sea Pearling Industry. PPA membership includes all *Pinctada maxima* pearl oyster licensees that operate within the Australian North-west Bioregion.
Australian Southern Bluefin Tuna Industry Association (ASBTIA)	Considered relevant persons under Regulation 11A(1) (e)	ASBTIA represents the Australian southern bluefin tuna industry. ASBTIA is also listed on AFMA's website as a contact for petroleum operators to use when consultation with Commonwealth fishing operators is required.
Tuna Australia	Considered relevant persons under Regulation 11A(1) (e)	Tuna Australia represents statutory fishing right owners, holders, fish processors and sellers, and associate members of the Eastern and Western Tuna and Billfish fisheries.
Community/ Other		
Australian Marine Oil Spill Centre	Considered relevant persons under Regulation 11A(1) (e)	AMOSC operates the Australian oil industry's major oil spill response facility.
Pilbara Ports Authority	Considered relevant persons under Regulation 11A(1) (e)	Pilbara Ports Authority manages port land at Dampier, Port Hedland, Ashburton and Cape Preston East, and facilitates the development of land and leases to support port-related industries.
Darwin Port	Considered relevant persons under Regulation 11A(1) (e)	The Port of Darwin is a key support hub for the offshore oil and gas fields in the Arafura Sea, Timor Sea and waters off the coast of WA.

Stakeholder	Relevant to Activity	Relevance/Reason for Engagement
Port of Broome (Kimberley Ports Authority)	Considered relevant persons under Regulation 11A(1) (e)	The Port of Broome is the largest deep-water access port servicing the Kimberley region and is open to shipping on a 24-hour basis, seven days a week. The port supports livestock export, offshore oil and gas operations, pearling, fishing, charter boats, cruise liners and is the main fuel and container receival point for the region.
Conservation Council of WA (CCWA)	Considered relevant persons under Regulation 11A(1) (e)	CCWA is a non-profit, non-government conservation organisation. CCWA represents more than 100 community environmental organisations from across WA.
Kimberley Land Council (KLC)	Considered relevant persons under Regulation 11A(1) (e)	KLC is the Native Title Representative Body for the Kimberley region.
Jadestone Energy (Australia) Pty Ltd	Considered relevant persons under Regulation 11A(1) (e)	Jadestone is listed as the titleholder of an adjacent petroleum permit.
Commercial Fisheries – State Managed		
Mackerel Managed Fishery (Area 1)	Considered relevant persons under Regulation 11A(1) (d)	Based on a review of DPIRD information and consultation with WAFIC, the Mackerel Managed Fishery (Area 1) boundary overlaps the proposed operational area and the licence holders permitted to fish in this fishery should be consulted.
Northern Demersal Scalefish Fishery	Considered relevant persons under Regulation 11A(1) (d)	Based on a review of DPIRD information and consultation with WAFIC, the Northern Demersal Scalefish Fishery boundary overlaps the proposed operational area and the licence holders permitted to fish in this fishery should be consulted.
Northern Shark Fishery	Considered relevant persons under Regulation 11A(1) (d)	Based on consultation with WAFIC, the Northern Shark Fishery should be consulted via Atlantis Fisheries Consulting Group.
Pearl Oyster Managed Fishery	Considered relevant persons under Regulation 11A(1) (e)	PPA has requested it be consulted on all Santos EPs.
Commercial Fisheries – Commonwealth Managed		
Southern Bluefin Tuna Fishery	Considered relevant persons under Regulation 11A(1) (e)	This fishery overlaps the proposed operational area and the licence holders in this fishery should be consulted via their industry body ASBTIA.
Western Tuna and Billfish Fishery	Considered relevant persons under Regulation 11A(1) (e)	This fishery overlaps the proposed operational area and the licence holders in this fishery should be consulted via their industry bodies ASBTIA and Tuna Australia.

4.3 Stakeholder consultation

The approach to stakeholder consultation for this EP follows the process adopted by Santos for all its EPs. Some modifications to this approach have been made based on feedback from WAFIC, commercial fishers and NOPSEMA. These include:

- providing more detailed information to commercial fishers, targeted to their fishery, in the initial consultation packs;
- engaging WAFIC to assist in reviewing and distributing commercial fisher consultation material;
- refining the stakeholder identification process to clearly identify and maintain current lists of 'relevant' persons; and
- clearly documenting and tracking notification commitments to relevant persons.

Key stakeholders were contacted before providing the Stairway-1 Exploration Drilling and Site Survey Program Consultation package, to increase activity awareness and to encourage two-way communication. Stakeholders, wherever possible, were provided personal emails with information tailored to their functions, interests and activities, including outlining why they had been identified as a relevant stakeholder.

The consultation package contained details such as an activity summary, location map, co-ordinates, water depth, distance to key regional features, exclusion zone details and estimated timing and duration. This consultation package outlined potential risks and impacts and summarised proposed management control measures.

Individual fishing licence holders, as identified through DPIRD data and in consultation with WAFIC, were provided the Stairway-1 Exploration Drilling and Site Survey Program *Commercial Fishers Stakeholder Consultation package* by email and the subsequent update by post and email.

Commercial fishers were provided additional information, which included:

- maps and information relevant to a specific fishery;
- information about the timing and duration of the activity; and
- information about operational area access and concurrent operations.

The intent of providing this level of information early in the consultation process was to facilitate each party proceeding with their business in a safe and efficient manner, and without loss or conflict, by minimising the extent of interruption by the activities on commercial fishing operators' activities to the lowest practicable level.

Stakeholders were afforded at least six weeks to review consultation packs, although Santos accepted stakeholder feedback after this period.

4.4 Assessment of stakeholder objections and claims

A summary of the stakeholder consultation undertaken for this EP, including Santos' assessment of all stakeholder comments received, is outlined in **Table 4-2**.

A summary of consultation material provided to stakeholders is contained in **APPENDIX D**. Full transcripts between Santos and stakeholders are provided in the *Stairway Vessel-Based Activity Environment Plan Sensitive Stakeholder Information Report* (SO-91-RI-20127) as a confidential submission to NOPSEMA.

Santos adopted the following process to address objections and claims received during the consultation process:

+ Santos acknowledged receipt of all comments made by stakeholders;
+ Santos assessed the merits of all objections and claims made by stakeholders. This included assessing all reasonably available options for resolving or mitigating the degree to which a stakeholder's functions, interests or activities may be affected. Control measures were proposed and adopted where reasonably practicable;
+ Santos responded to all stakeholder objections and claims, and advised the stakeholder how each of their objections and claims would be addressed in the EP; and
+ Santos invited the stakeholder to provide additional feedback and comment.

A similar process was applied to information provided and requests made by stakeholders not deemed to be an objection or claim.

Santos recognises the importance of ensuring a high degree of transparency in how a titleholder manages ongoing stakeholder consultation during the life of an EP. As such, should stakeholder comments be received additional to those described in **Table 4-2**, Santos will assess the comments using the above process and update the EP to document the assessment of additional objections or claims.

In relation to stakeholder consultation, Santos is of the opinion that Regulation 10A of the OPGGS(E)R has been met.

Table 4-2: Consultation summary for the activity

<table>
<tr><th>Stakeholder</th><th colspan="2">Stakeholder Consultation Summary (OPGGS(E)R 16 (b)(i))</th></tr>
<tr><td colspan="3">Commonwealth departments/agencies</td></tr>
<tr><td rowspan="3">Australian Hydrographic Office</td><td colspan="2">AHO was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package via email on 2 June 2021.
AHO acknowledged receipt of the consultation material on 3 June 2021.
AHO was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update via email 5 August 2021.
AHO acknowledged receipt of the consultation material on 6 August 2021.
AHO notification requirements, as requested by AMSA and Defence (refer to below), are addressed in Table 8-4.
This stakeholder also receives Santos' Quarterly Consultation Update for WA. The July 2021 update provided information on the Stairway 1 Site Survey Program.
Santos considers the level of consultation to be adequate and will address any comments from this stakeholder should they arise in the future.</td></tr>
<tr><td>Assessment of the merits of objections and claims (OPGGS(E)R 16 (b)(ii)), information and requests</td><td>Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests</td></tr>
<tr><td>No assessment required.</td><td>No response required.</td></tr>
<tr><td>Australian Maritime Safety Authority</td><td colspan="2">AMSA was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package via email on 2 June 2021.
AMSA responded on 3 June 2021 requesting timely and relevant Maritime Safety Information is promulgated for the area and nature of operations as follows:
+ Contact the AHO at datacentre@hydro.gov.au no less than four weeks before operations, with details relevant to the operations. The AHO will promulgate the appropriate Notice to Mariners, which will ensure other vessels receive information about activities. [REQUEST 001]
+ Notify AMSA's Joint Rescue Coordination Centre (JRCC) by email to rccaus@amsa.gov.au for promulgation of radio-navigation warnings at least 24 to 48 hours before operations commence. The JRCC will require vessel details (including name, callsign and Maritime Mobile Service Identity), 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. [REQUEST 002]
+ Provide updates to both AHO and the JRCC on progress and, importantly, any changes to the intended operations. [REQUEST 003]
+ Exhibit appropriate lights and shapes to reflect the nature of operations –we remind vessels of their obligation to comply with the International Rules for Preventing Collisions at Sea (COLREGS), particularly the use of appropriate lights and shapes to reflect the nature of your operations</td></tr>
</table>

Stakeholder	Stakeholder Consultation Summary (OPGGS(E)R 16 (b)(i))	
	(for example, restricted in the ability to manoeuvre). Vessels should also ensure their navigation status is set correctly in the ship's Automatic Identification System (AIS) unit. **[REQUEST 004]** + To obtain a vessel traffic plot showing AIS traffic data for your area of interest, please visit AMSA's spatial data gateway and Spatial@AMSA portal to download digital datasets and maps. **[INFORMATION 001]** Santos responded to AMSA on 9 June 2021 and addressed the matters raised in its correspondence of 3 June 2021 (refer assessment of stakeholder objections, claims, information and requests below). AMSA was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update via email 5 August 2021. No further comments received to date. This stakeholder also receives Santos' Quarterly Consultation Update for WA. The July 2021 update provided information on the Stairway 1 Site Survey Program. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder, should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests
	[REQUEST 001] Santos will notify AHO no less than four weeks before operations commence, where practicable. Notification requirements are addressed in **Table 8-4**.	Santos responded to AMSA confirming the notifications requirements would be addressed in the EP.
	[REQUEST 002] Santos will notify AMSA's JRCC at least 24 to 48 hours before operations commence for each activity and advise when operations start and end. Notification requirements are addressed in **Table 8-4**.	Santos responded to AMSA confirming the notifications requirements would be addressed in the EP.
	[REQUEST 003] Santos will notify both AHO and AMSA's JRCC on any changes to the intended operations. Notification requirements are addressed in **Table 8-4**.	Santos responded to AMSA confirming the notifications requirements would be addressed in the EP.
	[REQUEST 004] Santos noted the advice on obligations to comply with COLREGS, particularly the use of appropriate lights and shapes to reflect the nature of operations, and this is addressed in **Section 6.2**.	Santos responded to AMSA and noted the information provided.
	[INFORMATION 001] Santos noted the information provided on traffic data.	Santos responded to AMSA and noted the information provided.

Stakeholder	Stakeholder Consultation Summary (OPGGS(E)R 16 (b)(i))	
Department of Defence (Defence)	Defence was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package via email on 2 June 2021. Santos sent a subsequent email on 21 June 2021, inviting comment. Defence was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update via email 5 August 2021. No response received to date. Defence has previously requested continued liaison with AHO, particularly to ensure AHO is notified three weeks before the actual commencement of activities. Notification requirements in **Table 8-4** This stakeholder also receives Santos' Quarterly Consultation Update for WA. The July 2021 update provided information on the Stairway 1 Site Survey Program. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder, should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests
	.No assessment required.	No response required.
Australian Fisheries Management Authority	AFMA was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package via email on 2 June 2021. AFMA responded on 16 June 2021, advising it was important to consult with all fishers who have entitlements to fish within the proposed area. This can be done through the relevant fishing industry associations or directly with fishers who hold entitlements in the area. AFMA provided guidance on where to find this information. **[REQUEST 001]** Santos responded to AFMA on 16 June 2021 and addressed the matters raised in its correspondence of 16 June 2021 (refer assessment of stakeholder objections, claims, information and requests below). AFMA was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update via email 5 August 2021. No further comments received to date. This stakeholder also receives Santos' Quarterly Consultation Update for WA. The July 2021 update provided information on the Stairway 1 Site Survey Program. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder, should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests

Stakeholder	Stakeholder Consultation Summary (OPGGS(E)R 16 (b)(i))	
	[REQUEST 001] Santos consulted directly with relevant fishers and fishing industry associations, as outlined in **Table 4-1**.	Santos responded to AFMA advising relevant fishers and fishing industry associations had been consulted when preparing the EP.

Department of Agriculture, Water and the Environment – Biosecurity (vessels, aircraft and personnel)	The department was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package via email on 2 June 2021. Santos sent a subsequent email on 21 June 2021, inviting comment. The department responded on 28 June 2021 and provided the following advice on the Australian Government's biosecurity requirements: + Your intended operating practices may expose domestic conveyances (support vessels and aircraft) to interactions with your project vessel, which may pose an unacceptable level of biosecurity risk. Where domestic conveyances become exposed through interactions with persons, goods or conveyances outside Australian territory, they automatically become subject to biosecurity control upon their return. + You must report to the department for each project, using the required template. + The department will then assess whether the project, and the level of biosecurity risk associated with the survey vessel or platform, is low. Within the meaning of the Biosecurity (Exposed Conveyances – Exceptions from Biosecurity Control) Determination 2016 (the Determination), an exposed conveyance may be eligible for an exception from biosecurity control. For exposed conveyances to be assessed as low risk, the offshore installation must demonstrate that it meets the requirements set out in the Determination. + To have risk status assessed, offshore installation projects must apply to the department at least one month before project commencement. The department will work with installation representatives to assess the biosecurity risk of the installation and associated support conveyances (vessels and aircraft). + Please review the department's Offshore Installations webpage and associated Offshore Installations Biosecurity Guide, which provides specific biosecurity information for operators of offshore installations, and notify the department where your project which may have conveyance interactions with Australian territory, or to discuss a biosecurity assessment. + Also review Australian ballast water and biofouling requirements and pre-arrival reporting using MARS. The project's support vessels will need to be registered and managed using MARS, where they are travelling between the drill site and Australian ports for resupply/refuelling/waste management. Support aircraft will need to be arranged in compliance with aircraft biosecurity reporting requirements. + This reporting is in addition to reporting that your company provides to other agencies such as NOPSEMA. While the department will review your NOPSEMA application, you are required to report to the department as part of Australia's management of the biosecurity risk. The *Biosecurity Act 2015* saw existing offshore operations continue as usual; however, new reporting requirements are now in place. Santos responded to the Department on 30 June 2021 and addressed the matters raised in their correspondence of 28 June 2021 (refer assessment of stakeholder objections, claims, information and requests below). The department was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update via email 5 August 2021. No further comments received to date. This stakeholder also receives Santos' Quarterly Consultation Update for WA. The July 2021 update provided information on the Stairway 1 Site Survey Program. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder, should they arise in the future.

Stakeholder	Stakeholder Consultation Summary (OPGGS(E)R 16 (b)(i))	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests
	The Environment Plan commits to applying to the department, using the form provided, at least one month before the commencement of the activity, where practicable, for the vessel/s biosecurity risk to be assessed as low (as applicable to vessel and location). This requirement is in **Table 8-4**. Control measure SVA-CM018 in **Table 7-3** specifically addresses the *Biosecurity Act 2015* requirements and management of invasive marine pest species is addressed in **Section 7.2**.	Santos responded to the department on 30 June 2021 and acknowledged the advice.
Department of Agriculture, Water and the Environment – Biosecurity (marine pests)	The department was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package via email on 2 June 2021. Santos sent a subsequent email on 21 June 2021, inviting comment. The department was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update via email 5 August 2021. No response received to date. Management of invasive marine pest species is addressed in **Section 7.2**. This stakeholder also receives Santos' Quarterly Consultation Update for WA. The July 2021 update provided information on the Stairway 1 Site Survey Program. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests
	No assessment required.	No response required.

<table>
<tr><th>Stakeholder</th><th colspan="2">Stakeholder Consultation Summary (OPGGS(E)R 16 (b)(i))</th></tr>
<tr><td rowspan="3">Department of Agriculture, Water and the Environment – Fisheries</td><td colspan="2">The Department was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package via email on 2 June 2021.
Santos sent a subsequent email on 21 June 2021, inviting comment.
The department was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update via email 5 August 2021.
No response received to date.
The department has previously requested:
+ to be informed of future developments relating to specific Santos projects
+ that Santos communicates future developments with the Australian Fisheries Management Authority at petroleum@afma.gov.au and the relevant fishing industry representation organisations in that region.
Santos continues to keep the Department informed through the Quarterly Consultation Update and continues to consult with AFMA and relevant Commonwealth fishing industry bodies as required.
This stakeholder also receives Santos' Quarterly Consultation Update for WA. The July 2021 update provided information on the Stairway 1 Site Survey Program.
Santos considers the level of consultation to be adequate and will address any comments from this stakeholder, should they arise in the future.</td></tr>
<tr><td>Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests</td><td>Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests</td></tr>
<tr><td>No assessment required.</td><td>No response required.</td></tr>
</table>

Stakeholder	Stakeholder Consultation Summary (OPGGS(E)R 16 (b)(i))
Director of National Parks	DNP was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package via email on 2 June 2021. Santos sent a subsequent email on 21 June 2021, inviting comment. Marine Parks responded on 28 July 2021, providing the following comments: + Based on the information provided, we note that the planned activities do not overlap any Australian Marine Parks. The nearest marine parks are Cartier Island Marine Park at 145 km and Ashmore Reef Marine Park at 199 **[INFORMATION 001]**. + To assist in the preparation of an EP for petroleum activities that may affect Australian marine parks, NOPSEMA has worked closely with Parks Australia to develop and publish a guidance note that outlines what titleholders need to consider and evaluate. In preparing the EP, you should consider the Australian marine parks and their representativeness. In the context of the management plan objectives and values, you should ensure that the EP **[REQUEST 001]:** - identifies and manages all impacts and risks on Australian marine park values (including ecosystem values) to an acceptable level and has considered all options to avoid or reduce them to as low as reasonably practicable. - clearly demonstrates that the activity will not be inconsistent with the management plan. + I can confirm that we do not require further notification of progress made in relation to this activity unless details regarding the activity change and result in an overlap with or new impact to a marine park, or for emergency responses (see details below) [**REQUEST 002].** + Emergency responses: the DNP should be made aware of oil/gas pollution incidences which occur within a marine park or are likely to impact on a marine park as soon as possible. Notification should be provided to the 24 hour Marine Compliance Duty Officer on 0419 293 465. The notification should include **[REQUEST 003]**: - titleholder details - time and location of the incident (including name of marine park likely to be effected) - proposed response arrangements as per the Oil Pollution Emergency Plan (e.g. dispersant, containment, etc.) - confirmation of providing access to relevant monitoring and evaluation reports when available; and - contact details for the response coordinator. Note that the DNP may request daily or weekly Situation Reports, depending on the scale and severity of the pollution incident. Santos responded to Marine Parks on 5 August 2021 and addressed the matters raised in their correspondence of 28 July 2021 (refer assessment of stakeholder objections, claims, information and requests below). Santos' response of 5 August 2021 included the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update. No further comments received to date. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder should they arise in the future.

Stakeholder	Stakeholder Consultation Summary (OPGGS(E)R 16 (b)(i))	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests
	[INFORMATION 001] Santos notes the planned activities do not overlap any Australian Marine Parks.	Santos responded to Marine Parks and acknowledged their comments..
	[REQUEST 001] Santos is following the NOPSEMA guidance note Petroleum activities and Australian Marine Parks (N-04750-GN1785 A620236) in preparation of the EP and OPEP, where relevant.	Santos responded to Marine Parks and confirmed the guidance note was being followed in preparation of the EP and OPEP where relevant.
	[REQUEST 002] Notification requirements are addressed in Table 8-4.	Santos responded to Marine Parks and acknowledged their notification requirements.
	[REQUEST 003] The Oil Pollution Emergency Plan (OPEP) for the activity will include DNPs notification requirements. These can be found in Section 7 of the OPEP.	Santos responded to Marine Parks and confirmed the required notification requirements would be included in Section 7 of the OPEP.
Department of Foreign Affairs and Trade	The DFAT was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package via email on 10 June 2021. Santos sent a subsequent email on 21 June 2021, inviting comment. The department was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update via email 5 August 2021. The department responded on 6 August 2021 acknowledging receipt of the consultation material and confirming nil comment on the proposed activities **[INFORMATION 001]** Santos responded to the department on 6 August 2021 and addressed the matters raised in their correspondence of 5 August 2021 (refer assessment of stakeholder objections, claims, information and requests below). Santos considers the level of consultation to be adequate and will address any comments from this stakeholder should they arise in the future	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests
	[**INFORMATION 001]** Nil comment acknowledged..	Santos responded to the department and acknowledged response

Stakeholder	Stakeholder Consultation Summary (OPGGS(E)R 16 (b)(i))	
State Government Departments		
Department of Transport	DoT was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package via email on 2 June 2021. Santos sent a subsequent email on 21 June 2021 inviting comment. DoT responded on 21 June 2021 and requested: + if there is a risk of a spill impacting State waters from the activity, please ensure DoT is consulted as outlined in the Department of Transport Offshore Petroleum Industry Guidance Note – Marine Oil Pollution: Response and Consultation Arrangements (July 2020). **[REQUEST 001]** Santos responded to DoT on 22 June 2021 and addressed the matters raised in its correspondence of 21 June 2021 (refer assessment of stakeholder objections, claims, information and requests below). DoT was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update via email 5 August 2021. DoT acknowledged receipt of Santos email on 5 August 2021. Dot responded on 19 August 2021 and requested: + if there is a risk of a spill impacting State waters from the activity, please ensure DoT is consulted as outlined in the Department of Transport Offshore Petroleum Industry Guidance Note – Marine Oil Pollution: Response and Consultation Arrangements (July 2020). **[REQUEST 001]** Santos responded to DoT on 24 August 2021 and addressed the matters raised in its correspondence of 21 June 2021 (refer assessment of stakeholder objections, claims, information and requests below). This stakeholder also receives Santos' Quarterly Consultation Update for WA. The July 2021 update provided information on the Stairway 1 Site Survey Program. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder, should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests
	[REQUEST 001] As required in the Department of Transport Offshore Petroleum Industry Guidance Note – Marine Oil Pollution: Response and Consultation Arrangements (July 2020), Santos will provide the department a copy of the OPEPs for each Environment Plan for review, upon submission to NOPSEMA.	Santos responded to DoT on 22 June 2021 and 24 August 2021 and confirmed requested consultation requirements would be met.

<table>
<tr><th>Stakeholder</th><th colspan="2">Stakeholder Consultation Summary (OPGGS(E)R 16 (b)(i))</th></tr>
<tr><td>Department of Primary Industries & Regional Development</td><td colspan="2">DPIRD was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package via email on 2 June 2021.
Santos sent a subsequent email on 21 June 2021, inviting comment.
DPIRD was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update via email 5 August 2021.
No response received to date.
Santos has assessed the impact to fish and commercial fisheries in Section 6.5.
This stakeholder also receives Santos' Quarterly Consultation Update for WA. The July 2021 update provided information on the Stairway 1 Site Survey Program.
Santos considers the level of consultation to be adequate and will address any comments from this stakeholder, should they arise in the future.</td></tr>
<tr><td></td><td>Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests</td><td>Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests</td></tr>
<tr><td></td><td>No assessment required.</td><td>No response required.</td></tr>
<tr><td>Department of Biodiversity and Conservation Attractions</td><td colspan="2">DBCA was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package via email on 2 June 2021.
DBCA responded on 10 June 2021 and provided the following feedback:
+ Based on the information provided and other readily available information, DBCA does not have any comments in relation to its Conservation and Land Management Act 1984 and Biodiversity Conservation Act 2016 related responsibilities. [INFORMATION 001]
+ Please continue to send all notifications to EMBadmin@dbca.wa.gov.au. [REQUEST 001]
Santos responded to DBCA on 10 June 2021 and addressed each of the matters raised in their correspondence of 10 June (refer assessment of stakeholder objections, claims, information and requests below).
DBCA was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update via email 5 August 2021.
No further comments received to date.
This stakeholder also receives Santos' Quarterly Consultation Update for WA. The July 2021 update provided information on the Stairway 1 Site Survey Program.
Santos considers the level of consultation to be adequate and will address any comments from this stakeholder should they arise in the future.</td></tr>
<tr><td></td><td>Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests</td><td>Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests</td></tr>
</table>

Stakeholder	Stakeholder Consultation Summary (OPGGS(E)R 16 (b)(i))	
	[INFORMATION 001] Noted. No assessment required.	Santos responded to DBCA and acknowledged its feedback.
	[REQUEST 001] Santos will continue to provide all future notifications to EMBAdmin@dbca.wa.gov.au and this notification request in addressed in **Table 8-4** of the EP.	Santos responded to DBCA and acknowledged its feedback.
Department of Mines, Industry Regulation and Safety	DMIRS was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package via email on 2 June 2021. Santos sent a subsequent email on 21 June 2021, inviting comment. DMIRS responded on 22 June 2021 and provided the following comments: + Noted activities that are regulated by NOPSEMA under the provisions of the OPGGS(E)R. + Request Santos continues to send commencement and cessation notifications to DMIRS. **[REQUEST 001]** Santos responded to DMIRS on 22 June 2021 and addressed the matters raised in its correspondence of 22 June 2021 (refer assessment of stakeholder objections, claims, information and requests below). DMIRS was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update via email 5 August 2021. No further comments received to date. This stakeholder also receives Santos' Quarterly Consultation Update for WA. The July 2021 update provided information on the Stairway 1 Site Survey Program. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests
	Santos has addressed the department's notification requirements in **Table 8-4**.	Santos responded to DMIRS and confirmed its notification requirements would be met.
Fishing Bodies		
Western Australian Fishing Industry Council	WAFIC was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package via email on 2 June 2021. Santos sent a subsequent email on 21 June 2021, inviting comment. Santos and WAFIC spoke on 1 July 2021 and WAFIC advised it had no further comments to make on the VBA EP at this stage. WAFIC was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update via email 5 August 2021. All fisheries are described in **Section 3.2.4** and potential impact to fisheries, fish habitat and commercial fishers are discussed in **Section 6.5**.	

<table>
<tr><th>Stakeholder</th><th colspan="2">Stakeholder Consultation Summary (OPGGS(E)R 16 (b)(i))</th></tr>
<tr><td></td><td colspan="2">OPEP
WAFIC emailed Santos on 1 June 2021, seeking clarification on aspects of the OPEP. Santos responded on 14 June 2021. Following is a summary of the WAFIC comments and Santos' response:
+ Baseline scientific data on aquatic organisms and the aquatic environment.
The OPEP includes an overview of Santos' Scientific Monitoring Plans which includes a description of the approach to collecting baseline data.
+ Communication strategy in the event of a spill that includes the commercial fishing industry.
In the event of a major spill, notifications to state and commonwealth government fisheries agencies, including AFMA and WA DPIRD (Fisheries), will be made, if applicable. Although WAFIC is not in the list of agencies notified by the Incident Management Team (IMT), WAFIC is listed as a key stakeholder in Santos' communications register and would be contacted in the event of an oil spill.
+ A detailed process for post-spill scientific monitoring of aquatic organism and aquatic environment.
The OPEP includes an overview of the process for scientific monitoring after spills.
+ Support to the commercial fishing industry with regards to traceability of fish product to manage tainting risks.
There is a dedicated Scientific Monitoring Plan for Seafood Quality which aims to identify potential human health risks due to the presence of hydrocarbon concentrations in the flesh of targeted seafood species for consumption.
+ Commitment/consideration for financial assistance to the commercial fishing industry in the event of a spill.
These matters are not addressed in an OPEP. Santos referred to a similar query from WAFIC (via Tuna Australia) in January 2021 and provided WAFIC a copy of that response.
This stakeholder also receives Santos' Quarterly Consultation Update for WA. The July 2021 update provided information on the Stairway 1 Site Survey Program.
As a key commercial fishing sector stakeholder, consultation with WAFIC will be ongoing for this and other Santos activities.
WAFIC Fee for Service
Santos requested WAFIC Fee for Service to assist with identifying and consulting with commercial fishers for the Stairway-1 Exploration Drilling and Site Survey Program. Draft consultation material was provided for WAFIC review, including an assessment of relevant fisheries.
WAFIC provided feedback on the consultation material and relevant fishers.
WAFIC sent the agreed consultation material to relevant fishers on behalf of Santos on 3 June 2021.</td></tr>
<tr><td></td><td>Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests</td><td>Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests</td></tr>
<tr><td></td><td>No assessment required.</td><td>No response required.</td></tr>
</table>

Stakeholder	Stakeholder Consultation Summary (OPGGS(E)R 16 (b)(i))	
Commonwealth Fisheries Association	CFA was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package via email on 2 June 2021. Santos sent a subsequent email on 21 June 2021, inviting comment. CFA was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update via email 5 August 2021. No response received to date. All fisheries are described in **Section 3.2.4** and potential impact to fisheries, fish habitat and commercial fishers are discussed in **Section 6.5**. This stakeholder also receives Santos' Quarterly Consultation Update for WA. The July 2021 update provided information on the Stairway 1 Site Survey Program. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder, should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests
	No assessment required.	No response required.
Pearl Producers Association	PPA was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package via email on 2 June 2021. Santos sent a subsequent email on 21 June 2021, inviting comment. PPA was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update via email 5 August 2021. No response received to date. All fisheries (including pearl oysters) are described in **Section 3.2.4** and potential impact to fisheries, fish habitat and commercial fishers are discussed in **Section 6.5**. This stakeholder also receives Santos' Quarterly Consultation Update for WA. The July 2021 update provided information on the Stairway 1 Site Survey Program. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder, should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests
	No assessment required.	No response required.

Stakeholder	Stakeholder Consultation Summary (OPGGS(E)R 16 (b)(i))	
Australian Southern Bluefin Tuna Industry Association	ASBITA was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package via email on 2 June 2021. Santos sent a subsequent email on 21 June 2021, inviting comment. ASBTIA was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update via email 5 August 2021. No response received to date. All listed fisheries are described in **Section 3.2.4** and potential impact to fisheries, fish habitat and commercial fishers are discussed in **Section 6.5.** This stakeholder also receives Santos' Quarterly Consultation Update for WA. The July 2021 update provided information on the Stairway 1 Site Survey Program. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder, should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests
	No assessment required.	No response required.
Tuna Australia	Tuna Australia was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package via email on 2 June 2021. Santos sent a subsequent email on 21 June 2021, inviting comment. Tuna Australia was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update via email 5 August 2021. No response received to date. All listed fisheries are described in **Section 3.2.4** and potential impact to fisheries, fish habitat and commercial fishers are discussed in **Section 6.5.** This stakeholder also receives Santos' Quarterly Consultation Update for WA. The July 2021 update provided information on the Stairway 1 Site Survey Program. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder, should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests
	No assessment required.	No response required.
Community/Port Hedland		

Stakeholder	Stakeholder Consultation Summary (OPGGS(E)R 16 (b)(i))	
Australian Marine Oil Spill Centre	AMOSC was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package via email on 2 June 2021. Santos sent a subsequent email on 21 June 2021, inviting comment. AMOSC was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update via email 5 August 2021. No response received to date. This stakeholder also receives Santos' Quarterly Consultation Update for WA. The July 2021 update provided information on the Stairway 1 Site Survey Program. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder, should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests
	No assessment required.	No response required.
Pilbara Ports Authority	Pilbara Ports Authority was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package via email on 2 June 2021. Santos sent a subsequent email on 21 June 2021, inviting comment. Pilbara Ports was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update via email 5 August 2021. No response received to date. This stakeholder also receives Santos' Quarterly Consultation Update for WA. The July 2021 update provided information on the Stairway 1 Site Survey Program. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder, should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests
	No assessment required.	No response required.
Darwin Port	Darwin Ports was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package via email on 2 June 2021. Santos sent a subsequent email on 21 June 2021, inviting comment. Darwin Ports was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update via email 5 August 2021. No response received to date. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder, should they arise in the future.	

Stakeholder	Stakeholder Consultation Summary (OPGGS(E)R 16 (b)(i))	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests
	No assessment required.	No response required.
Port of Broome (Kimberley Ports Authority)	Port of Broome was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package via email on 2 June 2021. Santos sent a subsequent email on 21 June 2021, inviting comment. Port of Broome was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update via email 5 August 2021. No response received to date. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder, should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests
	No assessment required.	No response required.
Conservation Council of WA	Santos phoned CCWA on 10 June 2021 to discuss consultation requirements. CCWA was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package via email on 10 June 2021. Santos sent a subsequent email on 21 June 2021, inviting comment. CCWA contacted Santos on 9 July 2021 asking if Stairway would be a potential gas or oil development. Santos responded to CCWA on 19 July 2021 and advised that given Stairway-1 is an exploration well, Santos is not yet sure what the prospect could be. Accordingly, Santos has undertaken technical studies for both an oil and a gas discovery. In the Environment Plan, to be conservative in terms of worst-case environmental impacts, Santos has modelled the worst-case loss of well control scenario based on the properties of the Balnaves-3 Condensate assay. This assay represents the oil case for Stairway-1 because this known fluid is the most relevant hydrocarbon example available for the geological age of the Stairway-1 target. CCWA was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update via email 5 August 2021. No further response received to date. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder, should they arise in the future.	

Stakeholder	Stakeholder Consultation Summary (OPGGS(E)R 16 (b)(i))	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests
	No assessment required.	No response required.
Kimberley Land Council	The KLC was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package via email on 2 June 2021. Santos sent a subsequent email on 21 June 2021 inviting comment. KLC was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update via email 5 August 2021. No response received to date. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder should they arise in the future	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests
	No assessment required.	No response required.
Jadestone Energy (Australia) Pty Ltd	Jadestone was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package via email on 2 June 2021. Santos sent a subsequent email on 21 June 2021, inviting comment. Jadestone was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update via email 5 August 2021. No response received to date. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder, should they arise in the future	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests
	No assessment required.	No response required.

Stakeholder	Stakeholder Consultation Summary (OPGGS(E)R 16 (b)(i))	
State-managed fisheries		
Mackerel Managed Fishery (Area 1)	Relevant licence holders in this fishery were provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package for commercial fishers via WAFIC on 3 June 2021. Relevant licence holders in this fishery were provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update via post sent 5 August 2021. No comments received to date from individual fishers in this fishery. All fisheries are described in **Section 3.2.4** and potential impacts to fisheries, fish habitat and commercial fishers are discussed in **Section 6.5**. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder, should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests
	No assessment required.	No response required.
Northern Demersal Scalefish Fishery	Relevant licence holders in this fishery were provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package for commercial fishers via WAFIC on 3 June 2021. Relevant licence holders in this fishery were provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update via post sent 5 August 2021. No comments received to date from individual fishers in this fishery. All fisheries are described in **Section 3.2.4** and potentials impact to fisheries, fish habitat and commercial fishers are discussed in **Section 6.5**. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder, should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests
	No assessment required.	No response required.

Stakeholder	Stakeholder Consultation Summary (OPGGS(E)R 16 (b)(i))	
Northern Shark Fishery	Relevant licence holders in this fishery were provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package for commercial fishers via WAFIC on 3 June 2021. Relevant licence holders in this fishery were provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update via email on 5 August 2021. No comments received to date from individual fishers in this fishery. All fisheries are described in **Section 3.2.4** and potentials impact to fisheries, fish habitat and commercial fishers are discussed in **Section 6.5**. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder, should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests
	No assessment required.	No response required.
Pearl Oyster Managed Fishery	PPA was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package via WAFIC on 3 June 2021. PPA was provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update via email on 5 August 2021. No comments received to date from individual fishers in this fishery. All fisheries are described in **Section 3.2.4** and potentials impact to fisheries, fish habitat and commercial fishers are discussed in **Section 6.5**. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder, should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests
	No assessment required.	No response required.
Commonwealth Managed Fisheries		
Southern Bluefin Tuna Fishery	These licence holders were provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package via ASBTIA on 2 June 2021. ASBTIA and CFA were provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update via email on 5 August 2021. No comments received to date from individual fishers in this fishery. All fisheries are described in **Section 3.2.4** and potentials impact to fisheries, fish habitat and commercial fishers are discussed in **Section 6.5**. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder, should they arise in the future.	

Stakeholder	Stakeholder Consultation Summary (OPGGS(E)R 16 (b)(i))	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests
	No assessment required.	No response required.
Western Tuna and Billfish Fishery	These licence holders were provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation package via ASBTIA and Tuna Australia on 2 June 2021. ASBTIA, Tuna Australia and CFA were provided the Stairway-1 Exploration Drilling and Site Survey Program Consultation Update via email on 5 August 2021. No comments received to date from individual fishers in this fishery. All fisheries are described in **Section 3.2.4** and potentials impact to fisheries, fish habitat and commercial fishers are discussed in **Section 6.5**. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder, should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests
	No assessment required.	No response required.

4.5 Ongoing consultation

Stakeholder consultation for this activity will be ongoing and Santos will work with stakeholders before, during and after the activity. Should new stakeholders be identified (**Section 4.2**), they will be added to the stakeholder database and included in all future correspondence as required, including activity-specific notifications.

Santos, as a marine user, understands there will be the need to interact and communicate with other marine users to ensure mutual and individual stakeholder goals are met.

To this end, Santos commits to the following ongoing stakeholder consultation process:

+ Before commencing the activity, Santos will notify all relevant stakeholders listed, or as revised, in **Table 8-4**. The notification will include information on activity timing, vessel movements and vessel details;
+ Upon completing the activity, Santos will provide a cessation notification to the relevant stakeholders listed, or as revised, in **Table 8-4**. The final cessation notification will advise stakeholders that the activity has ended; and
+ Santos' Quarterly Consultation Update (see **Section 4.6**) will include reference to the Stairway Site Survey . This consultation will cease once the activity has ended.

Up-to-date knowledge of stakeholders will be managed as described in **Section 8.10**.

Santos will assess any additional stakeholder objections or claims in accordance with **Section 4.4**.

4.6 Quarterly consultation update

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

The Quarterly Consultation Update is circulated to a broad group of Santos stakeholders, including many of the stakeholders identified in **Table 4-1**.

If stakeholders request additional information or raise concerns on any activity listed in a Quarterly Consultation Update, a dialogue with these stakeholders can continue during or after preparing an EP and will be recorded for future reference. Santos commits to responding to and addressing any comments to the satisfaction of both parties and keeping any consultation on file during and after acceptance of an EP.

4.7 Addressing consultation feedback

Santos' Consultation Coordinator is available before, during and after the activity to ensure opportunities are available for stakeholders to provide feedback.

Santos will maintain records of all stakeholder consultation related this this EP and activity.

4.8 Stakeholder-related control measures, performance outcomes and standards

Control measures and performance outcomes and standards for stakeholder consultation are included in **Section 8.4**.

If, in stakeholder consultation, a change to any control measure or activity outlined in this EP is required, Santos will undertake an internal assessment using the management of change process (**Section 8.10.2**).

5. Impact and Risk Assessment Methodology

OPGGS(E)R 2009 Requirements
Regulation 13 Environmental assessment
Evaluation of environmental impacts and risks 13(5) The environment plan must include: (a) details of the environmental impacts and risks for the activity; and (b) an evaluation of all the impacts and risks, appropriate to the nature and scale of each impact or risk; and (c) details of the control measures that will be used to reduce the impacts and risks of the activity to as low as reasonably practicable and an acceptable level. 13(6) To avoid doubt, the evaluation mentioned in paragraph (5)(b) must evaluate all the environmental impacts and risks arising directly or indirectly from: (a) all operations of the activity; and (b) potential emergency conditions, whether resulting from accident or any other reason.

Environmental impact and risk assessment refers to a process whereby planned and unplanned events that will or may occur during an activity are quantitatively and qualitatively assessed for their impacts on the environment (physical, biological and socio-economic) at a defined location and specified period of time. In addition, unplanned events are assessed on the basis of their likelihood of occurrence, which contributes to their level of risk.

Santos has undertaken environmental impact and risk assessments for the planned events (including any routine, non-routine and contingency activities) and unplanned events in accordance with the OPGGS(E)R.

Provided in this section of the EP is information relating to the environmental impact and risk assessment approach, specifically:

+ terminology used; and
+ summary of the approach.

A full description of the process applied in identifying, analysing and evaluating the impacts and risks relating to the planned activity is documented in Santos' *Offshore Division Environmental Hazard Identification and Assessment Guideline* (EA-91-IG-00004_5).

5.1 Impact and risk assessment methodology

Common terms applied during the impact and risk assessment process, and used in this EP, are defined in **Table 5-1**. For a more comprehensive list of the terms and definitions used in environmental impact and risk assessment, refer to Santos' *Offshore Division Environmental Hazard Identification and Assessment Guideline* (EA-91-IG-00004_5).

Table 5-1: Impact and risk assessment terms and definitions

Term	Definition
Acceptability	Determined for both impacts and risks. Acceptability of events is in part determined by the consequence of the impact after management controls. Acceptability of unplanned events is in part determined from its risk ranking after management controls. For both impacts and risks, acceptability is also determined from a demonstration of the ALARP principle, consistency with Santos' Policies, consistency with all applicable legislation and consideration of relevant stakeholder consultation when determining management controls.
Activity	Specific tasks and actions undertaken throughout the lifecycle of oil and gas exploration, production and decommissioning.
ALARP	As Low As Reasonably Practicable. The term refers to reducing risk to a level that is as low as reasonably practicable. In practice, this means showing, through reasoned and supported arguments, that there are no other practicable options that could reasonably be adopted to further reduce risks.
Authorised Person	Person with authority to make the decision or take the action. Examples are Vessel Master, Field Superintendent, Supervisor, Person-in-charge, Company Authorised Representative and Project Manager.
Control Measure	Means a system, an item of equipment, a person or a procedure, that is used as a basis for managing environmental impacts and risks[1].
DMIRS	Department of Mines, Industry Regulation and Safety.
Environment	Includes the natural and socio-economic values and sensitivities which will or may be affected by the activity. Is defined by NOPSEMA and DMIRS as: (a) ecosystems and their constituent parts, including people and communities (b) natural and physical resources (c) the qualities and characteristics of locations, places and areas (d) the heritage value of places (e) the social, economic and cultural features of the matters mentioned in paragraphs (a), (b), (c) and (d).
Environmental consequence	A consequence is the outcome of an event affecting objectives. Note 1: An event can be one or more occurrences and can have several cases. Note 2: An event can consist of something not happening. (Reference: ISO 73:2009 Risk Vocabulary)
Environmental impact	Defined by NOPSEMA[1] as any change to the environment, whether adverse or beneficial, wholly or partly resulting from a planned or unplanned event[1]. Defined by DMIRS[2] as any change to the environment, whether adverse or beneficial, that wholly or partly results from a petroleum activity of an operator.
ENVID	Environmental hazard identification workshop.
Environmental risk	Applies to unplanned events. Risk is a function of the likelihood of the unplanned event occurring and the consequence of the environmental impact that arises from that event.

[1] Defined by the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009

Term	Definition
Hazard	A situation with the potential to cause harm.
Grossly disproportionate	Where the sacrifice (cost and effort) of implementing a control measure to reduce impact or risk, grossly exceeds the environmental benefit to be gained.
Impact assessment	The process of determining the consequence of an impact (in terms of the consequence to the environment) arising from a planned or unplanned event over a specified period of time.
Likelihood	The chance of an unplanned event occurring.
Non-routine planned event	An attribute of the planned activity that may occur or will occur infrequently during the planned activity. A non-routine planned event is intended to occur at the time.
Planned activity	A description of the activity to be undertaken, including the services, equipment, products, assets, personnel, timing, duration and location and aspect of the activity.
Planned event	An event arising from the activity which is done with intent (in other words, not an unplanned event) and has some level of environmental impact. A planned event could be routine (expected to occur consistently throughout the activity) or non-routine (may occur infrequently, if at all). Air emissions, bilge water discharge and drill cuttings discharge would be examples of planned events.
Receptor	A feature of the environment that may have environmental, social or economic values.
Risk	The effect of uncertainty on objectives.
Risk assessment	The process of determining the likelihood of an unplanned event and the consequence of the impact (in terms of economic, human safety and health, or ecological effects) arising from the event over a specified period of time.
Routine planned event	An attribute of the planned activity that results in some level of environmental impact and will occur continuously or frequently through the duration of the planned activity.
Senior Leadership Team	Senior Leadership Team.
Unplanned event	An event that results in some level of environmental impact and may occur despite preventative safeguards and control measures being in place. An unplanned event is not intended to occur during the activity.

5.2 Summary of the environmental impact and risk assessment approach

5.2.1 Overview

Santos operates under an overarching Risk Management Policy. The company Risk Procedure (SMS-MS1-ST01) underpins the Risk Management Policy and is consistent with the requirements of AS/NZS ISO 31000:2018, Risk Management – Guidelines (ISO, 2018).

The key steps to risk management are illustrated in **Figure 5-1**. The forum used to undertake the assessment is the environmental hazard workshop, referred to as an ENVID, which is described in Section 4 of *Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline* (EA-91-IG-00004_5).

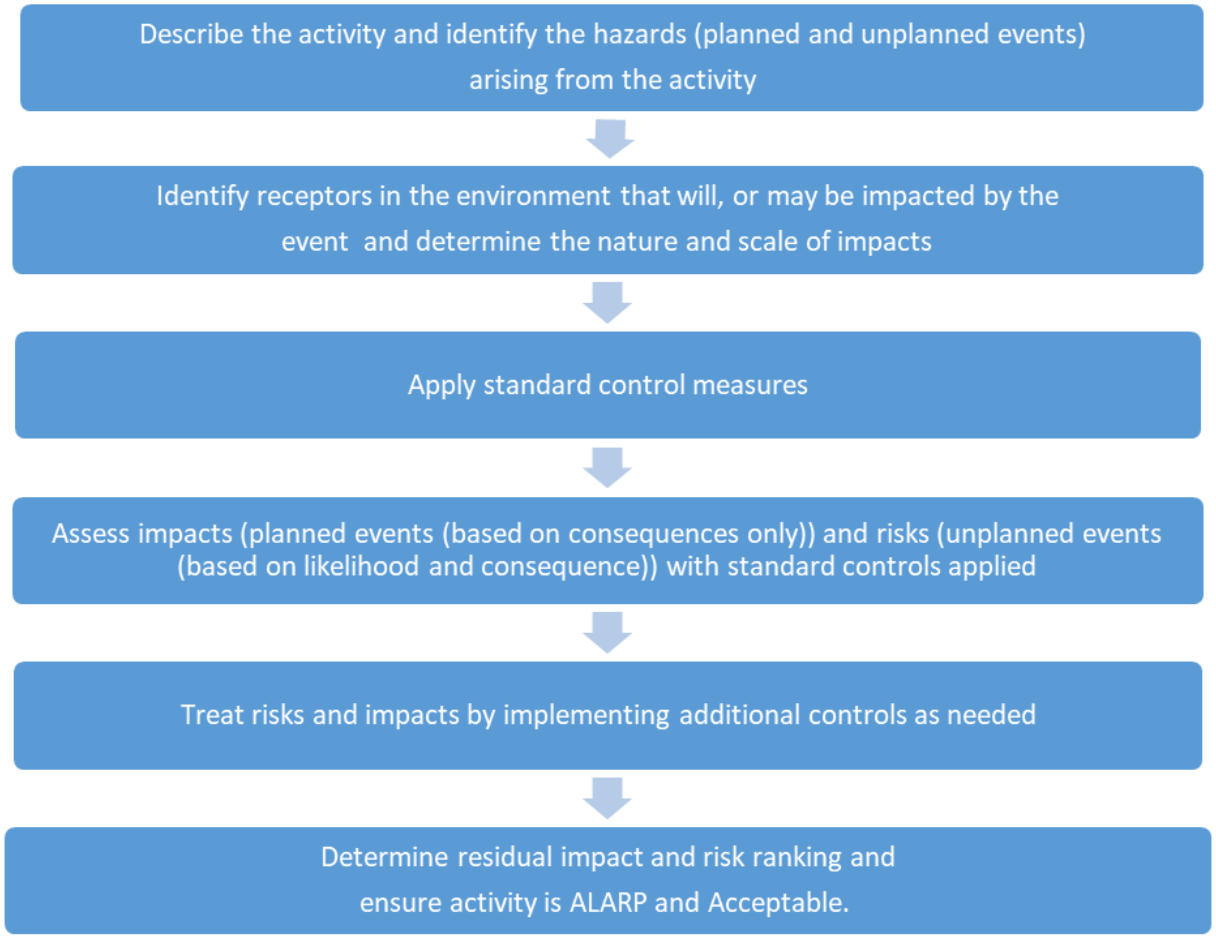

Figure 5-1: Hazard identification and assessment guideline

Santos' *Offshore Division Environmental Hazard Identification and Assessment Guideline* (EA-91-IG-00004) includes consideration of key areas in an impact and risk assessment, specifically:

+ description of the activity (including location and timing);
+ description of the environment (potentially affected by both planned and unplanned activities);
+ identification of relevant persons;
+ identification of legal requirements ('legislative controls') that apply to the activity;
+ Santos' policy and safety management system requirements;
+ principles of ecologically sustainable development (ESD); and
+ Santos acceptable levels of impact and risk.

These factors were considered in an environmental impact and risk assessment workshop held in May 2021, in which environmental hazards were identified and assessed (ENVID workshop). The workshop involved participants from Santos' Health, Safety and Environment (HSE) and Drilling departments and specialist environmental consultants.

5.2.2 Describe the activity and hazards (planned and unplanned events)

A description of the activity is required to determine the planned events that will occur and the credible unplanned events that may occur. The location, timing and scope of the activity must be described to

determine the impacts from planned events, and the impacts and risks from unplanned events since these have a bearing upon the environment that may be affected by the activity.

The outcome of this assessment is detailed in the relevant subsections of **Sections 6** and **7**.

5.2.3 Identify receptors and determine nature and scale of impacts

A description of the environment (natural and socio-economic) within which hazards from the activity will, or may, occur is required. This constitutes a crucial stage of the risk assessment, as an understanding of the environment that will or may be affected is required to determine the type and consequence of impacts from the activity being assessed. The environment must be understood with respect to the spatial and temporal limits of the activity and key resources at risk that will or could be impacted by planned and unplanned events. Santos has developed a *Values and Sensitivities of the Marine and Coastal Environment* (EA-00-RI-10062, **APPENDIX C**) reference document that describes the existing environment that may be affected by Santos activities, which is reviewed and updated annually.

Where the existing environment is being reviewed for regulatory approvals, a comparison shall be made against the *Values and Sensitivities of the Marine and Coastal Environment* (EA-00-RI-10062). A new protected matters search is required to ensure a thorough understanding of the existing environment to ensure all risks are assessed.

The extent of actual impacts from each planned activity or risks from each unplanned activity are assessed, where required, using modelling (for example, hydrocarbon spills) and scientific reports. The duration of the event is also described, including the potential duration of any impacts, should they occur. Receptors identified as potentially occurring within impacted area(s) are detailed in **Section 3** and **APPENDIX C**.

5.3 Describe the environmental performance outcomes and control measures

For each planned and unplanned event, a set of environmental performance outcomes (EPOs), control measures (CMs), environmental performance standards (EPS) and measurement criteria (MC) are identified. The definitions of the performance outcomes, control measures, standards and measurement criteria must be consistent with the OPGGS(E)R 2009, and the NOPSEMA EP Content Requirements Guidance Note (NOPSEMA, 2019).

For any hazard, additional controls must also be considered and either accepted for use or rejected, based on whether the standard controls reduce impacts and risks to levels that are ALARP and acceptable.

Controls are allocated in order of preference according to **Figure 5-2**.

Control	Effectiveness	Example
Eliminate		*Removal of the risk.* Refueling of vessels at port eliminates the risks of an offshore refueling.
Substitute		*Change the risk for a lower one.* The use of low-toxicity chemicals that perform the same task as a more toxic additive.
Engineering		*Engineer out the risk.* The use of oil-in-water separator to minimise the volume of oil discharged.
Isolation		*Isolate people or the environment from the risk.* The use of bunding for containment of bulk liquid materials.
Administrative		*Provide instructions or training to people to lower the risk.* The use of Job Hazard Analysis to assess and minimise the environmental risks of an activity.
Protective		*Use of protective equipment.* Containment and recovery of spilt hydrocarbons.

Figure 5-2: Hierarchy of controls

5.4 Determine the impact consequence level and risk rankings (on the basis that all control measures have been implemented)

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

The consequence level of the impact is then determined for each planned and unplanned event using the Santos Environment Consequence Descriptors (**APPENDIX E**).

These detailed environmental consequence descriptions are based on the consequence of the impact to relevant receptors within the categories of:

+ threatened/migratory/local fauna;
+ physical environment/habitat;
+ threatened ecological communities;
+ protected areas; and
+ socio-economic receptors.

This process determines a consequence level, based on set criteria for each receptor category, and takes into consideration the duration and extent of the impact, receptor recovery time and the effect of the impact at

a population, ecosystem or industry level. The level of information required to complete the impact or risk assessment depends on the nature and scale of the impact or risk. Impacts to social and economic values are also considered based on existing knowledge and feedback from stakeholder consultation. As the result of historic consultation with stakeholders, the social and economic values in the region that are of interest are evident.

As planned events are expected to occur during the activity, the likelihood of their occurrence is not considered during the risk assessment, and only a consequence level is assigned.

Table 5-2: Summary environmental consequence descriptors

Consequence Level	Consequence Level Description
I	**Negligible** – No impact or negligible impact
II	**Minor** – Detectable but insignificant change to local population, industry or ecosystem factors
III	**Moderate** – Significant impact to local population, industry or ecosystem factors
IV	**Major** – Major long-term effect on local population, industry or ecosystem factors
V	**Severe** – Complete loss of local population, industry or ecosystem factors AND/OR extensive regional impacts with slow recovery
VI	**Critical** – Irreversible impact to regional population, industry or ecosystem factors

For unplanned events, the consequence level of the impact is combined with the likelihood of the impact occurring (**Table 5-3**), to determine a residual risk ranking using the Santos corporate risk matrix (**Table 5-4**). For oil spill events, potential impacts to environmental receptors are assessed where they occur within the EMBA using results from modelling.

Table 5-3: Likelihood description

No.	Matrix	Description
f	Almost Certain	Occurs in almost all circumstances OR could occur *within days to weeks*
e	Likely	Occurs in most circumstances OR could occur *within weeks to months*
d	Occasional	Has occurred before in Santos OR could occur *within months to years*
c	Possible	Has occurred before in the industry OR could occur *within the next few years*
b	Unlikely	Has occurred elsewhere OR could occur *within decades*
a	Remote	Requires exceptional circumstances and is unlikely even in the long term

Table 5-4: Santos risk matrix

		Consequence					
		I	II	III	IV	V	VI
Likelihood	f	Low	Medium	High	Very High	Very High	Very High
	e	Low	Medium	High	High	Very High	Very High
	d	Low	Low	Medium	High	High	Very High
	c	Very Low	Low	Low	Medium	High	Very High
	b	Very Low	Very Low	Low	Low	Medium	High
	a	Very Low	Very Low	Very Low	Low	Medium	Medium

5.5 Evaluate if impacts and risks are as low as reasonably practicable

For planned and unplanned events, an ALARP assessment is undertaken to demonstrate that the standard control measures adopted reduce the impact (consequence level) or risk to ALARP. This process relies on demonstrating that further potential control measures would require a disproportionate level of cost/effort in order to reduce the level of impact or risk. If this cannot be demonstrated, further control measures are adopted. The level of detail included within the ALARP assessment is based on the nature and scale of the potential impact or risk. For example, more detail is required for a risk ranked as `Medium' compared to a risk ranked as `Low'.

5.6 Evaluate impact and risk acceptability

Santos considers an impact or risk associated with the activities to be acceptable if:

+ the consequence of a planned event is ranked as I or II; or a risk of impact from an unplanned event is ranked Very Low to Medium;
+ an assessment has been completed to determine whether further information or studies are required to support or validate the consequence assessment;
+ assessment and management of risks have addressed the principles of ESD;
+ the acceptable levels of impact and risks have been informed by relevant species recovery plans, threat abatement plans and conservation advice can be demonstrated;
+ performance standards are consistent with legal and regulatory requirements;
+ performance standards are consistent with Santos' Environment, Health and Safety Policy;
+ performance standards are consistent with industry standards and best practice guidance (for example, National Biofouling Management Guidance Guidelines for the Petroleum Production and Exploration Industry (Marine Pest Sectoral Committee, 2018));
+ performance outcomes and standards are consistent with stakeholder expectations; and
+ performance standards have been demonstrated to reduce the impact or risk to ALARP.

6. Planned Activities Risk and Impact Assessment

OPGGS(E)R 2009 Requirements
Regulation 13(5)
The environment plan must include: (a) details of the environmental impacts and risks for the activity; and (b) an evaluation of all the impacts and risks, appropriate to the nature and scale of each impact or risk; and (c) details of the control measures that will be used to reduce the impacts and risks of the activity to ALARP and an acceptable level.
Regulation 13(6)
To avoid doubt, the evaluation mentioned in paragraph (5)(b) must evaluate all the environmental impacts and risks arising directly or indirectly from: (a) all operations of the activity; and (b) potential emergency conditions, whether resulting from accident or any other reason.
Regulation 13(7)
The environment plan must: (a) set environmental performance standards for the control measures identified under paragraph (5)(c); and (b) set out the environmental performance outcomes against which the performance of the titleholder in protecting the environment is to be measured; and (c) include measurement criteria that the titleholder will use to determine whether each environmental performance outcome and environmental performance standard is being met.

Santos' environment assessment identified seven potential sources of environmental impact associated with the planned activities to be undertaken in the operational area. The results of the impact assessments are summarised in **Table 6-1**. Given the risk of a planned event occurring is 100% likelihood (in other words, it will occur), the residual risk ranking is not assessed (as explained in **Section 5.2**). The potential impact assessment for each planned event and the subsequent control and management measures proposed by Santos to reduce the extent of the impacts are detailed in the next subsections.

Table 6-1: Summary of the consequence level rankings for hazards associated with planned events

EP Section	Planned event	Consequence level
6.1	Acoustic disturbance to marine fauna	II – Minor
6.2	Light emissions	I – Negligible
6.3	Atmospheric emissions	I – Negligible
6.4	Seabed and benthic habitat disturbance	II – Minor
6.5	Interaction with other marine users	I – Negligible
6.6	Vessel operational discharges	I – Negligible
6.7	Spill response operations	II – Minor

6.1 Acoustic disturbance to marine fauna

6.1.1 Description of event

Event	Underwater noise emissions will be generated by: + vessel activities (**Section 2.4**) + geophysical and geotechnical survey equipment (**Sections 2.5** to **2.8**) + use of helicopters. Noise originating from these sources could potentially have the following effects on marine fauna: + Masking of vocalisations/signals from predators/prey. + Modification of fauna behaviour (avoidance/attraction/disruption of normal behaviour). + Physical injury to fauna from exposure to excessive noise (barotrauma, hearing loss).
Extent	Localised: A support vessel using main engines and bow thrusters to maintain position will become inaudible above background noise within **thousands of metres**. Localised: A conservative estimate for using geophysical equipment (SBESs, MBESs and SSSs) is within a **thousands of metres,** depending on the activity characteristics. Localised: Helicopter noise will be highly localised as most of the noise will not **transfer into the water**. Localised: ROV and AUV adjacent to vessels. A 20km radius around the defined operational area has been assumed as a conservative area within which impacts could occur, this includes physiological and behavioural impacts.
Duration	Vessel noise for the duration of the activity, with intermittent survey equipment noise.

6.1.1.1 Noise generated from vessels

Noise associated with vessel activity that could impact marine fauna includes noise generated by vessel thrusters, engines and propellers, as well as noise emitted onboard which is converted to underwater noise through the hull (for example, from heavy machinery). The main source of vessel noise will be from propellers or dynamic positioning (DP) thrusters.

Noise will be generated during transit, towing of equipment and seafloor sampling. The sound levels from the representative vessel are likely to be similar to those from *R/V Ocean Pioneer*, a 62 m long 5600 HP (4,175 kW) vessel. The *R/V Ocean Pioneer* was measured during transit at ten knots and found to have a monopole source level of 166.3 dB re 1 µPa @ 1 m (Chorney *et al.*, 2011). In this study, in the Arctic in 46 m of water, the maximum distance to 120 dB re 1 µPa was found to be 1600 m. A monopole source level is a source level that has been calculated using an acoustic model that accounts for the effect of the sea-surface and seabed on sound propagation, assuming a point-like (monopole) sound source. To place this in context with other studies, McCauley (1998) measured underwater sound levels from the *Pacific Ariki*, a 64 m long support vessel with 8000 HP (6,000 kW) main engines during calm conditions in the Timor Sea in 110 m of water while transiting at 11 knots, and found the distance to 120 dB re 1 µPa to be approximately 1 km.

The work rate of vessel engines, and thus output power and noise, will depend upon speed and sea-state, and the propagation will depend upon the location. Practical spreading loss, $15\log_{10}$ (Range) (Urick, 1983), is a reasonably conservative approach to take in waters on the continental shelf, representing a balance between spherical and cylindrical spreading. If practical spreading loss is applied with the monopole source level of the *Ocean Pioneer* under transit, 166.3 dB re 1 µPa @ 1 m, the distance to 120 dB re 1 µPa (sound pressure level, or 'SPL') will be less than 1,200 m.

The thrusters on survey vessels are significantly smaller than the main engines; therefore, use of the monopole source level, derived from the main engines to represent the vessel during position holding, is conservative. To place this in context with available information, McCauley (1998) calculated the *Pacific Ariki* to have a monopole source level equivalent to approximately 182 dB re 1 µPa @ 1 m while holding position using both main engines and an unspecified bow thruster.

The distance to 120 dB re 1 µPa (SPL), estimated using practical spreading loss for the *Ocean Pioneer* under transit, is used as a conservative estimate of the representative vessel under DP.

Considering the vessel to have a monopole source level of 166.3 dB re 1 µPa, and operating in a single location for 24 hours, allows the accumulated sound levels to be estimated through the addition of $10*\log_{10}$ (time in seconds) to sound levels. This approach can be used to calculate the unweighted sound exposure level (SEL), which can be used in a conservative comparison against relevant SEL impact assessment thresholds.

6.1.1.2 Noise generated from helicopter

Sound traveling from a source in the air (for example, a helicopter) to a receiver underwater is affected by both in-air and underwater propagation processes, which are further complicated by processes occurring at the air-seawater surface interface (for example, wind and waves). The level of noise received underwater depends on source altitude and lateral distance, receiver depth, water depth and other variables.

Helicopter engine noise is emitted at various frequencies; however, the dominant tones are generally of a low frequency below 500 Hz (Richardson *et al.*, 1995). Sound pressure in the water directly below a helicopter is greatest at the surface and diminishes with increasing receiver depth. Noise also reduces with increasing helicopter altitude, but the duration of audibility often increases with increasing altitude. The noise from the flyover of a Bell 214 helicopter (stated to be one of the noisiest) has been recorded underwater (Richardson *et al.*, 1995). The sound source was 162 dB re 1 µPa @ 1 m at its peak and had a frequency of 155 Hz.

6.1.1.3 Underwater acoustic positioning

An acoustic pulse is transmitted by the transceiver and detected by the subsea transponder, which replies with its own acoustic pulse. This return pulse is detected by the shipboard transceiver. The time from the transmission of the initial acoustic pulse until the reply is detected is measured by the ultra-short baseline (USBL) system and is converted into a range. To calculate a subsea position, the USBL calculates both a range and an angle from the transceiver to the subsea beacon. Angles are measured by the transceiver, which contains an array of transducers. The transducer will then send sound signals, typically at 19 to 33 kHz, to a USBL transponder.

The source level and frequency range of the Sonardyne Ranger USBL from previous field measurements (Warner and McCrodan, 2011) were found to be 18 to 36 kHz and 204 dB re 1 µPa @1 m (SPL). The per-pulse SEL source level was 173 dB re 1 μPa^2s @ 1 m, and the measured maximum PK was approximately 170 dB re 1 µPa at 30 m. This source can be considered an impulsive sound source for impact assessment purposes for this activity. Austin *et al*. (2012) calculated the distances to SPL isopleths for the Ranger USBL in open water and found the distance to 160 dB re 1 µPa (SPL) to be 36 m. Considering 1000 impulses at 40 m range through summing the received SEL from each impulse results in an unweighted SEL of 144 dB re 1 μPa^2s, which can be used in a conservative comparison against relevant SEL impact assessment thresholds which require the assessment over the length of the activity or 24 hours.

6.1.1.4 Multibeam echo sounder

The representative MBES considered for the VBA is an R2Sonic 2024, operating at 200 to 400 kHz with a 60° total beam width. This is considered a typical MBES for the types of activities that will be undertaken as part

of this EP. The transmit power from this echo sounder is up to 221 dB re 1 µPa @1 m (SPL), with a short (15 µs to 1 ms) pulse width; however, the operational power level and pulse width influence the potential sound fields. This can be considered an impulsive sound source for impact assessment purposes for this activity. Measurements for the R2Sonic 2024 were reported in Martin *et al*. (2012), who measured a maximum SPL of 162 dB re 1 µPa at 4 m, with the system operating at an average pulse length of 0.11 ms. The accumulated SEL over 363 measured pulses was 121.5 dB re 1 μPa^2s. Measurements of another similar system,-operating at 240 kHz, were reported in Chorney *et al*. (2011). These measurements show that at 40 m, the PK levels are approximately 170 dB re 1 µPa, and the per-pulse SEL 130 dB re 1 μPa^2s. Zykov (2013) modelled another similar MBES and found the sound levels would not exceed an unweighted 171 dB re 1 $\mu Pa^2 \cdot s$ more than 2 m from the source while conducting a 2.5 hour geophysical survey. Additionally, this sonar generates only high-frequency signals, and as such will only be relevant for fauna with sensitivity to signals of approximately 200 kHz or higher, which excludes low-frequency cetaceans, fish and turtles.

6.1.1.5 Side scan sonar

The representative SSS considered for this VBA is the EdgeTech 4200-FS Digital Towfish, which outputs signals at 120 and 410 kHz. This is considered a typical SSS for the types of activities that will be undertaken as part of this EP. Measurements of an EdgeTech 4200 were reported in Crocker and Fratantonio (2016) for 100 and 400 kHz modes, with a maximum per-pulse source level of 176 dB re 1 μPa^2s @ 1 m (SEL), 205 dB re 1 µPa @ 1 m (SPL) and 210 dB re 1 µPa @1 m (PK). Austin *et al*. (2013) also measured the system during an operational program, focusing on the 120 kHz impulses. The authors reported a PK of less than 175 dB re 1 µPa and an SPL of less than 170 dB re 1 µPa at 39 m, with the distance from in-beam pulses to an SPL of 160 dB re 1 µPa calculated to be 130 m. The sonar is highly directional, with distances to sound levels outside the beam significantly less than those in the beam. The EdgeTech 4200-FS Digital Towfish in use for this survey will be towed approximately 10 to 20 metres above the seabed, thus the beam will be restricted to a swath close to the seabed. Additionally, this sonar generates only high-frequency signals, and as such will only be relevant for fauna with sensitivity to signals of approximately 110 kHz or higher, as shown in Austin *et al.* (2013), which excludes low-frequency cetaceans, fish and turtles.

6.1.1.6 Boomer sub-bottom profiler

The representative boomer SBP considered for this VBA is an Applied Acoustics S-Boom Boomer SBP being used with a CSP-D 2400-Joule power source, but only operating at 300 Joules. The output from boomer SBP systems depends highly on the model and operational power levels. A measurement of a very similar SBP, also operating at lower power levels, is the Applied Acoustics AP3000 boomer SBP operating at both 750 and 1,000 J, as reported in Martin *et al.* (2012). This boomer had a primary frequency range of 100 to 1,000 Hz. During the study, the acoustic data was collected as close as 8 m to the source and directly below it. The data showed the broadband source level for the system was 203.3 dB 1 µPa @ 1 m SPL over 0.2 ms window length and 172.6 dB re 1 μPa^2s @ 1 m SEL. They found that even with the closest measurement at 8 m, SPL values never exceeded 175 dB re 1 µPa, with the distance to 160 dB re 1 µPa calculated to be 12 m, and the unweighted accumulated SEL over an entire measurement track (525 impulses) in 28 m of water which passed directly over the recorder while operating at 1,000 J was 161.5 dB re 1 μPa^2s.

6.1.2 Nature and scale of environmental impacts

Potential Receptors: Threatened/migratory fauna (marine mammals (particularly cetaceans), marine turtles, sharks, rays and fish). The operational area overlaps only one BIA and no protected areas. This is outlined in **Table 6-2**. A PMST Search was conducted on a 20 km buffer around the defined operational area to identify any MNES species that could be affected by noise outside of the operational area. All species and protected

areas identified within this search were also identified in the operational area PMST (**APPENDIX C**), no additional matters of NES were identified in this area not already described in the operational area.

Table 6-2: Summary of the overlapping biologically important areas within 20 km of the operational area

	BIA				
	Internesting BIA	Migration BIA	Foraging BIA	Breeding BIA	Distribution
Operational Area	-	-	Whale shark	-	-

The use of sound in the underwater environment is important for marine animals, particularly cetaceans, to navigate, communicate and forage effectively, along with reptiles, sharks/rays and other fish, for a range of functions such as social interaction, foraging and orientation. Underwater noise may impact on marine fauna through:

+ attraction;
+ increased stress levels;
+ disruption to underwater acoustic cues;
+ localised avoidance;
+ disturbance, leading to behavioural changes or displacement from areas;
+ masking or interference with other biologically important sounds such as communication or echolocation (used by certain cetaceans for locating prey and other objects);
+ physical injury to hearing or other organs; and
+ indirectly by inducing behavioural and physiological changes in predator or prey species.

The nature and scale of impacts must be considered in the context of the ambient noise environment. Ambient underwater noise levels depend on location and are often dominated by local wind noise, waves, biological noise and ship traffic. Wind speed and seabed conditions have a clear influence on the ambient noise level. Fish choruses are capable of raising background noise levels to 120 to 130 dB re 1 µPa (McCauley, 2011). Anthropogenic underwater noise sources in the region comprise shipping and small vessel traffic, petroleum production and exploration drilling activities, and sporadic petroleum seismic surveys.

The survey will involve the vessel, acoustic positioning through USBL, MBES, SSS and a boomer SBP, as detailed in **Section 2.5**. These sound sources are both non-impulsive (vessel) and impulsive (USBL, MBES, SSS and a boomer SBP), and thus require the consideration of different criteria to assess their potential impact.

Marine fauna respond variably when exposed to underwater noise from anthropogenic sources, with effects dependent on factors such as distance from the sound source, water depth and bathymetry, the animal's hearing sensitivity, type and duration of sound exposure and the animal's activity at the time of exposure. Broadly, the effects of sound on marine fauna can be categorised as:

+ Acoustic masking – anthropogenic sounds may interfere with, or mask, biological signals, therefore reducing the communication and perceptual space of an individual. Auditory masking impacts may occur when there is a reduction in audibility for one sound (signal) caused by the presence of another sound (noise). For this to occur, the noise must be loud enough and have a similar frequency to the signal and both signal and noise must occur at the same time;

+ Behavioural response – behavioural impacts will depend on the audible frequency range of each potential receptor in relation to the frequency of the noise, as marine animals will only respond to acoustic signals they can detect, as well as the intensity of the noise. The intensity of behavioural responses of marine mammals to sound exposure ranges from subtle responses, which may be difficult to observe and have little implications for the affected animal, to obvious responses, such as avoidance or panic reactions. The context in which the sound is received by an animal affects the nature and extent of responses to a stimulus. The threshold for eliciting behavioural responses depends on received sound level, as well as multiple contextual factors such as the activity state of animals exposed to different sounds, the nature and novelty of a sound, spatial relations between a sound source and receiving animals, and the gender, age and reproductive status of the receiving animal; and
+ Physiological impacts – auditory threshold shift (temporary and permanent hearing loss) – marine fauna exposed to intense sound may experience a loss of hearing sensitivity, or even potentially mortal injury. Hearing loss may be in the form of a temporary threshold shift (TTS) from which an animal recovers within minutes or hours, or a permanent threshold shift (PTS) from which the animal does not recover.

Available threshold criteria associated with behavioural and physiological impacts for sensitive receptors have been derived from a number of sources (NMFS, 2018; NMFS, 2014; Popper *et al*., 2014). These criteria have been compared with measured and predicted sound levels for different sound sources to assess potential impacts.

6.1.2.1 Marine mammals

No known aggregation, resting, breeding or feeding areas for mammals lie within 20 km of the operational area, nor does the operational area overlap with any marine mammal BIAs, though individuals of many marine mammal species may be encountered. Recovery plans for humpback whales and blue whales list noise interference as a potential threat.

Table 6-3 and **Table 6-4** detail receptor noise impact and behavioural thresholds for continuous noise (vessels) and impulsive noises (survey equipment), being:

+ low-frequency cetaceans: which consists of baleen whales such as humpback whales; and
+ mid-frequency cetaceans: which consists of toothed whales except porpoises and river dolphins.

Table 6-3: Continuous noise: acoustic effects of continuous noise on marine mammals: unweighted SPL and SEL_{24h} thresholds

Hearing Group	NMFS (2014)	NMFS (2018); Southall *et al* (2019)	
	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)	Weighted SEL_{24h} ($L_{E,24h}$; dB re 1 µPa^2·s)
Low-frequency	120	199	179
High-frequency		198	178

Table 6-4: Impulsive noise: 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 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)
Low-frequency	160	183	219	168	213
High-frequency		185	230	170	224

Potential impacts from vessels

Auditory masking impacts may occur when there is a reduction in audibility for one sound (signal) caused by the presence of another sound (noise). For this to occur, the noise must be loud enough and have a similar frequency to the signal and both signal and noise must occur at the same time. Therefore, the closer the whale is to the vessel, and the more overlap there is with their vocalisation frequencies, the higher the probability of masking. The potential for masking and communication impacts is therefore classified as high near the vessel (within tens of metres) and moderate within hundreds to low thousands of metres (Clark *et al*., 2009).

There is a potential for auditory masking impacts to whales due to vessel noise; however, impacts are considered temporary and localised because the individual and the vessels will be almost constantly moving during most of the activities and stationary for short periods (such as during geotechnical survey) and therefore no single area will be impacted for any length of time.

The estimated distances to behavioural and physiological thresholds (as listed in **Table 6-3**) for marine mammals from vessels are provided in **Table 6-5**.

Table 6-5: Estimated distances to behavioural and physiological thresholds (as listed in Table 6-3) for marine mammals from vessels

Potential Marine Fauna Receptor	Estimated Distance	Justification
PTS		
Low-frequency cetaceans	12 m	Based upon accumulation of unweighted SEL over 24h for a vessel with a source level of 166.3 dB re 1 µPa (SPL), and applying practical spreading loss, see **Section 6.1.1**
Mid-frequency cetaceans	Not predicted to occur	Not predicted to occur for vessels with a significantly greater power output (McPherson *et al.*, 2019)
TTS		
Low-frequency cetaceans	266 m	Based upon accumulation of unweighted SEL over 24h for a vessel with a source level of 166.3 dB re 1 µPa (SPL), and applying practical spreading loss, see **Section 6.1.1**
Mid-frequency cetaceans	Not predicted to occur	Not predicted to occur for vessels with a significantly greater power output (McPherson *et al.*, 2019)
Behaviour		
Low-frequency cetaceans	Within 1,200 m	Considering a vessel with a source level of 166.3 dB re 1 µPa (SPL), and applying practical spreading loss (McPherson *et al.*, 2019)
Mid-frequency cetaceans		

Potential impacts from survey equipment and positioning equipment

The sound levels from positioning equipment (USBL) are described in **Section 6.1.1.3**. The proposed equipment has sound levels that could reach the threshold for behavioural disturbance (**Table 6-4**) within 36 m. A nominal accumulation scenario for 1000 impulses (**Section 6.1.3**) results in an unweighted accumulated SEL significantly below thresholds for PTS and TTS in marine mammals. The measured PK at 30 m was 170 dB re 1 µPa; therefore, considering both SEL and PK metrics within the criteria (**Table 6-4**), PTS and TTS are not predicted to occur from the positioning equipment.

The sound levels from MBES are described in **Section 6.1.1.4**. The measurement study from Martin *et al.* (2012) indicates the threshold for behavioural disturbance (**Table 6-4**) could be exceeded within less than 10 m. PTS and TTS due to SEL are not predicted to occur, considering a measurement along a trackline with a closest point of approach of 4 m did not result in accumulated unweighted levels higher than 121.5 dB re 1 µPa^{2}s. PTS and TTS considering PK is unlikely to occur, given the measurement of 170 dB re 1 µPa PK at 40 m. Therefore, considering both SEL and PK metrics within the criteria (**Table 6-4**), PTS and TTS due to the MBES are not predicted to occur.

The sound levels from SSS are described in **Section 6.1.1.5**. The measurement study by Austin *et al.* (2015) indicates the threshold for behavioural disturbance (**Table 6-4**) could be exceeded within less than 130 m for marine mammals in the highly directional source output beam pattern. The reported per-pulse sound levels at 40 m are similar to those from the MBES, and as it is not predicted to exceed either the PTS or TTS criteria, when considering both SEL and PK metrics (**Table 6-4**), neither is the SSS. Additionally, the per-pulse peak

pressure source level of the SSS is below the PK criteria threshold; therefore, the criteria cannot be exceeded and PTS and TSS impacts are not predicted to occur.

The sound levels from the boomer SBP are described in **Section 6.1.1.6**. The modelling results from McPherson and Wood (2017) and Wood and McPherson (2019) indicate the threshold for behavioural disturbance (**Table 6-4**) could be exceeded within less than 145 m for the boomer, the louder of the two SBP systems. PTS due to SEL is not predicted to occur, although the SEL24h threshold for TTS could be exceeded within 10 m of the source. None of the PK metric criteria (**Table 6-5**) are exceeded.

Survey and positioning equipment could cause auditory masking of vocalisations of cetaceans due to the overlap in frequency range between signals and vocalisations. However, due to the limited propagation range of the relevant frequencies (higher frequencies attenuate rapidly), the range at which the impact could occur will be within hundreds of metres. The masking will apply to mid-frequency whales for the positioning equipment, MBES and SSS, with all signals above 2 kHz. The boomer SBP could potentially mask vocalisations from low-frequency whales, as it has a primary frequency range from 100 to 1000 Hz; however, the low source affected distances are expected to be within hundreds to low thousands of metres.

6.1.2.2 Marine reptiles

Turtles use shallow waters around mainland Australia (and the beaches of Ashmore Reef and Cartier Island) for feeding, nesting, breeding and internesting. No BIAs for turtles are within 20 km of the defined operational area; however, individuals may be encountered.

Marine turtles use sounds for navigation, to avoid predators and to find prey (Dow Piniack, 2012). Turtles have been shown to become agitated to impulsive noise sound pressure levels above 175 dB re 1 µPa (McCauley *et al*., 2000). The threshold level of 166 dB re 1 µPa is used as a behavioural disturbance response by turtles to impulsive noise (NSF, 2011).

The Recovery Plan for Marine Turtles (Commonwealth of Australia, 2017) notes there is limited information available on the impact of noise on marine turtles and that the impact of noise on turtle stocks may vary, depending on whether exposure is short- (acute) or long-term (chronic). Turtles have been shown to respond to low-frequency sound, with indications they have the highest hearing sensitivity in the frequency range of 100 to 700 Hz (Bartol and Musick, 2003).

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. Popper *et al*. (2014) suggested thresholds for onset of mortal injury (including PTS) and mortality for sea turtles and, in the absence of taxon-specific information, adopted the levels for fish that do not hear well (suggesting this would likely be conservative for sea turtles).

Finneran *et al*. (2017) presented revised thresholds for sea turtle injury and hearing impairment (TTS and PTS). Their rationale is that sea turtles have best sensitivity at low frequencies and are known to have poor auditory sensitivity (Bartol & Ketten, 2006; Dow Piniak *et al*., 2012; Martin *et al*., 2012). Accordingly, TTS and PTS thresholds for turtles are likely more similar to those of fishes than to marine mammals (Popper *et al*., 2014).

Studies show that behavioural responses occur to received sound levels of approximately 166 dB re 1 µPa and that avoidance responses occur at around 175 dB re 1 µPa (McCauley *et al*., 2000). These levels overlap with the sound frequencies produced by vessels and survey activities. Based on the limited data regarding noise levels that illicit a behavioural response in turtles, the lower level of 166 dB re 1 µPa drawn from National Science Foundation (NSF, 2011) is typically applied, both in Australia and by NMFS, as the threshold level at which behavioural disturbance could occur.

The recommended criteria for impulsive and continuous sound sources are shown in **Table 6-6** and **Table 6-7**.

Sea snakes

There is limited information about the effects of noise on sea snakes. A current research project investigating the impacts of seismic surveys found that hearing sensitivity of sea snakes is similar to species of fish without a swim bladder (discussed below). Therefore, it is considered that there is a moderate risk in the near and intermediate distances (which extends hundreds of metres) of behavioural impacts to sea snakes, with the impacts being limited to temporary avoidance of the area.

Table 6-6: Acoustic effects of continuous noise on sea turtles

Potential Marine Fauna Receptor	Popper *et al.* 2014		Finneran *et al.* (2017) Weighted SEL_{24h} ($LE_{,24h}$; dB re 1 $\mu Pa^2 \cdot s$)	
	Masking	Behaviour	PTS onset threshold	TTS onset threshold
Marine Turtle	(N) High (I) High (F) Moderate	(N) High (I) Moderate (F) Low	220	200

Note: Relative risk (high, moderate, low) is given for animals at three distances from the source defined in relative terms as near (N) – tens of metres, intermediate (I) - hundreds of metres, and far (F) – thousands of metres.

Table 6-7: Acoustic effects of impulsive noise on sea turtles: Unweighted SPL, SEL24h, and PK thresholds

NFS, 2011	Moein *et al.*, 1995; McCauley *et al.* 2000b, 2000a	Finneran *et al.*, 2017			
Behaviour		PTS onset threshold		TTS onset threshold	
SPL (L_p; dB re 1 µPa)		Weighted SEL_{24h} ($LE_{,24h}$; dB re 1 $\mu Pa^2 \cdot s$)	PK (L_{pk}; dB re 1 µPa)	Weighted SEL_{24h} ($LE_{,24h}$; dB re 1 $\mu Pa^2 \cdot s$)	PK (L_{pk}; dB re 1 µPa)
166	175	204	232	189	226

Potential impacts from vessels

Based on the criteria detailed within **Table 6-6**, there is a low risk of any injury to marine turtles from vessel noise (**Section 6.1.1**). Behavioural changes, such as avoidance and diving, are only predicted for individuals in close proximity to the activity vessel (high risk of behavioural impacts within tens of metres of a vessel and moderate risk of behavioural impacts within hundreds of metres of a vessel). There is a high risk of masking within hundreds of metres of the vessel, and a moderate risk of masking within thousands of metres from the vessel. Turtles have not been shown to rely on sound for finding food or avoiding predators. Sounds potentially could be used by turtles in a social manner to synchronise activities during the nesting season (Ferrara *et al.*, 2014); however, this has not been demonstrated for sea turtles. The noises are relatively quiet (Ferrara *et al.*, 2014) and thus would only have a limited range of detection by turtles, even in ideal conditions, with masking from natural sounds likely. The impacts from masking are expected to be low.

Potential impacts from survey equipment and positioning equipment

The sound levels of the survey equipment and positioning equipment (**Section 6.1.1**) are below those associated with the PK criteria for injury (PTS and TTS) (**Table 6-7**) beyond a few metres, and are low enough that SEL criteria will not be reached (McPherson and Wood, 2017). Behavioural changes, such as avoidance and diving, are only predicted for individuals close to the vessels (high risk of behavioural impacts within tens of metres of the source and moderate risk of behavioural impacts within hundreds of metres of the source).

Turtles are unlikely to experience masking, even at close range to the source, from all sources except the boomer SBP. This is partly because the sounds from most survey and positioning equipment (except the boomer SBP) are all outside of the hearing frequency range for turtles, which for green and loggerhead turtles is approximately 50 to 2000 Hz, with highest sensitivity to sounds between 200 and 400 Hz (Ridgway *et al*., 1969; Ketten and Bartol, 2005; Bartol and Ketten, 2006; Bartol, 2008; Yudhana *et al*., 2010; Piniak *et al*., 2011; Lavender *et al*., 2012, 2014). The boomer SBP could potentially mask turtle hearing, as it has a primary frequency range from 100 to 1000 Hz; however, the low source levels mean the distances within which masking may occur for turtles will be within hundreds to low thousands of metres.

6.1.2.3 Sharks, fish and rays

The whale shark foraging BIA overlaps the operational area and therefore whale sharks are considered likely to occur.

All fish species can detect noise sources, although hearing ranges and sensitivities vary substantially between species (Dale *et al.*, 2015). Sensitivity to sound pressure seems to be functionally correlated in fishes to the presence and absence of gas-filled chambers in the sound transduction system. These enable fishes to detect sound pressure and extend their hearing abilities to lower sound levels and higher frequencies (Ladich and Popper, 2004; Braun and Grande, 2008). Based on their morphology, Popper *et al*. (2014) classified fishes into three animal groups, comprising:

+ fishes with swim bladders whose hearing does not involve the swim bladder or other gas volumes;
+ fishes whose hearing does involve a swim bladder or other gas volume; and
+ fishes without a swim bladder that can sink and settle on the substrate when inactive.

Thresholds for PTS and recoverable injury are between 207 dB PK and 213 dB PK (depending on the presence or absence of a swim bladder), and the threshold for TTS is 186 dB SEL_{cum} (Popper *et al*., 2014). Given there are no exposure criteria for sharks and rays, the same criteria are adopted, though typically sharks and rays do not possess a swim bladder.

Individual demersal fish may be impacted in the vicinity of the activity and tuna and billfish and other mobile pelagic species may traverse the operational area. However, the operational area is not known to be an important spawning or aggregation habitat for commercially-caught targeted species. Therefore, no impacts to fish stocks are expected.

The criteria defined in Popper *et al*. (2014) for continuous (**Table 6-8**) and impulsive (

Table 6-9) noise sources have been adopted.

Table 6-8: Continuous noise: criteria for noise exposure for fish, adapted from Popper *et al*. (2014)

Potential Marine Fauna Receptor	Mortality and Potential mortal injury	Impairment			Behaviour
		Recoverable injury	TTS	Masking	
Fish: No swim bladder (particle motion detection)	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Fish: Swim bladder not involved in hearing (particle motion detection)	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Fish: Swim bladder involved in hearing (primarily pressure detection)	(N) Low (I) Low (F) Low	170 dB SPL for 48 h	158 dB SPL for 12 h	(N) High (I) High (F) High	(N) High (I) Moderate (F) Low
Fish eggs and fish larvae	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low	(N) Moderate (I) Moderate (F) Low

Table 6-9: Impulsive noise: criteria for noise exposure for fish, adapted from Popper *et al*. (2014)

Potential Marine Fauna Receptor	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	> 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

Note: Relative risk (high, moderate, low) is given in **Table 6-8** and

Table 6-9 for animals at three distances from the source, defined in relative terms as near (N) – tens of metres, intermediate (I) – hundreds of metres, and far (F) – thousands of metres.

Potential impacts from vessels

Based on criteria developed by Popper *et al*. (2014) for noise impacts on fish, vessel noise has a low risk of resulting in mortality and a moderate risk of TTS impacts when fish are within tens of metres of a vessel. The most likely impacts to fish from noise will be behavioural responses. Popper *et al*. (2014) identified a moderate risk of behavioural impacts to fish in near (tens of metres) and intermediate (hundreds of metres) distances from the noise source. Masking could occur within thousands of metres under a worst-case scenario of vessel operations; however, typically any effect will be limited to within hundreds of metres.

Potential impacts from survey equipment and positioning equipment

Potential impacts of survey and positioning equipment on fish have been assessed based on available criteria from Popper *et al.* (2014). Impulsive noises from survey equipment could result in physiological impacts to fish located within metres of the sound source, considering the results presented in **Section 6.1.1**. The likelihood of fish being close enough to the sound source for physiological impacts to occur is considered remote.

Behavioural impacts to fish from survey equipment noise will be limited to behavioural responses within metres of the noise source. Fish (including sharks and rays) may be temporarily displaced from the vicinity of the noise emissions. The only survey equipment with energy below 1 kHz is the boomer SBP; all other equipment that operates at higher frequencies is unable to be heard by most fish, which further reduces the risk of impact (Ladich and Fay, 2013).

The impact of masking is low at all ranges, apart from fish who specialise in pressure detection, which can be impacted in a moderate way at thousands of metres. However, this is only relevant for the boomer SBP, as all other sources have signals outside the hearing range of most fish in the region, which reduces the risk of impact.

6.1.2.4 Invertebrates

Underwater noise emissions from the activity are not expected to cause a change in behaviour to benthic invertebrates.

Potential impacts from vessels

Benthic invertebrates are unlikely to be negatively impacted by noise generated from vessel operations, due to the fact the activity is intermittent and of short duration, with the vessel not sitting in one location for a period of time. Additionally, there is no convincing scientific evidence for any significant effects induced by non-impulsive noise in benthic invertebrates.

Plankton, including fish eggs and larvae, and pelagic invertebrates could drift close to high-energy noise sources (for example, bow thrusters). However, any negative impacts that could occur would be restricted to within metres of the sound source. At such a localised extent, impacts would be negligible at an ecosystem or population level.

Potential impacts from survey equipment and positioning equipment

For impulsive noise and benthic invertebrates, the source is an important consideration in the assessment. Low-frequency sources, such as the boomer SBP, can be considered for the purposes of this assessment in the context of scientific findings relevant to seismic surveys, with no other information available to suggest a more appropriate alternative. Therefore, for the boomer SBP impulsive noise, the sound levels defined in

Day *et al.* (2016) and Payne *et al*. (2008) are considered appropriate to guide an impact assessment (**Table 6-10**).

Table 6-10: Impulsive noise: sound levels relevant to invertebrates

Receptor	Sound levels
Invertebrates: effect at the seafloor (Day *et al.,* 2016)	186 to 190 dB SEL 192 to 199 dB SEL_{24h} 209 to 212 dB PK-PK
Invertebrates: no effect at the seafloor (Payne *et al*., 2008)	202 dB PK-PK

Site-specific modelling was not conducted against these thresholds for the proposed geophysical activities. However, the Beach Energy Otway Basin Geophysical Survey acoustic modelling, by Wood and McPherson (2017), did undertake modelling. This work, as described above, was in a similar geological environment and water depths; therefore, the results can be used to conduct a high-level comparative assessment. The site-specific study in the Otway Basin found that none of the sound levels listed in **Table 6-10** were exceeded. This result is estimated to be appropriate for geophysical survey activities within the operational area.

The short duration of the survey is expected to reduce the potential for impact on plankton and invertebrates. Any negative impacts that could occur would be restricted to within metres of the sound source. At such a localised extent, impacts would be negligible at an ecosystem or population level.

There are no thresholds or information available for assessing the potential impacts from high-frequency sources such as SSS or MBES on either water column or benthic invertebrates. These sources are often used to assess and quantify plankton densities, including within McCauley *et al*. (2017), who used a Simrad EK60 echosounder operating at 120 kHz.

6.1.2.5 Protected and significant areas

The operational area does not overlap any protected or significant areas, with the closest feature being the Carbonate Bank and Terrace System of the Sahul Shelf key ecological feature (KEF) which is around 9 km away. Impacts from noise will not affect the feature itself but could impact on fauna that are found in proximity to the KEF, such as fish and sharks that traverse the operational area. Impacts to these fauna are described above.

6.1.2.6 Socio-economic

Impacts to fish may result in indirect impacts to fisheries in the operational area (**Section 3.2.4**), with impacts restricted to moderate within hundreds of metres of the vessel and equipment, as detailed above. With most of the noise emissions being of short duration and limited extent, any impact on commercial or recreational fishing is expected to be minimal. There are expected to be no impacts to other marine users (petroleum industry, shipping or tourism) from the noise emissions associated with the VBA.

6.1.3 Environmental performance outcomes and control measures

The EPO relating to this hazard is:

+ No injury or mortality to EPBC Act 1999 and WA *Biodiversity Conservation Act 2016* listed fauna during activities (EPO-1).

The control measures considered for this activity are shown in **Table 6-11**, with EPSs and MC for the EPOs described in **Section 8**.

The priority action plan for turtles is set out in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017), which states to manage anthropogenic activities to ensure marine turtles are not displaced from identified Critical Habitat. The recovery plan identifies that a precautionary approach should be applied with surveys that have the potential to cause noise interference when undertaken within internesting habitat. The adoption of the controls in **Table 6-11** ensure a precautionary approach to the potential impacts on turtles; a behavioural impact is expected for the short duration of the activity, but would not result in significant displacement from critical habitat.

The conservation advice for humpback whales identifies threats from anthropogenic noise and sets out management actions (controls) to address the threat. The assessment of noise emissions has determined that the activity may have a behavioural impact from anthropogenic noise during the activity. Therefore, the two relevant controls from the conservation advice for humpback whales that have been assessed are:

+ site-specific acoustic modelling (as per Approved Conservation Advice for *Megaptera novaeangliae* (humpback whale) (2015)); and
+ noise management plan (as per Approved Conservation Advice for *Megaptera novaeangliae* (humpback whale) (2015)).

Table 6-11: Control measure evaluation for noise emissions

CM Reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
SVA-CM01	Procedure for interacting with marine fauna	Reduces risk of physical and behavioural impacts to marine fauna from vessel, because if they are sighted, then the vessel can slow down or move away, and helicopters can increase distances from sighted fauna if required.	Operational costs to adhere to marine fauna interaction restrictions, such as vessel and helicopter speed and direction, are based on legislated requirements and must be adopted.	**Adopted** – Benefits in reducing impacts to marine fauna outweigh the costs incurred by Santos. Control drives compliance with EPBC Regulations (Part 8).
SVA-CM02	Watchkeeping maintained on bridge	Monitoring of surrounding marine environment to identify potential collision risks (and reducing harm) to cetaceans and other marine fauna.	No additional cost – industry practice.	**Adopted** – Industry practice, benefits outweigh cost. Control drives compliance with the EPBC Regulations.
SVA-CM23	Pre-Start Requirements	Potential reduction in impact of noise to some sensitive receptors based on principles of the EPBC Policy	Impracticable to schedule activities to avoid all listed marine fauna due to variability in timing of environmentally	**Adopted –** Where practical controls (in other words, where equipment allows).

CM Reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
		Statement 2.1 – Part A.	sensitive periods and the constant or unpredictable presence of some species. Short duration activity (in other words, a few days) that is low risk to marine fauna.	
N/A	Undertake site-specific acoustic modelling as per Approved Conservation Advice for *Megaptera novaeangliae* (humpback whale) (2015)	Increase the knowledge of potential impacts. However, noise emissions from geophysical surveys are already well documented.	Additional cost to undertake site specific acoustic modelling.	**Rejected** – Cost is disproportionate to increase in environmental benefit and area is not a BIA or known habitat for humpback whales.
N/A	Develop a noise management plan as per approved Conservation Advice for *Megaptera novaeangliae* (humpback whale) (2015)	Potential reduction in impacts to marine fauna.	Additional cost to develop a noise management plan for a short duration activity (in other words, a few days at a time) that is low risk to marine fauna.	**Rejected** – Cost is disproportionate to increase in environmental benefit and area is not a BIA or known habitat for humpback whales.
N/A	Dedicated Marine Mammal Observer (MMO) (as per EPBC Policy Statement 2.1 – Part B.1)	Improved ability to spot and identify marine fauna at risk of impact from vessel and survey noise.	Additional cost of contracting specialist MMO per survey.	**Rejected** –Potential impacts are low and of short duration for the VBA and therefore the potential for interaction is considered low. The use of trained crew to undertake pre-start observations is considered appropriate for the nature and scale of the activity, cost of MMOs is disproportionate to environmental benefit.
N/A	Schedule activities to avoid coinciding with sensitive periods	Potential reduction in impact of noise to some sensitive receptors.	The timing of surveys is subject to vessel availability and weather windows, and there are requirements for some VBA to be conducted within a set timeframe	**Rejected** – The operational area does not overlap with any known migration BIAs (such as humpback whale and blue whale migration) but these species could be present all year round. However, the potential impacts to cetaceans are

CM Reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
			before MODU arrival (MODU activities are subject to separate approvals); therefore, avoidance of activities for this six-month period, given the low impact, can result in the objectives of the survey being unable to be met. Short duration activity (in other words, a few days) that is low risk to marine fauna.	predicted to be low and, if they occur, would be well within 500 m of the vessel and equipment and, with the controls in place to manage interaction with fauna within 500 m of the vessel (SVA-CM01 and SVA-CM23), the potential for impact is significantly reduced. The activity will not restrict the movement of whales within the area as the area within which they are distributed is widespread. Cost is disproportionate to increase in environmental benefit.
N/A	Schedule activities to avoid coinciding with sensitive periods such as turtle nesting, internesting and hatching (September to April for multiple species)	Potential reduction in impact of noise to some sensitive receptors.	The timing of surveys is subject to vessel availability and weather windows, and there are requirements for some VBA to be conducted within a set timeframe before MODU arrival (MODU activities are subject to separate approvals) and therefore avoidance of activities for this 8 -month period given the low impact can result in the objectives of the survey being unable to be met. Short duration activity (in other words, a few days) that is low risk to marine fauna.	**Rejected** – The operational area does not overlap with any BIAs for turtles and is more than 120 km from the nearest turtle nesting areas (Ashmore Reef), but these species could be present all year round. However, the potential impacts to turtles if they occur would be well within 500 m of the vessel and equipment (behavioural impacts within tens of metres of the vessel) and, with the controls in place to manage interaction with fauna within 500 m of the vessel (SVA-CM01 and SVA-CM23), the potential for impact is significantly reduced. The activity will not restrict the movement of turtles within the area as the BIA and the area within which they are distributed is widespread. Cost is disproportionate to increase in environmental benefit.

CM Reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
N/A	Pre-survey research would involve sending a dedicated research vessel to the survey area ahead of time. Allows for survey planning around areas of peak migration and aggregation, therefore reducing risks to marine fauna (EPBC Policy Statement 2.1 – Part B.2)	Increased knowledge of marine fauna activity in the area.	Long lead time as a research vessel sent out to the field would need to go one year ahead of the survey at the planned time to collect relevant data, survey areas often not defined >1 year in advance, further risks from vessel collision and emissions; cost of research vessel.	**Rejected** – Cost is disproportionate to increase in environmental benefit.
N/A	No start-up or operations at night-time/low visibility (EPBC Policy Statement 2.1 – Part B.2)	Reduced probability of a cetacean occurring within the low power/shutdown zone and not being detected.	Increased time of survey. Increased cost due to increased survey time. Survey objectives would not be met in available timeframe.	**Rejected** – Cost is disproportionate to increase in environmental benefit.
N/A	Spotter planes/vessels sent to spot fauna ahead of the vessels over whole survey area (EPBC Policy Statement 2.1 – Parts B.2 and B.3).	Increased detection of individuals or groups of marine fauna which may be displaced or disturbed during night-time operations when visibility is low.	Marine fauna may have moved away from the area by the time the vessel arrives. Cost of specialist aircraft with good downward visibility, or cost of an additional spotter vessel, additional marine fauna observers (MFOs) required on board aircraft. Additional risks to environment through use of vessels/airplanes, increased safety risks to personnel onboard additional vessels/airplanes.	**Rejected** – Cost is disproportionate to increase in environmental benefit.

CM Reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
N/A	Passive acoustic monitoring (PAM) involves using hydrophones subsea to detect and monitor the presence of vocalising marine mammals and can assist in the confirmation of the presence of vocalising cetaceans. Additional detection methods reduce the risks to marine fauna in the vicinity by influencing the survey operations (EPBC Policy Statement 2.1 – Part B.5).	Potential to identify toothed cetaceans that do not breach the sea surface (for example, on long dives).	Difficult to detect the distance and direction of cetaceans to enable implementation of precaution zones unless confirmed by visual observations, only applicable to vocalising cetaceans, PAM very dependent on environmental conditions. Minimal costs for basic PAM; however, to enable PAM to be used efficiently, more complex PAM systems would be required with a dedicated vessel, thus increasing cost.	**Rejected** – Cost is disproportionate to increase in environmental benefit.
N/A	Adaptive management: (a) Terminating the survey for 24 hours if there are three or more humpback whale-induced shutdowns/power downs within the previous 24-hour period. (b) Terminating the survey if there are three consecutive days of no collection of survey data due to the presence of migrating humpback whales. (EPBC Policy Statement 2.1 – Part B.6)	Potential reduction in impacts to humpback whales.	Impracticable to schedule activities to avoid all listed marine fauna due to variability in timing of environmentally sensitive periods and the constant or unpredictable presence of some species. Short duration activity (in other words, a few days for each VBA) that is low risk to marine fauna.	**Rejected** – Cost is disproportionate to increase in environmental benefit.

6.1.4 Environmental impact assessment

Underwater noise emissions	
Key receptors	**Consequence level**
Noise from operation of equipment and vessels	
Threatened/ migratory fauna	Noise emitted by vessels and the survey activity will be short in duration and is likely to be reduced to background levels within within "thousands of metres" as described in studies assessed above. As such, any potential related marine fauna behavioural impacts are expected to be temporary and short ranged and are not expected to lead to long-term changes in individual behaviour (for example, migration) or lead to changes at the population level. Avoidance behaviour is likely to be localised within the area of the activity (due to small spatial extent of elevated noise) and temporary; in other words, for the duration of the activity only. Potential PTS to low-frequency whales (for example, humpback and blue whales) could occur within 12 m of the centre of the vessel (considering a representative vessel that is 54 m long) if the vessel and the cetacean remain in the same place for 24 hours. However, the vessel will never remain in one position for this long when conducting the noisier surveys (such as the SBP), and as whales are also always moving, the potential for this impact is extremely low. Behavioural impacts may be expected for marine mammals, that is, humpback whales, from the vessels and equipment. There are no known BIAs for marine mammals within 20 km of the defined operational area. There are no known BIAs for marine reptiles within 20 km of the defined operational area and therefore impacts are not expected on a population level or on turtle habitat. Individuals may be encountered within the operational area but are likely to be internesting adults due to the distance from the closest nesting beaches at Ashmore Reef and mainland Australia. Behavioural impacts could occur within the immediate vicinity of the vessel and equipment for a short duration and will likely result in the turtles moving away from the area. As the area within which foraging and distribution of all turtle species is widespread, the minimal disturbance is not expected to significantly impact the critical habitat for turtles, or impact at a population level due to the nature and scale of the activity (temporary, short duration, vessel-based activity). Some behavioural response to vessel noise could occur to benthic fish communities within the operational area. The homogenous, flat, featureless soft sediment, predominantly comprised of sand with small rubble/shell fragments, seabed of the operational area suggests there are unlikely to be any areas of particularly high abundance or diversity of fishes within this area. It is possible that whale sharks could pass through the operational area, as the whale shark foraging BIA overlaps. Whale sharks would be expected to show a behavioural response only, as it is unlikely this species would swim within close range (within metres) of high-energy sound sources (for example, bow thrusters) or the geophysical survey activities that could result in physiological damage. The slow working speed of vessels within the operational area further reduces the risk of any negative impacts attributable to vessel noise as well as the additional controls to manage interaction with marine fauna (SVA-CM01) and pre-survey requirements (SVA-CM23). The Conservation Advice *Rhincodon typus* Whale Shark (Threatened Species Scientific Committee, 2015b) identifies habitat disturbance as a risk. The expected noise levels and behavioural response are not considered to result in habitat disturbance, which is consistent with this advice. Seabirds are also unlikely to be directly affected by underwater noise generated during the VBA. Due to the distance of the operational area from any seabird nesting colonies, the potential for airborne noise from VBA to cause disturbance to seabirds is extremely low.

Underwater noise emissions	
Key receptors	**Consequence level**
Physical environment/ habitat	Not applicable – noise will not impact the physical environment itself, only the species mentioned above utilising it.
Threatened ecological communities	Not applicable – no threatened ecological communities identified in the area over which noise emissions are expected.
Protected areas	Not applicable – Closest protected area is 9 km from the operational area and is a subsea feature (Carbonate Bank and Terrace System of the Sahul Shelf KEF) and Ashmore Reef which is 120 km away.
Socio-economic	Noise levels are not expected to impact on socio-economic receptors due to their low activity level within the vicinity of the operational area. Impacts to fish may result in indirect impacts to fisheries in the area; however, considering the noise emissions are localised, the available catch area for commercial fishers and the area over which commercial species spawn, impacts to fisheries are considered acceptable.
Overall worst-case consequence	II – Minor

6.1.5 Demonstration of as low as reasonably practicable

Using the vessels and survey equipment is unavoidable if the planned activity is to proceed. Equipment maintenance will keep the noise levels to within normal operating limits, which will also aid in reducing the likelihood of impacts to sensitive receptors.

The sound levels generated by geophysical surveys are medium to high frequency and decay rapidly with distance travelled from the source, as demonstrated by Zykov (2013).

Note that marine fauna affected in varying degrees by acoustic noise (in other words, marine mammals, turtles, sharks and fish) are all expected to avoid the source of noise. This avoidance is likely to be from a small area (due to the small spatial extent of required activities) and to be temporary; in other words, activities are planned for up to ten days.

The vessel is also expected to produce similar noise emissions to other marine vessels that frequent or transit through the vicinity of the operational area (oil and gas industry vessels). The vessel will adhere to the EPBC Regulations (Part 8) to ensure actions are undertaken to avoid marine mammals and whale sharks within 500 m of a vessel. All crews will be inducted into these requirements. It is further expected that the vessel will typically emit sufficient noise for sensitive marine fauna to exhibit avoidance behaviour and move away from the activity to avoid physical impact zones.

Any behavioural impact caused by vessel and survey activity noise is likely to be localised and temporary. Marine species are expected to resume normal behavioural patterns in the open oceanic waters surrounding the operational area within a short timeframe, with no significant impact on their normal behaviour, including during sensitive periods such as migration, nesting or foraging.

The selection of equipment is based on the operational objectives of the activity. The equipment selected is generally tailored to the specific scope and location. Noise from the vessel will be sufficient for sensitive marine fauna to exhibit avoidance behaviour away from the activity to greater than the limited extent that

the equipment would cause physiological impacts (within a few metres). The use of equipment is necessary to undertake the survey to inform planned future activities. No viable alternatives exist.

Santos has considered the actions prescribed in various recovery plans and conservation advices, such as Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017), Blue Whale Conservation Management Plan 2015–2025 (2015) and Approved Conservation Advice for *Megaptera novaeangliae* (humpback whale) (2015) when developing the controls relevant to potential VBA to minimise noise impacts on marine cetaceans, sharks, fish and marine turtles. Management controls are in place to reduce operating noise, including vessel operational protocols, and to adhere to the fauna interaction management stated in Part 8 of the *Environment Protection and Biodiversity Conservation Regulations 2000*. As such, noise emitted during the activities is not expected to significantly impact on marine fauna within the receiving environment.

Avoiding periods of higher sensitivity, such as migration or nesting periods for whales and turtles, is not considered feasible. The operational area does not overlap with any established BIAs for marine fauna other than foraging whale sharks, and therefore species are not expected to be present in large numbers. Coupled with the fact that some of the proposed surveys are required within a set timeframe before MODU arrival to ensure safe placement of MODU legs, this restricts the timeframe within which surveys must be completed. Given the low potential impacts to individual fauna, there is not expected to be an impact at population level or significant impacts on migratory or nesting behaviours.

Additional controls were identified and considered but rejected, as detailed in **Section 6.1.3**. Therefore, the risks to marine fauna from noise associated with the project activities are considered to be ALARP.

6.1.6 Acceptability evaluation

Is the consequence ranked as I or II?	Yes – maximum consequence from underwater noise emissions is II (minor).
Is further information required in the consequence assessment?	No – potential impacts and risks are well understood through the information available.
Are risks and impacts consistent with the principles of ESD?	Yes – activity evaluated in accordance with Offshore Division Environmental Hazard Identification and Assessment Guideline which considers principles of ESD.
Are risks and impacts consistent with relevant legislation, international agreements and conventions, guidelines and codes of practice (including species recovery plans, threat abatement plans, conservation advice and AMP zoning objectives)?	Yes – controls implemented will minimise the potential impacts from the activity to species identified in Recovery Plans as having the potential to be impacted by noise emissions. Relevant species Recovery Plans, Conservation Management Plans and management actions, including: + Recovery Plan for Marine Turtles in Australia (2017) + Approved Conservation Advice for *Megaptera novaeangliae* (humpback whale) + Conservation Management Plan for the Blue Whale, 2015–2025 (2015b) + Approved Conservation Advice for *Balaenoptera physalus* (fin whale) (2015)
Are risks and impacts consistent with Santos Environment, Health and Safety Policy?	Yes – aligns with Santos' Environment, Health and Safety Policy.
Are risks and impacts consistent with stakeholder expectations?	Yes – no concerns raised.
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – see ALARP above.

No significant impacts are expected from noise for sensitive receptors in the operational area, given the localised and temporary and intermittent nature of the underwater emissions associated with planned activities and the proposed controls.

Minimal behavioural changes are expected from all marine fauna in the operational area; therefore, the negligible impacts expected from these noise sources are considered environmentally acceptable. No long-term harm is expected to result to EPBC listed marine fauna during VBA. Through adherence to Santos' *Protected Marine Fauna Interaction and Sighting Procedure* (EA-91-11-00003), which drives compliance with EPBC Policy Statement Part 8 (reflected in SVA-CM01), and consideration of EPBC Policy Statement 2.1 (reflected in SVA-CM23), the activity is considered acceptable to undertake in the area. In addition, no concerns from stakeholders (including fisheries) have been raised to indicate that the activity will have any unacceptable impacts to socio-economic receptors.

6.2 Light emissions

6.2.1 Description of event

Event	Potential impacts from light emissions may occur in the operational area from: + safety and navigational lighting on the support vessels + spot lighting that may also be used as needed, such as equipment deployment and retrieval. Lighting will typically consist of bright white (in other words, metal halide, halogen, fluorescent) lights typical of lighting used in the offshore petroleum industry and not dissimilar to lighting used for other offshore activities in the region, including shipping and fishing.
Extent	Localised: Limited light 'spill' or 'glow' on surface waters surrounding the vessel. Impacts expected to remain within the operational area, though a 20km buffer around the defined operational area is assumed as a precautionary limit.
Duration	Navigational and task lighting is required 24 hours a day for the duration of the activity.

6.2.2 Nature and scale of environmental impacts

Potential Receptors: Threatened/migratory fauna (marine mammals, marine reptiles – marine turtles (particularly hatchlings), sharks, rays and fish, and zooplankton and birds (sea)).

Continuous lighting emanating from the same location for an extended period of time may result in alterations to fauna behaviour. The combination of colour, intensity, closeness, direction and persistence of a light source are key factors in determining the magnitude of environmental impact (EPA, 2010). Disturbance may include the following:

+ Seabirds may either be attracted by the light source itself or indirectly due to marine fauna prey (such as fish and invertebrates) being attracted to light;
+ Marine turtles and turtle hatchlings may be misoriented and disoriented by lights; and
+ Fish and zooplankton may be directly or indirectly attracted to lights.

According to the National Light Pollution Guidelines for Wildlife, a 20 km threshold provides a precautionary limit based on observed effects of sky glow on marine turtle hatchlings, demonstrated to occur at 15 to 18 km from the light source and fledgling seabirds grounded in response to artificial light 15 km away. The intensity and extent of light glow, and the potential to result in biological impact, will depend on the light source itself, including the number, intensity, spectral output and position of individual lights at the source. The effect of light glow may occur at distances greater than 20 km for some species and under certain environmental conditions (Commonwealth of Australia, 2020).

Fish and plankton

The response of fish to light emissions varies according to species and habitat. Experiments using light traps have found that some fish and zooplankton species are attracted to light sources (Meekan *et al*., 2001), with traps drawing catches from up to 90 m away (Milicich *et al*., 1992). Lindquist *et al*. (2005) concluded from a study that artificial lighting associated with offshore oil and gas activities resulted in an increased abundance of clupeids (herring and sardines) and engraulids (anchovies). These species are known to be highly photopositive: the artificial light serves to focus their marine plankton prey and consequently leads to enhanced foraging success.

Threatened/migratory fauna

A PMST Search was conducted on a 20km buffer around the defined operational area to identify any MNES species within the recommended 20km threshold. All species identified within this search were also identified in the operational area PMST (**APPENDIX C**).

Marine mammals

There is no evidence to suggest artificial light sources adversely affect the migratory, feeding or breeding behaviours of marine mammals. Cetaceans predominantly use acoustic senses to monitor their environment rather than visual sources (Simmonds *et al*., 2004). Therefore, light from the project vessel night-time activity is not expected to have an impact on marine mammal behaviour.

Marine reptiles

There are no known BIAs for marine reptiles within 20 km of the defined operational area (**Table 6-2**). The closest BIA for marine reptiles lies more than 120 km away, as an internesting buffer BIA for the green turtle. Individuals may traverse the operational area and the nearest turtle nesting beach is more than 150 km away, at Cartier Island.

Marine turtles are particularly sensitive to artificial lighting, which is known to disrupt breeding adult turtles, post-emergent hatchlings and hatchlings dispersing in nearshore waters (Limpus, 1971; Salmon & Wyneken, 1992; Limpus, 2007, 2008a, 2008b, 2009a, 2009b; Wilson *et al*. 2018).

The Recovery Plan for Marine Turtles in Australia: 2017–2027 (Commonwealth of Australia, 2017) highlights artificial light as one of several threats to marine turtles. The recovery plan indicates that artificial light may reduce the overall reproductive output of a stock, and therefore recovery of the species, by:

+ inhibiting nesting by females;
+ disrupting hatchling orientation and sea-finding behaviour; and
+ creating pools of light that attract swimming hatchlings and increase their risk of predation.

This disruption can occur because hatchlings orient themselves to the lowest-elevation light horizon and away from high silhouettes when moving from the nest to the sea. When the direction of the lowest-elevation light horizon is not clear, hatchlings move towards the brightest, lowest horizon (Limpus & Kamrowski, 2013).

The National Light Pollution Guidelines states that a 20 km buffer (based on sky glow) to important habitat for turtles should be applied when considering possible impacts (DoEE, 2020). However, given the distance to the nearest turtle nesting beach is more than 150 km away, light from the vessel will not be visible and therefore impacts to nesting females, emerging hatchlings and internesting females is not credible. At these distances post-dispersal hatchings will be well dispersed, so the chances of them drifting through the operational area is reduced compared to nearshore areas adjacent to nesting beaches.

The North-west Marine Bioregion supports globally significant breeding populations of green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), loggerhead (*Caretta caretta*) and flatback (*Natator depressus*) turtles (DSEWPaC, 2012). However, there are no significant nesting locations near the operational area, with the closest nesting BIA lying more than 150 km away, on Ashmore and Cartier Reefs.

It is acknowledged that marine turtles may face multiple threats simultaneously across their lifecycle, including background noise increases and vessel strikes. Light emissions may act as a contributor to stock level decline when considering cumulative impacts of threats; however, behavioural responses are not expected to disturb long-distance movements, reproductive or feeding activities of turtles as there will only be individuals transiting the operational area. No impact is expected to turtles at a population level, including

those green turtles that nest on the Ashmore and Cartier Reefs, given the nature and scale of the activity, distance from the closest nesting site and the level of light emissions on the vessel.

Sharks, fish and rays

The response of fish to light emissions varies according to species and habitat. Experiments using light traps have found that some fish and zooplankton species are attracted to light sources (Meekan *et al*., 2001), with traps drawing catches from up to 90 m (Milicich *et al.,* 1992). Lindquist *et al*. (2005) concluded from a study that artificial lighting associated with offshore oil and gas activities resulted in an increased abundance of clupeids (herring and sardines) and engraulids (anchovies); these species are known to be highly photopositive. Lighting impacts may increase the risk of predation to these fish species. Shaw *et al.* (2002), in a similar light trap study, noted that juvenile tunas (Scombridae) and jacks (Carangidae), which are highly predatory, may have been preying upon concentrations of zooplankton attracted to the light field of the platforms. This could potentially lead to increased predation rates compared to unlit areas.

However, the low level of light emitted from a vessel is unlikely to lead to large-scale changes in species abundance or distribution. Impacts to transient fish will therefore be limited to short-term behavioural effects, with no decrease in local population size or area of occupancy of species nor loss or disruption of critical habitat or disruption to the breeding cycle.

A localised increase in fish activity as a result of vessel lighting is expected to occur as a result of the activity.

Birds (seabirds/shorebirds)

Lighting from the vessels may result in behavioural impacts to seabirds including terns and shearwaters. However, as they will be for a short duration, the consequence is considered negligible.

Studies conducted between 1992 and 2002 in the North Sea confirmed that artificial light was the reason birds were attracted to and accumulated around illuminated offshore infrastructure (Marquenie *et al*., 2008) and that lighting can attract birds from large catchment areas (Wiese *et al*., 2001). Birds may either be attracted by the light source itself or indirectly as structures in deep-water environments tend to attract marine life at all trophic levels, creating food sources and shelter for seabirds (Surman, 2002). The light from vessels may also provide enhanced capability for seabirds to forage at night.

Light potentially impacts breeding seabirds in the operational area in much the same way as it does marine turtles, though is species-dependent, and some seabirds may not be expected to experience any impact at all due to their diurnal behaviour (such as terns). Disoriented adult birds may not be able to return to their nests to relieve their mates or feed their young. Fledglings are particularly vulnerable to light through misorientation and disorientation when departing the colony for the first time.

The operational area does not overlap any BIAs for seabirds; therefore, the location of the operational area should not significantly impact seabird behaviour, given the large distances typically covered by breeding individuals.

Protected Areas

There are no marine protected areas within the operational area, with the Kimberley Marine Park being the closest, at more than 92 km away.

6.2.3 Environmental performance outcomes and control measures

The EPO relating to this hazard is:

+ Reduce impacts to marine fauna from lighting on vessels through limiting lighting to that required by safety and navigational lighting requirements (EPO-2).

The control measures for this activity are shown in **Table 6-12**, with EPSs and MC for the EPOs described in **Section 8**.

Table 6-12: Control measures evaluation for light emissions

CM Reference	Control Measure	Environmental benefit	Potential cost/issues	Evaluation
Standard control measures				
SVA-CM03	Lighting will be used as required for safe work conditions and navigational purposes	Light spill from unnecessary lighting reduced, even further lowering the likelihood of impacts to the fauna from vessel lighting. Lighting is assessed to only provide necessary lighting for safety and navigation during the activity, including orientation of lighting to reduce light spill on the water wherever feasible without compromising navigation and safety requirements. Reduces potential for additional light pollution to the environment, thus reducing the potential impacts to fauna.	Additional costs associated with implementing control.	**Accepted** – Cost is considered acceptable for the benefit that may be realised from this control.
Additional Control Measures				
N/A	Do not use lighting at night-time	Reduced risk of impacts from light emissions during environmentally sensitive periods for listed marine fauna (for example, turtle nesting and hatching).	Vessel lighting is required for safe operations; therefore, this control would restrict activity to daylight hours only, causing delays in scheduled activities, which in turn will have time and cost implications.	**Rejected** – Cost is disproportionate to increase in environmental benefit.

CM Reference	Control Measure	Environmental benefit	Potential cost/issues	Evaluation
N/A	Exclude offshore lighting during key periods for fauna	Reduced risk of impacts from light emissions during environmentally sensitive periods for fauna	Delays in scheduled activities, including future activities that are relying on this survey information, which in turn may have time and cost implications. This would also mean the activity can only be conducted during daylight hours, extending the length of the activity and the potential impacts from other planned aspects.	**Rejected** – Cost is disproportionate to increase in environmental benefit.
N/A	Reduce light intensity and/or frequencies which may attract turtles	Reduced risk of impacts from the intensity of light emissions for fauna (for example, turtle nesting and hatching and bird migration).	Delays in scheduled activities and cost involved with changing lighting may have significant implications on future activities.	**Rejected** – Cost is disproportionate to increase in environmental benefit given the short duration of the activity.
N/A	Review lighting on vessels to replace with a type (colour) that has less potential to impact	Reduces potential for impacts on certain sensitive receptors from light emissions.	High cost to complete lighting change-out. Navigational lighting colours are stipulated by law. Other non-navigational lighting on the vessels could be considered for change-out, but a pre-mobilisation review of lighting will ensure only essential lighting is used as required.	**Rejected** – Cost considered disproportionate compared to the incremental environmental benefit and is a legislative requirement.
N/a	Use of dark, matt surfaces to reduce sky glow across all activities	Reduces potential for impacts on turtles from light emissions during hours of darkness when light sources are more apparent and potential impacts are greatest.	Additional cost to repaint vessel surfaces.	**Rejected –** Given the distances from the nesting beaches, short duration of the activity and controls in place to limit lighting, the cost is considered disproportionate**.**

6.2.4 Environmental impact assessment

Receptor	Consequence level
Light emissions	
Threatened/migratory fauna	Sensitive receptors that may be impacted by light emissions in the same location for an extended period of time include fish at the surface, marine turtles and seabirds. Light emissions may be visible to turtles transiting or internesting in surrounding areas, however, it is unlikely due to distance from BIAs. The National Light Pollution Guidelines for Wildlife states a 20 km threshold provides a precautionary limit based on observed effects of sky glow on marine turtle hatchlings, demonstrated to occur at 15 to 18 km and fledgling seabirds grounded in response to artificial light 15 km away. This is particularly in relation to lights onshore rather than offshore, due to the use of visual cues to find the ocean being disrupted. The operational area is more than 20 km from any nesting, foraging or internesting sites, the closest being Ashmore and Cartier Reefs (150 km away). The activities will also be intermittent and short in duration so impacts will be negligible. Cetaceans and marine mammals are not known to be significantly attracted to light sources at sea; therefore, disturbance to behaviour is unlikely. Indirect impacts on food sources or habitats also unlikely (see below). Fish, sharks and birds have been shown to be attracted to artificial light sources; however, the short duration of the activity is unlikely to lead to large-scale changes in species abundance or distribution. Impacts to transient fish, sharks and seabirds will therefore be limited to short-term behavioural effects, with no decrease in local population size or area of occupancy of species, loss or disruption of critical habitat, or disruption to the breeding cycle. Due to management controls in place and distance from sensitive receptors, the artificial lighting associated with the VBA is considered to have a negligible impact on fauna.
Physical environment/ habitat	Not applicable – No impacts to physical environments and/or habitats from light emissions are expected.
Threatened ecological communities	Not applicable – No threatened ecological communities identified in the area over which light emissions are expected.
Protected areas	Not applicable – There are no marine protected areas within the operational area.
Socio-economic receptors	Not applicable – Lighting is not expected to cause an impact to socio economic receptors other than as a visual cue for avoidance of the area.
Overall worst-case consequence level	I – Negligible

6.2.5 Demonstration of as low as reasonably practicable

With the described controls, the consequence of artificial light on marine fauna and seabirds is considered to be negligible for the operational area, with insignificant impacts to ecological function. No population level impacts are expected, and the consequence is considered environmentally acceptable. There are no BIAs overlapping the operational area, with the closest for the green turtle lying more than 120 km away. As a result, there is no expected impact to the population or impact to individuals.

Avoiding periods of higher sensitivity nesting periods for turtles is not considered feasible for all species. Given the operational area does not overlap with any BIAs for turtle species, coupled with the fact that some of the proposed VBA are required within a set timeframe before MODU arrival to ensure safe placement of

MODU legs, this restricts the timeframe within which surveys must be completed. Given the low potential impacts to individual fauna, there is not expected to be an impact at population level or significant impacts on migratory or nesting behaviours.

The Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017) specifies the following priority action for the Pilbara genetic stock of flatback turtles:

+ Artificial light within or adjacent to habitat critical to the survival of marine turtles will be managed such that marine turtles are not displaced from these habitats.

As the operational area does not overlap any BIAs for turtles, lighting from the transient planned activity is not expected to impact aggregating adults or internesting and nesting behaviour; therefore, displacement will not occur and the habitat critical to survival of the species will not be affected.

The increased risks/impacts with potentially larger-scale consequences associated with reduced light levels are considered to present a cost that is grossly disproportionate to any environmental benefit. Given that lighting on the vessels will be consistent with industry standards and will result in negligible consequences, and no reasonably practicable additional controls or alternatives were identified, it is considered that the environmental impacts of using 24-hour artificial lighting at an intensity to allow work to proceed safely are ALARP. The assessed residual consequence for this impact is Negligible and cannot be reduced further. Additional control measures were considered but rejected since the associated cost or effort was grossly disproportionate to any benefit, as detailed in **Section 6.2.3**. It is considered therefore that the impact of the activities conducted are acceptable and ALARP.

6.2.6 Acceptability evaluation

Is the consequence ranked as I or II?	Yes – maximum consequence from light emissions is I (Negligible).
Is further information required in the consequence assessment?	No – potential impacts and risks are well understood through the information available.
Are risks and impacts consistent with the principles of ESD?	Yes – activity evaluated in accordance with Offshore Division Environmental Hazard Identification and Assessment Guideline which considers principles of ESD.
Are risks and impacts consistent with relevant legislation, international agreements and conventions, guidelines and codes of practice (including species recovery plans, threat abatement plans, conservation advice and AMP zoning objectives)?	Yes – management consistent with International Convention of the *Safety of Life at Sea (SOLAS) 1974 and the Navigation Act 2012*. Consistent with relevant species recovery plans, conservation management plans and management actions set out in **Table 3-9**, including: + National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds (DoEE, 2020) + Recovery Plan for Marine Turtles in Australia (2017).
Are risks and impacts consistent with Santos Environment, Health and Safety Policy?	Yes – aligns with Santos' Environment, Health and Safety Policy.
Are risks and impacts consistent with stakeholder expectations?	Yes – no stakeholder concerns have been raised.
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – see ALARP above.

Lighting of the vessels is industry standard and required to meet relevant maritime and safety regulations. The potential consequences of the anthropogenic light sources in the operational area are considered to be insignificant in nature and restricted to short-term behavioural impacts on individual fauna that may be present in the operational area during the activity.

The operational area does not overlap any BIAs for turtles, and therefore lighting from the planned VBA is not expected to impact aggregating adults. Significant impacts are not expected on fauna, including nesting turtles or hatchlings, and will not cause turtles to be displaced from these habitats. The Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017) specifies the following priority action for the turtles in relation to light pollution:

+ Artificial light within or adjacent to habitat critical to the survival of marine turtles will be managed such that marine turtles are not displaced from these habitats.

The potential consequence of light emissions on receptors is assessed as negligible (I) and will not have a significant impact on any habitat identified as critical to the survival of marine turtles. With the control measures in place, including compliance with navigational safety legislation, no significant impacts are expected. Therefore, the impacts of light emissions to the receiving environment are ALARP and considered environmentally acceptable.

6.3 Atmospheric emissions

6.3.1 Description of event

Event	Potential atmospheric emissions include greenhouse gases (GHG), such as carbon dioxide (CO_2) and nitrous oxide (N_2O), non-GHGs such as sulphur oxides (SOx), oxides of nitrogen (NOx) and ozone depleting substances (ODS) resulting from: + use of fuel to power vessel engines, generators and equipment + incineration generating point source emissions including CO_2, carbon monoxide (CO), NOx, sulphur dioxide (SO_2) and particulates + ODS should leaks occur from refrigeration and chiller systems on vessels.
Extent	Localised: The quantities of gaseous emissions are relatively small and will, under normal circumstances, quickly dissipate into the surrounding atmosphere.
Duration	Intermittent for the duration of the activities.

6.3.2 Nature and scale of environmental impacts

Potential Receptors: Physical environment (air quality), socio-economic (commercial fishers, shipping traffic and other oil and gas activities).

The potential impacts from the release of air emissions identified above include:

+ deterioration of local and regional air quality; and
+ contribution to regional, national and global greenhouse gas emissions.

Physical environment

Hydrocarbon combustion may result in a temporary, localised reduction of air quality in the environment immediately surrounding the discharge point during the activity, which could affect seabirds and humans in the immediate vicinity. The combustion emission of GHGs can lead to a reduction in local air quality and add to the national GHG loading, which could in turn contribute to climate change. Non-GHGs may be toxic, odoriferous or aesthetically unpleasing.

ODSs are used in closed refrigeration systems onboard vessels. ODSs have the potential to contribute to ozone-layer depletion if accidentally released to the atmosphere. ODSs are not used, generated or discharged by vessel activity other than what is incidentally located and used in closed systems onboard vessels. ODSs will not be deliberately released during the course of the activity. ODS air emissions would only occur in the event of damaged or faulty refrigeration equipment.

Based on the information available, the atmospheric emissions that are a key focus in terms of potential environmental impacts are:

+ GHG (principally CO_2); and
+ oxides of nitrogen.

Socio-economic

Additional atmospheric emissions in the area may have a negative impact on other users of the area. There is no exclusion zone in place around the vessel during the activity; therefore, other marine users may encounter changes in air quality.

6.3.3 Environmental performance outcomes and control measures

The EPOs relating to this hazard are:

+ Reduce impacts to air and water quality from planned discharges and emissions from the activities (EPO-03); and
+ No unplanned objects, emissions or discharges to sea or air (EPO-06).

The control measures for this activity are shown in **Table 6-13**, with EPS and measurement criteria for the EPOs described in **Section 8**.

Table 6-13: Control measures evaluation for atmospheric emissions

CM Reference	Control Measure	Environmental benefit	Potential cost/issues	Evaluation
Standard Control Measures				
SVA-CM04	Vessel planned maintenance system to maintain vessel DP, engines and machinery	Reduced emissions from vessels because equipment is operating within its parameters.	Operational costs and labour/access requirements of maintaining vessels.	**Adopted** – Benefits of operating equipment within operational parameters will help maintain vessel fuel efficiency.
SVA-CM05	Fuel oil quality	Reduced emissions through use of low sulphur fuel in accordance with MARPOL.	Operational costs of refuelling.	**Adopted** – Environmental benefit outweighs the costs.

CM Reference	Control Measure	Environmental benefit	Potential cost/issues	Evaluation
SVA-CM06	International Air Pollution Prevention Certification (IAPP)	Reduced probability of potential impacts to air quality due to ODS emissions, high NOx, SOx and incineration emissions.	Vessel has current IAPP Certificate as per vessel class, during vessel contracting procedure and in pre-mobilisation audits/inspections.	**Adopted** – Under Marine Orders, the vessel must be compliant to operate in Australian waters.
SVA-CM07	Waste incineration	Reduces potential impacts to air quality due to waste incineration.	Increase in health risk from storage of wastes. Increase in risk due to transfers (increased fuel usage, potential increase in collision risk, disposal on land).	**Adopted** – Environmental benefit outweighs the costs associated with transporting waste to shore for landfill.
Additional Control Measures				
N/A	No incineration during vessel-based operations activities	Eliminates the potential for emissions due to waste incineration to impact air quality.	Increase in health risk from storage of wastes. Increase in risk due to transfers (increased fuel usage, potential increase in collision risk, disposal on land).	**Rejected** – Health and safety risks outweigh the benefit, given the offshore location. Cost associated with transporting waste to shore for landfill or incineration outweighs onboard incineration.
N/A	Removal of all ODS-containing equipment	Eliminates the potential of ODS emissions occurring, impacting on air quality.	Lack of refrigeration systems onboard the vessels would lead to unacceptable workplace conditions. It is noted that ODS is rarely found on vessels.	**Rejected** – Based on unacceptable workplace conditions (health and safety).
N/A	Alternative fuel type (non-hydrocarbon based) selected for the vessel	Could reduce level of pollutants released to the environment during fuel combustion.	Practical and reliable alternative fuel types and power sources for the vessel have not been identified. If an alternative was available, vessels have fuel specification for equipment. Change of fuel may require further modifications to equipment.	**Rejected** – Not feasible.

CM Reference	Control Measure	Environmental benefit	Potential cost/issues	Evaluation
N/A	Use incinerators and engines with higher environmental efficiency	Improves air quality by more efficient burning or fuel combustion.	Significant cost in changing unknown vessel equipment.	**Rejected** – Cost grossly disproportionate to low environmental benefit (impact rated negligible).

6.3.4 Environment impact assessment

Key receptors	Consequence level
Atmospheric emissions	
Threatened/migratory fauna	Emissions are relatively small and will, under normal circumstances, quickly dissipate into the surrounding atmosphere. Short-term behavioural impacts to seabirds could be expected if they overfly the location; they may avoid the area. No decrease in local population size or area of occupancy of species, loss or disruption of critical habitat, disruption to the breeding cycle or introduction of disease. Therefore, any potential impacts are not expected to result in a decrease in local population size or disruption to the breeding cycle in the operational area (I – Negligible).
Physical environment/ habitat	The activity may result in the deterioration of local and regional air quality. Gaseous and particulate emissions will, under normal circumstances, quickly dissipate into the surrounding atmosphere.
Threatened ecological communities	Not applicable – no threatened ecological communities identified in the area over which air emissions are expected.
Protected areas	Not applicable – there are no protected areas within the operational area over which air emissions are expected.
Socio-economic receptors	As the activity occurs in offshore waters, the combustion of fuels in such remote locations will not impact on air quality in coastal towns or large human settlements. The emissions will, under normal circumstances, quickly dissipate into the surrounding atmosphere. The highly dispersive nature of local winds (in other words, strong and consistent) is expected to reduce potentially harmful or 'noticeable' gaseous concentrations within a short distance from the vessel and therefore will not impact on other marine users in the vicinity. Atmospheric emissions will add to the global inventory of GHGs; however, they and non-GHGs are not expected to have any local environmental consequences.
Overall worst-case consequence level	I – Negligible

6.3.5 Demonstration of as low as reasonably practicable

Power generation through combustion of fossil fuels is essential to undertaking the VBA, either by vessel or power generation. Given the routine maintenance of these systems by suitably qualified personnel, all practicable management measures are considered to have been implemented, and the likelihood of significant impacts occurring have been reduced to ALARP.

Implementation of a zero-incineration policy on the vessels would result in significant costs associated with the transport of waste to shore for disposal. Further transportation of the waste to shore would increase the environmental impacts and risks associated with the VBA through increased vessel movements and generate greater volumes of emissions associated with the vessel movements. Since incineration is a permitted maritime operation in accordance with Marine Order 97 (reflecting MARPOL Annex VI requirements), it is considered ALARP.

Lack of refrigeration systems (in other words, air conditioning) would lead to unacceptable workplace conditions and poor food hygiene standards, limiting the ability to undertake the activities. Therefore, there is no practical alternative to using refrigeration.

The MARPOL standards and AMSA marine orders are considered to be the most appropriate standards for vessels to adhere to in this environment, given the nature and scale of the activities, and they are widely used by the industry. These include regulations controlling the level of NOx and SOx from vessel engines. Compliance with these requirements, together with implementation of the controls listed above, reduces to ALARP the environmental impacts associated with air emissions.

The assessed residual consequence for this impact is negligible (I) and cannot be reduced further. Additional control measures were considered but rejected since the associated cost or effort was grossly disproportionate to any benefit. It is considered therefore that the impact of the activities conducted is ALARP.

6.3.6 Acceptability evaluation

Is the consequence ranked as I or II?	Yes – maximum consequence from atmospheric emissions is I (Negligible).
Is further information required in the consequence assessment?	No – potential impacts and risks are well understood through the information available.
Are risks and impacts consistent with the principles of ESD?	Yes – activity evaluated in accordance with Offshore Division Environmental Hazard Identification and Assessment Guideline which considers principles of ESD.
Are risks and impacts consistent with relevant legislation, international agreements and conventions, guidelines and codes of practice (including species recovery plans, threat abatement plans, conservation advice and AMP zoning objectives)?	Yes – management consistent with Convention of SOLAS 1974, *Navigation Act 2012*. No plans identified atmospheric emissions like those described above as being a threat to marine fauna or habitats.
Are risks and impacts consistent with Santos Environment, Health and Safety Policy?	Yes – aligns with Santos' Environment, Health and Safety Policy.
Are risks and impacts consistent with stakeholder expectations?	Yes – no stakeholder concerns have been raised regarding this aspect.
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – see ALARP above.

Atmospheric emissions from vessels are permissible under the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*, which is enacted in Australian waters by Marine Order 97 (Marine pollution prevention – air pollution) (which also reflects MARPOL Annex VI requirements). This is an internationally

accepted standard that is used industry-wide, and compliance with MARPOL standards is considered to be an appropriate management measure in this case.

The overall impacts to the atmosphere and sensitive receptors are expected to be negligible (I) if the emission management is adhered to and impacts from emissions that are generated by the activity are considered environmentally acceptable.

6.4 Seabed and benthic habitat disturbance

6.4.1 Description of event

Event	Disturbance to the seabed and benthic habitats could potentially occur as a result of the following activities that may be undertaken in the operational area: + Geotechnical surveys: – Placement of seabed mounted drilling rig (approximate footprint of 20 to 25 m^2). – Collection of core samples via seabed or vessel-mounted drilling rig to an approximate maximum depth of 40 m and small core diameter (approximately 0.25 m); it is expected that only minor volumes of sediments and turbidity will be generated (approximately 2.5 m^3 per sampling borehole). Up to five boreholes may be required. – Shallow cores (vibrocoring, CPTs) to depths of less than 6 m with small core diameter (approximately 25 to 36 mm). Up to ten sampling boreholes may be required. – Discharge of water-based muds (such as bentonite or guar gum) at the seabed; small volumes would be discharged during drilling as part of the sediment volume indicated above. – Collection of grab sediment samples which is expected to disturb an area approximately 1.5 m deep and 1 m^2 area per sample. Up to eight samples may be required. + ROV/AUV surveys: Turbidity and increased sedimentation due to the use of ROVs (thrusters), AUVs and placement of equipment. This may result in minor seabed disturbance, sedimentation or water quality impacts (in other words, increased turbidity).
Extent	Localised: within the operational area.
Duration	For operational life of the activity up to ten days.

6.4.2 Nature and scale of environmental impacts

Potential Receptors: Physical environment (water quality and benthic habitats), threatened/migratory fauna (marine reptiles, sharks, fish and rays).

VBAs described above may cause the following impacts:

+ Direct physical disturbance of benthic and seabed habitat, including benthic fauna by equipment during sediment sampling (grabs, cores, drilling) and the temporary placement of equipment (transponders, seabed-mounted drilling rigs);
+ Geotechnical activities and generation of displaced materials during rotary drilling will produce minor amounts of suspended sediments in the water column, some minor localised increase in turbidity, and may lightly smother localised infauna and epifauna; and
+ The extent of accumulated material at seabed will depend on the depth of the borehole and ambient environmental energy (for example, currents, influence of swell and tidal energies). The offshore

environment is a high-energy, open-water environment and accumulation of materials from geotechnical activities is expected to be limited.

Physical environment

The use of equipment for the survey will directly contact the seafloor and will inevitably result in very localised impact (direct and indirect) to water quality, seabed features and the benthic environment in the operational area. The highest significance VBA resulting in seabed disturbance is geotechnical activities. Environmental impacts would be directly associated with placing seabed mounted rig, coring the seabed causing direct loss of benthic habitat in the sampling footprint, and secondary impacts due to deposition of materials at seabed and localised turbidity. Given a geotechnical core is expected to be approximately 0.25 m in diameter, a surface area of approximately 0.05 m^2 per core (1 m^3 volume), the impacts to seabed are expected to be highly localised and of short duration. CPTs and grab samples would be over much smaller areas.

Temporary or permanent direct loss of benthic habitat and associated biota and degradation of water quality may potentially occur during survey activities.

The benthic biota around the operational area is very similar to that of the wider region, with a low species abundance and high species richness. No significant seabed features or biota have been found in the immediate region surrounding the operational area.

The scale of potential habitat loss and seabed disturbance from localised vessel survey activities is small in comparison to the vast size of soft substrata habitats spanning the North Australian shelf and limestone pavement habitats in the region of operations. The relatively small disturbance area (2.5 m^3 volume for each activity) from these planned activities will therefore not have a significant impact on benthic biota or habitat. The holes from coring and sediment samples will also infill over time.

Indirect impacts associated with a temporary (several hours) and localised (within tens of metres) decline in water quality due to increased suspended sediments, discharged drilling chemicals/muds or sedimentation of the seabed are not expected to affect any values and sensitivities of regional importance. It is not considered that localised impacts within the operational area will result in significant indirect impacts (in other words, turbidity) to nearby marine reserves, offshore reefs or islands, given their distance from the activity.

Threatened/migratory fauna

Habitat modification is identified as a potential threat to marine fauna species in relevant Recovery Plans and Conservation Advice (**Table 3-9**). Disturbance of the seabed is not anticipated to significantly affect mobile marine fauna, such as marine mammals, marine reptiles, fish, sharks and rays. The area of seabed to be disturbed within the operational area also represents a negligible portion of the habitat available for these species. No decrease in local population size, area of occupancy of species, loss or disruption of critical habitat or disruption to the breeding cycle of any of these protected matters is expected.

There are no BIAs for marine turtles within the operational area (**Table 6-2**). The habitat within the operational area is representative of habitats within the broader region, and permanent displacement of habitat from seabed disturbance is not expected due to the small scale of the activity.

Fish, sharks and rays may also forage in the soft sediments for marine invertebrates. However, given the small scale of the activity (2.5 m^3 for each activity) and the regional availability of habitat, seabed and benthic habitat disturbance is not expected to affect these species.

Protected and significant areas

There are no protected or significant areas intersecting the operational area where seabed disturbance could occur.

6.4.3 Environmental performance outcomes and control measures

EPOs relating to this hazard include:

+ Seabed disturbance limited to planned activities and defined locations within the operational area (EPO-04); and
+ No unplanned objects, emissions or discharges to sea or air (EPO-06).

The control measures considered for this activity are shown in **Table 6-14**. EPSs and MC for the EPOs are described in **Section 8**.

Table 6-14: Control measures evaluation for seabed and benthic habitat disturbance

CM Reference	Control Measure	Environmental benefit	Potential cost/issues	Evaluation
Standard Control Measure				
SVA-CM08	Equipment deployment management	Requires using Santos-approved locations within the operational area, except in the case of an emergency, to prevent further seabed disturbance.	No additional costs to Santos other than negligible personnel costs of reviewing information in an emergency situation.	**Adopted –** Minimises impacts to the seabed through the identification of approved areas.
SVA-CM24	Chemical selection procedure	Aids in the process of chemical management that reduces the impact of chemical discharges to sea if lubricants are required for geotechnical drilling. Only environmentally acceptable products are used.	Cost associated with implementation of procedure. Range of chemicals reduced with potentially higher costs for alternative products.	**Adopted** – Environmental benefit of using lower toxicity chemicals outweighs procedural implementation costs.
SVA-CM16	Dropped object recovery	Requires dropped objects to be recovered (where safe and practicable to do so) unless the environmental consequences are negligible.	Additional personnel and vessel costs to plan and undertake if safe and practicable to do so.	**Adopted** – Benefits of recovering dropped objects where safe and practicable, unless the environmental consequences are negligible to do so, outweigh the costs.
SVA-CM17	Dropped object prevention procedures	Implementation of a dropped object prevention procedure for equipment	No additional costs to Santos other than negligible personnel	**Adopted** – Helps to minimise impacts and extent of seabed disturbance.

CM Reference	Control Measure	Environmental benefit	Potential cost/issues	Evaluation
		deployment helps to minimise impacts and extent of seabed disturbance through standards for lifting equipment inspection and maintenance and procedures for lifting.	costs of reviewing information.	
SVA-CM29	Recovery of all deployed equipment	Prevents ongoing impact to the seabed due to equipment being left in situ.	Minimal additional cost to recover equipment.	**Adopted** – Helps to minimise impacts and extent of seabed disturbance.
Additional Control Measures				
N/A	Take fewer samples	Impacts to the seabed are reduced.	Substantial cost to the quality of survey data obtained.	**Rejected** – Cost outweighs the benefit.

6.4.4 Environmental impact assessment

Key receptors	Consequence level
Seabed disturbance	
Threatened/migratory fauna	Given the small scale of the activity, minor and short-term nature of indirect impacts and the regional availability of the habitats present, seabed and benthic habitat disturbance is not expected to impact threatened/migratory species. Marine invertebrates may inhabit soft sediments and can contribute to the diet of some fauna. Non-coral benthic invertebrates may be present in the operational area; however, there is not expected to be any significant areas of these. Furthermore, the area of soft habitat that is potentially impacted is small compared to the amount of habitat available; therefore, the disturbance is not expected to affect prey availability or protected fauna species. Habitat modification is identified as a potential threat to marine fauna species in relevant Recovery Plans and Conservation Advice (**Table 3-9**). However, the operational area has not been identified as a significant habitat that supports any protected species. Impacts will be temporary, and the area potentially impacted is small compared to the size of the areas used by these species for foraging. Therefore, no long-term impacts to these species are expected. No decrease in local population size, area of occupancy of species, loss or disruption of critical habitat or disruption to the breeding cycle of any of these protected matters is expected. Given the fact that the activity is proposed in small areas, the activity is short-term and the nature of the existing environment is such that there is no benthic habitat providing significant environmental value to threatened or migratory species, the consequence level is considered to be Minor (II).
Physical environment/ habitat	Impacts from seabed disturbance are expected to be localised, and indirect impacts may result in short-term increases in turbidity in the immediate vicinity of sediment samples and placement of the equipment. The area of physical environment and habitat that will be impacted during the proposed activities is small compared to the area of similar habitat in the wider environment and is expected to re-establish after disturbance. Given the nature of the habitats within the operational area that are representative of those within the region, and the localised nature of disturbance, impacts to the physical environment/habitat are assessed as Minor (II).
Threatened ecological communities	Not applicable – no threatened ecological communities are identified in the area where seabed disturbance could occur.
Protected areas	Not applicable – there are no protected areas within the operational area where seabed disturbance could occur.
Socio-economic	Not applicable – disturbance of the seabed and benthic habitat within the operational area will not impact socio-economic receptors such as shipping. Any minor alteration or modification to habitats is not expected to impact commercial fisheries target species, based on the small size of disturbance. No stakeholder concerns have been raised regarding this aspect.
Worst case consequence level	II – Minor

6.4.5 Demonstration of as low as reasonably practicable

There are no additional practicable alternatives in order to proceed in a successful and safe manner to reduce seabed disturbance associated with the VBA. Management controls and installation procedures are designed to further limit the extent of direct seabed disturbance.

The activities within the operational area occur in benthic habitats (in other words, primarily soft sediments with little epifauna) that are widely represented at a regional scale. Impacts will be localised within the operational area and in the immediate vicinity of the sediment samples and equipment. The placement of equipment may leave indentations on the seabed and cause a temporary increase in water column turbidity, but this will be limited to the top layer of sediment. Coring that may be required will result in deeper indentations that will take a little longer to infill, but the footprint (0.25 m in diameter) and number of these (up to five) will be small and therefore have a minor impact on the seabed. The footprint from a seabed-mounted drilling rig to collect these samples will also result in impacts to the surface layers of sediment within the operational area, and where possible the use of a vessel mounted drilling rig will be used to minimise this disturbance. However, this depends on equipment availability; therefore, the worst case is assumed and can result in minor seabed disturbance.

Given the localised nature of activities which may cause seabed and benthic habitat disturbance, and expected rapid recovery time, environmental impacts are expected to be minor.

The proposed management controls for seabed disturbance are considered appropriate to manage the risk to ALARP.

6.4.6 Acceptability evaluation

Is the consequence ranked as I or II?	Yes – maximum consequence to seabed and benthic habitats is II (Minor).
Is further information required in the consequence assessment?	No – potential impacts and risks well understood through the information available.
Are risks and impacts consistent with the principles of ESD?	Yes – activity evaluated in accordance with Offshore Division Environmental Hazard Identification and Assessment Guideline which considers principles of ESD.
Are risks and impacts consistent with relevant legislation, international agreements and conventions, guidelines and codes of practice (including species recovery plans, threat abatement plans, conservation advice and AMP zoning objectives)?	Yes – no plans identified seabed disturbance like those described above as being a threat to marine fauna or habitats.
Are risks and impacts consistent with Santos Environment, Health and Safety Policy?	Yes – aligns with Santos' Environment, Health and Safety Policy.
Are performance standards consistent with stakeholder expectations?	Yes – no concerns raised.
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – see ALARP above.

The potential consequence of seabed disturbance on receptors is discussed above and is assessed as minor (II). With the control measures in place, including compliance with industry standards and legislation, no significant impacts are expected. As such, the risk is considered acceptable.

6.5 Interaction with other marine users

6.5.1 Description of event

Event	Sources of impact to other marine users may occur as a result of, but not limited to: + the vessel moving through the operational area posing collision risk and potential inconvenience + towed equipment. The presence of the activity could potentially inhibit marine user groups, such as commercial shipping, fishing and other oil and gas activities.
Extent	The operational area.
Duration	Temporary and intermittent interaction with vessels when transiting the operational area.

6.5.2 Nature and scale of environmental impacts

Potential Receptors: Socio-economic (commercial fishers, shipping traffic and other oil and gas activities).

Potential impacts to tourism and recreational fisheries include displacement while the vessels are in the operational area.

Socio-economic

There are three Commonwealth fisheries that overlap the operational area and could be actively fished (**Section 3.2.4**). An analysis of the current fishery closures, depth range of activity, historical fishing effort data, fishing methods and consultation feedback (refer to **Section 4**) has revealed there is a low potential for interaction with commercial fisheries. None of the Commonwealth fisheries identified in **Section 3.2.4** are likely to be active in the operational area. A number of State commercial fisheries also overlap the operational area but significant disruption to these fisheries is not expected, given the typical water depths they operate in and the vast areas available to the fisheries.

No shipping fairways overlap the operational area (**Figure 3-17**). Analysis of historical Australian Ship Reporting System shipping data indicates commercial vessels do use the area; however, this is most likely vessels in the oil and gas industry, as activity is mostly located around oil and gas fields with transit to and from ports. Should commercial vessels need to deviate from planned routes to avoid the activity vessel, this may slightly increase transit times and fuel consumption. No concerns have been raised by the shipping industry through consultation or in the past five years relating to disturbance to shipping routes as a result of activities within the region.

Tourism activities are expected to occur very infrequently in the operational area. Activities such as snorkelling, diving, surfing and fishing are most likely to occur around Ashmore Reef and Cartier Island, more than 130 km away from the operational area.

The nearest operating facility to the operational area is Jadestone's Montara oil field and associated infrastructure (**Figure 3-16**). Interaction with oil and gas related vessels could occur, potentially resulting in minor deviations from their planned route, which may slightly increase transit times and fuel consumption. No concerns have been raised by the oil and gas industry through consultation.

AMSA requires a high level of communication during the activities and inclusion of the activity on a Notice to Mariners, therefore reducing the likelihood of interaction with other sea users. Noting that other users will still be able to access the operational area during the activity as no exclusions are in place, but usual maritime safe distance to allow concurrent operations with other users will apply.

6.5.3 Environmental performance outcomes and control measures

The EPO relating to this hazard is:

+ Reduce impacts on other marine users through the provision of information to relevant stakeholders, such that they are able to plan for their activities and avoid unexpected interference (EPO-05).

The control measures for this activity are shown in **Table 6-15**. EPSs and MC for the EPOs are described in **Section 8**.

Table 6-15: Control measures evaluation for interaction with other marine users

CM Reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
Standard control measures				
SVA-CM02	Watchkeeping maintained on bridge	Reduced impacts to commercial fisheries by actively avoiding their activities and schooling fish in their vicinity.	Negligible costs.	**Adopted** – Benefits considered to outweigh costs.
SVA-CM03	Lighting used as required for safe work conditions and navigational purposes	Ensures vessels are seen by other marine users. Reduced risk of environmental impact from vessel collisions due to ensuring safety requirements are fulfilled. Marine Order Part 30: Prevention of Collisions, and with Marine Order Part 21: Safety of Navigation and Emergency Procedures, requires vessels to have navigational equipment to avoid collisions.	Negligible costs of operating navigational equipment. Costs associated with vessel fit-out with navigational equipment.	**Adopted** – Safety benefits (and thus environmental benefits) outweigh the cost. Compliance with Marine Orders are a legislated requirement.
SVA-CM09	Seafarer certification	Requires appropriately trained and competent personnel to navigate vessels, which reduces negative interaction with other marine users.	Costs associated with personnel time in obtaining qualifications.	**Adopted** – Benefits considered to outweigh costs and is a legislated requirement.
SVA-CM10	Stakeholder consultation strategy	Santos will update relevant stakeholders on a quarterly basis, before the activity commencing and upon activity cessation.	Costs associated with personnel time in preparing and distributing information and collating/addressing any feedback provided.	**Adopted** – Benefits considered to outweigh negligible costs to Santos.
SVA-CM11	No fishing from vessel	Reduces potential impacts to fisheries in the vicinity of the activity.	Negligible costs.	**Adopted** – Benefits considered to outweigh negligible costs to Santos.

CM Reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
Additional control measures				
N/A	Eliminate the use of vessels	Would eliminate potential impacts to other marine users.	Not considered feasible as a vessel is the only form of transport that can undertake the activities.	**Rejected** – Not feasible.
N/A	Manage the timing of the survey to avoid peak marine user periods (for example, tourism and recreational fishing)	Would eliminate potential impacts to other marine users.	Not considered feasible as marine users could potentially be in the area all year round. The area that stakeholders are excluded from is small when compared to the area available to other marine users, and there is low fishing and tourism activity in the area, as evidenced through consultation.	**Rejected** – Stakeholders in the area all year round.

6.5.4 Environmental impact assessment

Key receptors	Consequence Level
Interaction with other marine users	
Threatened/migratory fauna	Not applicable – related to socio-economic receptors only.
Physical environment/habitat	
Threatened ecological communities	
Protected areas	
Socio-economic receptors	Commercial fishing, shipping and tourism in the area are expected to be low. Other marine users currently plan their activities in consideration of other petroleum activities and other marine users (shipping) in the region. AMSA requires a high level of communication during the activity, therefore reducing the likelihood of interaction with other sea users through ongoing communication with relevant stakeholders.
Overall worst-case consequence	I – Negligible

6.5.5 Demonstration of as low as reasonably practicable

No alternative options to the use of vessels are possible in order to undertake marine based VBA. If the management controls are adhered to, the risk of interfering with other users of the sea will have been reduced to ALARP.

Stakeholders have been informed of the proposed activities as detailed in **Section 4**. Throughout the duration of EP preparation, details of the activity have been communicated to relevant stakeholders as appropriate.

In consultation, stakeholders are made aware of the proposed area from which other marine users may be excluded for the duration of the activity and the potential schedule.

No concerns have been raised by stakeholders regarding the activity within the proposed operational area.

The proposed management controls for marine user interaction are considered appropriate to manage the risk to ALARP.

6.5.6 Acceptability evaluation

Is the consequence ranked as I or II?	Yes – maximum interaction with other marine users; consequence is I (Negligible).
Is further information required in the consequence assessment?	No – potential impacts and risks well understood through the information available.
Are risks and impacts consistent with the principles of ESD?	Yes – activity evaluated in accordance with Offshore Division Environmental Hazard Identification and Assessment Guideline which considers principles of ESD.
Are risks and impacts consistent with relevant legislation, international agreements and conventions, guidelines and codes of practice (including species recovery plans, threat abatement plans, conservation advice and AMP zoning objectives)?	Yes – management consistent with the International Convention for the *SOLAS 1974* and *Navigation Act 2012.*
Are risks and impacts consistent with Santos Environment, Health and Safety Policy?	Yes – aligns with Santos' Environment, Health and Safety Policy.
Are risks and impacts consistent with stakeholder expectations?	Yes – no concerns raised.
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – see ALARP above.

The presence of the vessel is not expected to significantly affect tourism, commercial fishing operations or shipping traffic, given the amount of similar habitat available in the surrounding areas, the various routes that can be taken and the limited number of users in the vicinity. If third-party operations avoid the operational area, there should be no additional risk of collision, and this risk is therefore acceptable.

The risk level of inhibiting tourism, commercial fishing or shipping operations is therefore considered acceptable in this case, as the vessel will have a collision radar to allow communication between vessels, watchkeeping is maintained on the bridge and notifications are issued through AHO and AMSA. In addition, no concerns have been raised by other sea users regarding the proposed activity (**Section 4**).

6.6 Operational discharges

6.6.1 Description of event

Event	Planned discharges from vessels to the marine environment include: + deck drainage/run-off + sewage and grey water + food wastes + cooling water + bilge water + brine (if a reverse osmosis unit is used for water treatment) + chemicals used during geotechnical drilling. **Deck drainage/run off** Deck drainage from rainfall or wash-down operations would discharge to the marine environment. The deck drainage would contain particulate matter and residual chemicals such as cleaning chemicals, oil and grease. **Sewage and greywater** The volume of sewage and food waste is directly proportional to the number of persons onboard the vessels. Depending on waste production rates and the specifications of sewage systems available, the total volume of this waste stream generated typically ranges between 0.04 and 0.45 m^3 per day per person. Treated sewage/greywater will be disposed in accordance with Marine Order 96. **Food waste** Putrescible waste is estimated to consist of approximately 1 L of food waste per person per day. The vessel will dispose of food waste in accordance with AMSA and Marine Order 95, and MARPOL Annex V. **Cooling water** Seawater is used as a heat exchange medium for cooling machinery engines. Cooling water temperatures vary, depending on the vessel's engines' workload and activity. **Bilge water** While in the operational area, the vessel may discharge oily water after treatment at a concentration of up to 15 ppm through an approved oily water filter system required by Marine Order 91. **Brine** If a reverse osmosis unit is used for water treatment, waste brine generated will be discharged to the ocean at a salinity of approximately 10% higher than seawater. The volume of the discharge depends on the requirement for fresh (or potable) water and demand based on the number of people onboard.
Extent	Localised: The small volumes of non-hazardous discharges may cause localised nutrient enrichment, organic and particulate loading, toxic impacts to marine fauna, thermal impacts and increased salinity in waters around discharge points and in the direction of the prevailing current. The environment that may be affected by operational discharges will likely be contained within the operational area, and are predicted to be restricted to within approximately 100 m of the discharge point in the upper 5 m of the water column.
Duration	During the period of the activity, localised impacts to water quality will occur; however, water quality conditions will return to normal within minutes to hours of cessation of discharges.

6.6.2 Nature and scale of environmental impacts

Potential Receptors: Physical environment (water quality, benthic habitats), threatened/migratory fauna (marine mammals, marine turtles, sharks, rays and fish (pelagic) and seabirds).

6.6.2.1 Physical environment

Planned non-hazardous discharges will be small in volume and continuous, with volumes dependent on a range of variables. The discharge of non-hazardous wastes to the marine environment will result in a localised reduction in water quality. This would be expected to be temporary (minutes to hours), localised and limited to surface waters (less than 5 m depth). The discharges are expected to be dispersed and diluted rapidly, with concentrations of wastes significantly dropping with distance from the discharge point. Changes to ambient water quality outside of the operational area are considered unlikely to occur.

Specifics of potential impacts to water quality from vessel discharges are as follows.

Eutrophication impacts from sewage, greywater and putrescible food wastes.

Sewage liquids and grey water discharges to the ocean from the vessel can cause water discolouration, localised nutrient enrichment, increase in water column productivity of phytoplankton and bacteria, or oxygen depletion from increased biological oxygen demand around the discharge. Liquid sewage generally contains more than 99% fresh water, with trace contaminants and nutrients such as organic carbon, nitrogen and phosphorus, which could cause toxicity impacts to the marine environment, as well as suspended solids and bacterial organisms that could transmit disease to marine fauna and humans.

Dispersion and dilution of discharges is expected to be rapid in the open ocean environment, as the discharges are of low volume and short duration from a vessel that will be moving for most of the activity. The discharges will be subject to biodegradation of organics through bacterial action, oxidation and evaporation.

Salinity increases

The desalination of seawater results in a discharge of brine with a slightly elevated salinity (around 10% higher than seawater). On discharge to the sea, the desalination brine, being of greater density than seawater, will sink and disperse in the currents. On average, seawater has a salt concentration of 35,000 ppm. The volume of the discharge depends on the requirement for fresh (or potable) water and the number of people onboard.

Changes to seawater salinity can play a significant role in the growth and size of aquatic life and the marine species disturbance, either in a beneficial (for example, shellfish) or in an adverse way.

According to some studies about the effects of changes in the salinity of sea water on marine organisms, the primary and apparent changes might occur firstly in mobile species such as plankton and fish; the reaction will be highest in those organisms with a plankton stage in their life history (Hiscock *et al.*, 2004, cited in Danoun, 2007). However, impacts differ between different sorts of organisms. In some fish, juvenile stages are more vulnerable to salinity changes than the adult generation.

Most marine species are able to tolerate short-term fluctuations in salinity in the order of 20 to 30% (Walker and McComb, 1990), and it is expected that most pelagic species would be able to tolerate short-term exposure to the slight increase in salinity caused by the discharged brine.

Given the relatively low volume, temporary and intermittent nature of brine discharges from the vessels, the impact on water quality in the operational area is expected to be low. There is no relationship between the level of salinity and biological or chemical oxygen demand of the discharged concentrate – more than 80%

of the minerals that encompass concentrate salinity are sodium and chloride, and they are not food sources or nutrients for aquatic organisms.

Changes in water temperature

Cooling water will be discharged at a temperature above ambient seawater temperature. Upon discharge, it will be subjected to turbulent mixing and transfer of heat to the surrounding waters.

Temperature dispersion modelling shows that the temperature of discharged water will decrease rapidly as it mixes with the receiving waters, with discharge waters being less than 1°C above background levels within less than 100 m (horizontally) of the discharge point. Vertically, the discharge will be within background levels within 10 m (Woodside, 2008).

Several studies have been performed to determine how the distribution and abundance of marine flora and fauna species react to a change in temperature. Temperature can influence the growth and reproduction of marine species. Mobile species such as plankton and fish are the first and most likely sort of marine life to be influenced due to changes in the seawater temperature (Hiscock *et al.*, 2004, cited in Danoun, 2007). Temperature increase can have a positive effect on reproduction and growth rate but also lead to a shorter lifespan, depending on the species affected and the extent of temperature change.

Cooling water discharge points vary between vessels. However, they all adopt the same discharge design that permits cooling water to be discharged above the water line, in order to facilitate cooling and oxygenation of this wastewater stream before mixing with the surrounding marine environment. Given the relatively low volume of cooling water, the temperature differential and the open-ocean water surrounding the vessel, the impact on water quality is expected to be low and short-term.

Contamination from releases of bilge water and deck drainage

Discharges of oily bilge water could result in a localised reduction in water quality, with impacts on protected marine fauna and plankton. However, oily water discharged from vessels will be treated to a concentration (less than 15 ppm) in accordance with MARPOL and Marine Order 91: Marine Pollution Prevention – Oil requirements; therefore, it is unlikely to lead to any impacts to the receiving environment. Given the concentration and dosage of exposed receptors within surface waters (for example, plankton, fish) is expected to be very low, impacts to organisms would be on a negligible scale.

Given oil and grease residues in oily water drainage will be in low concentrations, the potential for impact is low and would be further reduced due to the strong tidal movements experienced in the region and the naturally turbid environment. Dispersion and biodegradation of potentially contaminated oily water drainage is expected to be rapid and highly localised, resulting in no long-term or adverse effects on water quality or marine ecology. An initial dilution of 100:1 is expected to occur from within metres to tens of metres from the discharge location.

Toxicity

Discharges from vessel systems may include chemicals within sewage systems, greywater, desalination and residues of those used for cleaning decks.

On discharge to the marine environment, the low volumes of these types of chemicals are expected to rapidly disperse in the offshore marine environment. Hence, any potential impacts would be confined to a localised area immediately surrounding the discharge.

There may be a localised and temporary (hours) reduction in water quality in the immediate vicinity of the release. Toxicity impacts to marine fauna from the release of chemicals are unlikely to eventuate because:

+ strong ocean currents result in the discharge being further diluted upon release to the marine environment, so the duration of exposure of chemicals to fauna will be minimal;
+ deck cleaning products planned to be released to sea will meet the criteria for not being harmful to the marine environment, according to MARPOL Annex V; and
+ potential discharges will be intermittent and temporary within the operational area.

6.6.2.2 Threatened/migratory fauna

As discussed in the sections above, the extent for planned discharges is localised, and rapid dilution is predicted to occur within the open-ocean environment. Marine fauna within the operational area are likely to be transient. If contact does occur with any marine fauna, it will be for a short duration due to the rapid dispersion of the plume and the transient nature of fauna movement, such that exposure time may not be of sufficient duration to cause a toxic effect.

Discharges may cause changes to behaviour in marine fauna (in other words, avoidance or attraction). Fishes and oceanic seabirds may be attracted to the discharge of food scraps. However, such discharges would be isolated occurrences and not in any one location, so no prolonged influence on faunal behaviour is expected. Discharges of cooling water and brine may cause avoidance behaviour in marine fauna. Given the nature of the discharges (localised, rapid dilution, intermittent), any behavioural impacts are expected to be short-term and minimal.

6.6.3 Environmental performance outcomes and control measures

EPOs relating to this hazard include:

+ Reduce impacts to air and water quality from planned discharges and emissions from the activities (EPO-03); and
+ No unplanned objects, emissions or discharges to sea or air (EPO-06).

The control measures considered for this activity are shown in **Table 6-16**. EPSs and MC for the EPOs are described in **Section 8**.

Table 6-16: Control measures evaluation for operational discharges

CM Reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
Standard control measures				
SVA-CM12	Vessel sewage system	Reduces potential impacts of inappropriate discharge of sewage. Provides compliance with MARPOL and Marine Order 96 (Marine Pollution Prevention – Sewage).	Personnel cost in ensuring vessel certificates are in place during vessel contracting and in premobilisation audits and inspections and in reporting discharge levels.	**Adopted** – Benefits of ensuring vessels are compliant with marine orders outweigh minimal costs of personnel time, and it is a legislated requirement.
SVA-CM13	Vessel oily water treatment system	Reduces potential impacts of planned discharge of oily water to the environment. Provides compliance with MARPOL and Marine Order 91 (Marine Pollution Prevention – Oil).	Time and personnel costs in maintaining oil record book.	**Adopted** – Benefits of ensuring vessels are compliant outweigh the minimal costs of personnel time, and it is a legislated requirement.
SVA-CM14	Waste (garbage) management plan	Reduces probability of garbage being discharged to sea, reducing potential impacts to marine fauna. Stipulates putrescible (food) waste disposal conditions and limitations and AMSA Placards displayed on vessels to provide a visual message to personnel about what wastes can be discharged where and improves waste awareness. Provides compliance with MARPOL and Marine Order 95 (Marine Pollution Prevention – Garbage).	Personnel cost of premobilisation audits and inspections and of reporting discharge levels.	**Adopted** – Benefits of ensuring vessels are compliant outweigh the minimal costs of personnel time, and it is a legislated requirement.
SVA-CM15	Deck cleaning product selection procedure	Improved water quality discharge (reduces toxicity) to the marine environment. Those deck cleaning products planned to be released to sea meet the criteria for not being harmful to the marine environment, according to MARPOL Annex V.	Personnel costs of implementing. Potential additional cost and delays of deck cleaning product substitution.	**Adopted** – Benefits of ensuring vessels are compliant and that those deck cleaning products planned to be released to sea meet MARPOL criteria outweigh the cost.

CM Reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
Additional control measures				
SVA-CM24	Chemical selection procedure	Aids in the process of chemical management that reduces the impact of chemical discharges to sea. Only environmentally acceptable products are used.	Cost associated with implementation of procedure. Range of chemicals reduced with potentially higher costs for alternative products.	**Adopted** – Environmental benefit of using lower toxicity chemicals outweighs procedural implementation costs.
N/A	Scupper plugs on vessels are continuously in place to prevent deck drainage	Would eliminate potential impacts of contaminants being discharged to sea in rainwater.	Increased health and safety risks from wet deck not draining. Large amounts of water on a vessel's deck can also cause stability issues (free-surface effect).	**Rejected** – Safety considerations outweigh the benefit, given small volumes of contaminants.
N/A	Mandatory closed drain system on vessels to prevent deck drainage discharge overboard		Increased cost due to treatment system required, modifications to vessels, storage space required for containing drained liquids, increase in transfers to vessels resulting in increased potential impacts and risks. Increased transfers result in increased fuel usage, increased safety risks to personnel during transfer (for example, crushing between skips) and increase in crane movements.	**Rejected** – Cost outweighs the benefit, given the low impact expected from planned discharges and high potential impacts from risk transfer.

CM Reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
N/A	Storage of some wastes on-board vessel (for example, oily water, food waste and sewage) for disposal onshore	Would eliminate discharge to sea, reducing potential impacts to the marine environment.	Storage space required for containment of waste, increase in transfers to vessels resulting in increased potential impacts and risks. Increased transfers results in increased fuel usage, increased safety risks to personnel during transfer (for example, crushing between skips), increase in crane movements.	**Rejected** – Cost outweighs the benefit, given the low impact expected from planned discharges and high potential impacts from risk transfer. Noting that vessels will adhere to Marine Order 95 to ensure waste is disposed of correctly.

6.6.4 Environmental impact assessment

Key receptors	Consequence level
Planned operational discharges	
Physical environment/ habitat	As the activity is located in an open oceanic environment where tides and currents would quickly dilute and disperse the planned discharges, and the activity is short-term (days) and transient, it is not expected that impacts to the physical environment or fauna will occur.
Threatened/migratory fauna	Impacts to water quality will be experienced in the discharge mixing zone, which will be localised and will occur only as long as the discharges occur (in other words, no sustained impacts). Therefore, recovery will be measured in hours to days. Changes to water quality may result in an alteration to marine fauna behaviour. Sensitive receptors that may be impacted include fish at surface, marine turtles and mammals, and seabirds. Any effects on water quality are expected to be within the surface waters only and have no effect on seabed receptors. As such, only short-term behavioural impacts are expected, with no decrease in local population size or area of occupancy of species, nor loss or disruption of critical habitat, disruption to the breeding cycle or introduction of disease.
Threatened ecological communities	Not applicable – no threatened ecological communities are identified in the area where operational discharges are expected to disperse.
Protected areas	Not applicable – no protected areas are identified in the area where operational discharges are expected to disperse.
Socio-economic	Not applicable – no planned operational discharges will occur within areas known to be used by third-party operators or for tourism and recreation. No impacts to fish stocks are expected to occur. Therefore, there is no conceivable impact to commercial, traditional or recreational fisheries.
Overall worst-case consequence	I – Negligible

6.6.5 Demonstration of as low as reasonably practicable

Vessels are required to undertake VBA. The alternative to discharging these small amounts of liquid wastes to the marine environment is to store and transport the wastes to land, where they would be disposed of in line with industry best practice. However, this would result in an increase in environmental impacts through increased fuel consumption and increased atmospheric emissions, both by the vessel (or transport vessel) having to return to port a number of times to unload the wastes and by land transport to the nearest disposal facility. Increased energy consumption and atmospheric emissions would also result from the disposal (for example, incineration or treatment) of the additional wastes. The vessel size would also potentially need to be larger to accommodate the additional storage for such wastes. Therefore, this option would be of no net environmental benefit and would increase the risk associated with the activity, so it has not been adopted.

To reduce the impacts and risks associated with discharging liquid wastes, these wastes will be treated in line with industry best practice. Discharge of sewage and other liquid wastes from vessels in Australian waters is permissible under the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*, which reflects requirements of MARPOL 73/78 Annexes IV, V and I and AMSA Marine Orders 95 and 96.

Onboard treatment of most wastes and their subsequent discharge to the marine environment is considered to be the most environmentally sound method of disposal, considering the waste streams will either be treated to a level unlikely to cause significant environmental harm or will be of a nature not considered to pose significant risk to the receiving environment. The proposed management controls for planned operational discharges are considered appropriate to manage the risk to ALARP. Additional controls considered but rejected are in **Section 6.6.3**.

6.6.6 Acceptability evaluation

Is the consequence ranked as I or II?	Yes – maximum planned operational discharge consequence is rated I (negligible).
Is further information required in the consequence assessment?	No – potential impacts and risks well understood through the information available.
Are risks and impacts consistent with the principles of ESD?	Yes – activity evaluated in accordance with Offshore Division Environmental Hazard Identification and Assessment Guideline which considers principles of ESD.
Are risks and impacts consistent with relevant legislation, international agreements and conventions, guidelines and codes of practice (including species recovery plans, threat abatement plans, conservation advice and AMP zoning objectives)?	Yes – consistent with relevant species recovery plans, conservation management plans and management actions set out in **Table 3-9**, including: + Recovery Plan for Marine Turtles in Australia (2017) + Recovery Plan for Threatened Albatrosses and Giant Petrels (DSEWPaC, 2011a).
Are risks and impacts consistent with Santos Environment, Health and Safety Policy?	Yes – aligns with Santos' Environment, Health and Safety Policy.
Are risks and impacts consistent with stakeholder expectations?	Yes – no concerns raised.
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – see ALARP above.

Release of non-hazardous discharges into the sea from vessels in Australian waters is permissible under the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*, which reflects MARPOL Annex IV, V and I requirements respectively and is enacted by:

+ Marine Order 91: Marine Pollution Prevention – Oil;
+ Marine Order 96: Marine Pollution Prevention – Sewage; and
+ Marine Order 95: Marine Pollution Prevention – Garbage.

The operational discharges are not expected to significantly impact the receiving environment with management controls proposed, including compliance with all MARPOL requirements. The MARPOL standard is considered to be the most appropriate standard, given the nature and scale of the activities. These standards are internationally accepted and used industry-wide. Therefore, compliance with the relevant and appropriate MARPOL requirements and standards is expected to reduce the potential for environmental impacts to a level which is considered environmentally acceptable.

Deteriorating water quality is identified as a potential threat to turtles in the marine turtle recovery plan and some bird and shark species. However, the operational discharges are not expected to significantly impact the receiving environment with management controls proposed. Therefore, the activities will be conducted in a manner that is considered acceptable.

6.7 Spill response operations

The spill response strategies that may be adopted in the event of a hydrocarbon spill that has been identified in **Section 7.4** are summarised below. Potential impacts arising from implementing the following spill response operations and actions have been assessed as planned events in this section.

6.7.1 Description of event

Event	In the event of a hydrocarbon spill, response strategies will be implemented to reduce environmental impacts to ALARP. The selection of strategies will be undertaken through the net environmental benefit analysis (NEBA) process, outlined in the OPEP. Spill response will be under the direction of the relevant Control Agency, as defined within the OPEP (section 2.2), which may be Santos or another agency or both. In all instances, Santos will undertake a 'first-strike' spill response and will act as the Control Agency until the designated Control Agency assumes control. The response strategies selected as appropriate for the worst-case oil spill scenarios identified for the event are detailed in table 3-5 of the OPEP and comprise: + source control + monitoring and evaluation + mechanical dispersion + shoreline clean-up + oiled wildlife response + scientific monitoring + waste management. While response strategies are intended to reduce the environmental consequences of a hydrocarbon spill, poorly planned and coordinated response activities can result in a lack of or inadequate information being available, which can lead to poor decisions being made, thereby exacerbating or causing further environmental harm. An inadequate level of training and guidance during the implementation of spill response strategies can also result in environmental harm over and above that already caused by the spill. The greatest potential for impacts additional to those described for routine operations is from shoreline clean-up and oiled wildlife response operations, where coastal and shoreline habitat damage and fauna disturbance may occur.
Extent	Extent of spill.
Duration	Until termination criteria are met.

6.7.2 Nature and scale of environmental impacts

Potential Receptors: Physical environment, threatened/migratory fauna, protected areas (Marine Parks, Commonwealth Heritage Place) and socio-economic receptors.

Given spill response operations will be within offshore waters and shorelines, primarily using vessels, the types of impact are consistent with operations described elsewhere within this EP for routine operations. Details of these environmental impacts and risks for spill response operations are outlined in **Table 6-17**.

Table 6-17: Nature and scale of environmental impacts and risks for activities – spill response operations

Light emissions:	
Spill response activities will involve using vessels that are required, at a minimum, to display navigational lighting. Vessels may operate close to shoreline areas during spill response activities. Spill response activities will also involve onshore operations, including the use of vehicles and temporary camps which may require lighting.	
Potential receptors:	Threatened/Migratory Fauna Protected Areas Socio-Economic
Lighting may cause behavioural changes to fish, birds and marine turtles, which can have a heightened consequence during key lifecycle activities, such as turtle nesting and hatching. Turtles and birds, which includes threatened and migratory fauna, have been identified as key fauna susceptible to lighting impacts; **Section 6.2** provides more detail on the nature of impacts to fish, birds and marine turtles. Spill response activities that require lighting may occur in protected areas important to turtles. For example, shoreline locations of Ashmore Reef and Cartier Island are seasonally important for turtles. During nesting and hatching season (primarily over summer months), lighting may cause behavioural impacts to turtles, including aborted nesting attempts and disorientation of newly hatched turtles, which may increase mortality rates. Spill response activities may also occur on shorelines used by nesting and feeding birds, including seabirds and shorebirds. Lighting can cause disorientation in flying birds, disrupt nesting and breeding behaviours and impact on the ability of birds to forage. Disturbance to feeding migratory shorebirds may reduce their ability to replenish energy reserves and alter the timing and success of migratory flights. As a consequence of impacts to fauna, lighting has the potential to directly impact supported industries, such as tourism, and indirectly impact the values of protected areas.	
Acoustic Disturbance:	
Spill response activities will involve using aircraft and vessels which will generate noise both offshore and in proximity to sensitive receptors in coastal areas. Spill response activities will also involve using equipment on coastal areas during clean-up of shorelines (for example, pumps and vehicles), for accessing shoreline areas (for example, vehicles) and for supporting temporary camps (for example, diesel generators).	
Potential receptors:	Threatened/Migratory Fauna Protected Areas Socio-Economic
Underwater noise from using vessels may impact marine fauna, such as fish (including commercial species), marine reptiles and marine mammals, in the worst instance causing physical injury to hearing organs, but more likely causing short-term behavioural changes, such as temporary avoidance of the area, which may impact key lifecycle processes (for example, spawning, breeding, calving). Underwater noise can also mask communication or echolocation used by cetaceans. **Section 6.1** provides further detail on these impacts from vessels. Whales have been identified as the key concern for vessel noise within the EMBA. The humpback migration BIA and the pygmy blue whale known distribution is within the EMBA. Spill response activities using vessels have the potential to impact fauna in protected areas. Noise and vibration from terrestrial activities on shorelines within the EMBA have the potential to cause behavioural disturbance to coastal fauna, including protected seabirds and turtles. Shoreline activities involving using noise-generating equipment may occur in important nesting areas for turtles and/or roosting/feeding areas for shorebirds.	

As a consequence of impacts to fauna (including shorebirds, marine mammals and fish), noise has the potential to impact supported industries such as tourism and commercial fishing.

Noise from aircraft used for surveillance purposes is not expected to cause disturbance to fauna, as the aircraft will remain airborne; however, there may be a resulting loss of amenity value through the presence of and noise from aircraft.

Atmospheric emissions:

The use of fuels to power vessel and aircraft engines, generators and mobile equipment used during spill response activities will result in emissions of GHG such as CO_2 and N_2O, along with non-GHG such as SOx and NOx. Emissions will result in localised decrease in air quality.

Potential receptors:	Physical Environment/Habitat Threatened/Migratory Fauna Protected Areas

Atmospheric emissions from spill response equipment will be localised (apart from aircraft emissions which will rapidly dissipate) and, while there is potential for fauna and flora impacts, the use of mobile equipment, vessels and vehicles is not considered to create emissions on a scale where noticeable impacts would be predicted. Emissions may occur in protected areas (such as the Ashmore Reef AMP); however, the scale of the impact relative to potential oil spill impacts is not considered great.

Operational discharges and waste:

Operational discharges include those routine discharges from vessels used during spill response, which may include:

- bilge water
- deck drainage
- putrescible waste and sewage
- cooling water from operation of engines
- brine.

In addition, there are specific spill response discharges and waste creation that may occur, including:

- cleaning of oily equipment/vessels and vehicles
- flushing water for the cleaning of shoreline habitats
- sewage/putrescible and municipal waste at camp areas
- creation, storage and transport of oily waste and contaminated organics.

Potential receptors:	Threatened/Migratory Fauna Physical Environment/Habitat Protected Areas Socio-Economic

Operational discharges from vessels may create a localised and temporary reduction in marine water quality. Effects include nutrient enrichment, toxicity, turbidity, temperature and salinity increases, as detailed in **Section 6.6**. These may impact a different set of receptors than previously described in that section, given vessel use may occur in shallower coastal waters during spill response activities. Discharge could potentially occur adjacent to marine habitats such as corals, seagrass, macroalgae, and in protected areas (in other words, receptors anywhere within the EMBA) which support a more diverse faunal community; however, discharges will be very localised and temporary.

Cleaning of oil-contaminated equipment, vehicles and vessels has the potential to spread oil from contaminated areas to those areas not impacted by a spill, potentially spreading the impact area and moving oil into a more sensitive environment.

Flushing of oil from shoreline habitats is a clean-up technique designed to remove oil from the receptor that has been oiled and remobilise back into the marine environment and result in further dispersion of the oil. The process of flushing has the potential to physically damage shoreline receptors such as mangroves and rocky shoreline communities, increase levels of erosion, and create an additional, and potentially higher, level of impact than if the habitat was left to bio-remediate.

Sewage, putrescible and municipal waste will be generated from onshore activities at temporary camps, which may include toilet and washing facilities. These wastes have the potential to attract fauna, impact habitats, flora and fauna and reduce the aesthetic value of the environment, which may be within protected areas. The creation, storage and transport of oily waste and contaminated organics has the potential to spread impacts of oil to areas, habitats and fauna not previously contaminated.

Physical presence and disturbance:

The movement and operation of vessels, aircraft, vehicles, personnel and equipment, undertaking of clean-up activities and the set-up of temporary camp areas during spill response activities has the potential to disturb the physical environment and marine/coastal habitats and fauna, which may include those habitats and fauna within protected areas. Disturbance may also impact cultural and amenity values of an area. The movement of vessels could potentially introduce IMS attached as biofouling to nearshore areas, while vehicle and equipment movement could spread non-indigenous flora and fauna.

Oiled wildlife response activities may involve deliberate disturbance (hazing), capture, handling, cleaning, rehabilitation and release of wildlife, which could lead to additional impacts to wildlife.

Potential receptors:	Threatened/Migratory Fauna Physical Environment/habitat Protected Areas Socio-Economic

The use of vessels may disturb benthic habitats in coastal waters, including corals, seagrass, macroalgae and mangroves. Impacts to habitats from vessels include damage through deploying anchor/chain, nearshore booms and grounding. Vessel use in shallow coastal waters also increases the chance of contact or physical disturbance with marine megafauna such as turtles and dugongs. Booms create a physical barrier on the surface waters that has the potential to injure or entangle passing marine fauna that are either surface-breathing or -feeding.

The presence of and noise from surveillance aircraft may result in a temporary loss of amenity value.

Vehicles, equipment, personnel presence and cleaning activities during shoreline response activities have the potential to damage coastal habitats such as dune vegetation, mangroves and habitats important to threatened and migratory fauna, including nests of turtles and birds and bird roosting/feeding areas. Shoreline clean-up may involve the physical removal of substrates that could cause impact to habitats and coastal hydrodynamics and alter erosion/accretion rates. As with vessel use, an assessment of appropriate vehicles and equipment to reduce habitat damage, along with the establishment of access routes/demarcation zones and operational restrictions on equipment/vehicle use, will limit sensitive habitat damage and damage to important fauna areas.

The presence of camp areas, although relatively short-term, may disrupt normal behaviour of coastal species such as shorebirds and turtles, and could potentially interfere with nesting and feeding behaviours. Temporary camp areas will be established under the direction of DoT and DBCA, with suitable advice sought if access is needed to culturally significant areas.

Oiled wildlife response may include the hazing, capture, handling, transportation, cleaning and release of wildlife susceptible to oiling, such as birds and marine turtles. While oiled wildlife response is aimed at having a net benefit, poor responses can potentially create additional stress and exacerbate impacts from oiling, interfering with lifecycle processes, hampering recovery and, in the worst instance, increasing levels of mortality.

Impacts from IMS released from vessel biofouling include out-competition, predation and interference with other ecosystem processes. The ability for a non-native species to establish is generally mitigated in deeper offshore waters where the depth, temperature, light availability and habitat diversity is not generally conducive to

supporting reproduction and persistence of the invasive species. However, in shallow coastal areas, such as areas where vessel-based spill response activities may occur, conditions are likely to be more favourable. Impacts from invasive terrestrial species are similar in that the invasive species can out-compete local species (for example, weeds) and interfere with ecosystem processes. Non-native species may be transported attached to equipment, vehicles and clothing. Such an introduction would be especially detrimental to wilderness areas or protected terrestrial reserves which may have a relatively undisturbed flora and fauna community. The disturbance to marine and coastal natural habitat, as well as the potential for disruption to culturally sensitive areas, which may occur in specially protected areas, may have flow-on impacts to socio-economic values and industry (for example, tourism, fisheries).
Disruption to other users of marine and coastal areas and townships:
Spill response activities may involve using vessels, aircraft, equipment and vehicles, and establishing temporary camps, in areas used by the general public or industry. The mobilisation of spill response personnel into an affected area may also place increased demands on local accommodation and other businesses.

Potential receptors:	Socio-Economic Receptors (commercial, recreational and traditional fishing, tourism and recreation, other oil and gas operators)

Using vessels in the nearshore and offshore environment and undertaking spill response activities at shoreline locations may exclude the general public and industry from using the affected environment. As well as impacting leisure activities of the general public, this may impact on revenue with respect to industries such as tourism and commercial fishing. The mobilisation of personnel to small communities has the potential to affect the local community through demands on local accommodation and business, reducing the availability of services to members of the public.

6.7.3 Environmental performance outcomes and control measures – spill response operations

EPOs, CMs, EPSs and MC for oil spill preparedness and response activities are outlined in the relevant strategy sections of the OPEP. Control measures relevant to reducing the potential impacts from spill response operations are shown in **Table 6-18**.

Table 6-18: Control measures evaluation for reducing potential impacts from spill response operations

Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
Competent IMT and oil spill responder personnel	Ensures spill response strategy selection and operational activities consider the potential for additional environmental impacts.	Personnel and operational costs associated with maintaining competent IMT team and responder personnel.	**Adopted –** Considered a standard spill response control.
Use of competent vessel crew and personnel	Reduces potential for environmental impacts from vessel usage.	Personnel and operational costs associated with maintaining contracts with competent vessel crew and personnel.	**Adopted –** Considered a standard spill response control.

Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
Acoustic Disturbance			
Vessels and aircraft compliant with Santos' Protected Marine Fauna Interaction and Sighting Procedure (EA-91-11-00003)	Reduces potential for behavioural disturbance to cetaceans.	No cost/issue associated with this CM.	**Adopted –** Ensures compliance with Part 8 of the EPBC Regulations 2000, which is considered a standard spill response control (regulatory requirement).
Light Emissions			
Select temporary base camps in consultation with DoT and DBCA	Reduces coastal habitat and fauna disturbance.	No cost/issue associated with this CM.	**Adopted –** Considered a standard control to be adopted by the relevant Control Agency.
Atmospheric Emissions			
Where required under MARPOL, vessels will maintain a current IAPP Certificate	Reduces level of air quality impacts.	Personnel and operational costs associated with maintaining Air Pollution Certificate.	**Adopted –** Considered a standard spill response control (regulatory requirement).
Disruption to Other Marine Users			
Stakeholder consultation	Promotes awareness and reduces potential impacts from response to socio-economic activities.	Minimal cost in relation to overall effort/costs in managing incident.	**Adopted –** Considered a standard control for incident management.
Operational Discharges and waste			
Vessel sewage system	Reduces potential for water quality impacts.	No cost/issue associated with this CM.	**Adopted –** Considered a standard spill response control (regulatory requirement).
Oily mixtures system	Reduces potential for water quality impacts.	No cost/issue associated with this CM.	**Adopted –** Considered a standard spill response control (regulatory requirement).
Compliance with controlled waste, unauthorised discharge and landfill regulations	Ensures correct handling and disposal of oily wastes.	No cost/issue associated with this CM.	**Adopted –** Considered a standard spill response control (regulatory requirement).

Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
Physical presence and disturbance			
Spill response activities selected on basis of a NEBA	Provides a systematic and repeatable process for evaluating strategies with net least environmental impact.	No cost/issue associated with this CM.	**Adopted –** Considered a standard spill response control.
Vessels and aircraft compliant with Santos' Protected Marine Fauna Interaction and Sighting Procedure (EA-91-11-00003)	Reduces potential for behavioural disturbance to cetaceans.	No cost/issue associated with this CM.	**Adopted** – Ensures compliance with Part 8 of the EPBC Regulations 2000, which is considered a standard spill response control (regulatory requirement).
Use of shallow draft vessels for shoreline and nearshore operations	Reduces seabed and shoreline disturbance.	Operational costs associated with operating shallow draft vessels for shoreline and nearshore operations.	**Adopted –** Considered a standard control.
Oil Spill Response Team Leader assesses and selects vehicles appropriate to shoreline conditions	Reduces coastal habitat and fauna disturbance.	No cost/issue associated with this CM.	**Adopted –** Considered a standard control.
Conduct shoreline, nearshore habitat, bathymetry assessment	Reduces shoreline habitat disturbance.	Operational costs associated with conducting shoreline nearshore habitat assessment.	**Adopted –** Considered a standard control.
Establish demarcation zones for vehicle and personnel movement considering sensitive vegetation, bird nesting and roosting areas and turtle nesting habitat	Reduces coastal habitat and fauna disturbance.	No cost/issue associated with this CM.	**Adopted –** Considered a standard control.
Operational restriction of vehicle and personnel movement to limit erosion and compaction	Reduces coastal habitat erosion and compaction.	No cost/issue associated with this CM.	**Adopted –** Considered a standard control.
Prioritise use of existing roads and tracks	Reduces coastal habitat and fauna disturbance.	No cost/issue associated with this CM.	**Adopted –** Considered a standard control.
Soil profile assessment prior to earthworks	Reduces habitat disruption and erosion.	Operational costs associated with soil profile assessment.	**Adopted –** Considered a standard control.

Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
Use of Heritage Advisor if spill response activities overlap with potential areas of cultural significance	Reduces disturbance to culturally significant sites.	No cost/issue associated with this CM.	**Adopted –** Considered a standard control to be adopted by the relevant Control Agency.
Pre-cleaning and inspection of equipment (quarantine)	Reduces potential for invasive species to offshore islands.	Cost/effort in inspecting equipment.	**Adopted –** Considered a standard control.

6.7.4 Environmental impact assessment

Key receptors	Consequence Level
Spill Response Operations – Light Emissions	
Threatened, migratory, or local fauna Physical environment or habitat Threatened ecological communities Protected areas Socio-economic receptors	The receptors considered most sensitive to lighting from vessel and shoreline operations are seabirds, shorebirds and marine turtles, particularly over summer months with respect to marine turtles where emerging hatchlings are sensitive to light spill onto beaches. Temporary camps will be positioned at the direction of DoT or DBCA; therefore, the consequence of shoreline lighting is considered *Negligible*. These species are likely to be values of the protected area they occur in and the impact to the protected area from light is also considered *Minor (II)*. As a consequence of impacts to fauna, lighting has the potential to impact supported industries, such as tourism; however, as impacts to fauna are considered negligible, any indirect impacts on tourism will also be *Negligible*.
Overall worst-case consequence level	II – Minor
Spill Response Operations – Acoustic Disturbance	
Threatened, migratory, or local fauna Physical environment or habitat Threatened ecological communities Protected areas Socio-economic receptors	The receptor considered most sensitive to vessel noise disturbance is the humpback whale during migration season, when these whales come close to the shoreline of mainland Australia during their peak migration (July to October), as well as populations of marine turtles, whale sharks and pygmy blue whales which occur around Ashmore Reef and Cartier Island. However, following the adoption of control measures to limit close interaction with protected fauna (in other words, Protected Marine Fauna Interaction and Sighting Procedure (EA-91-II-00003)), a temporary behavioural disturbance is expected only with a consequence of *Negligible*. With respect to noise from onshore operations (mobile equipment and vehicles), nesting, roosting or feeding birds are considered to be the most sensitive to noise, in particular shorebirds that may be aggregating Ashmore Reef. The equipment used is not considered to have excessive sound levels and, following direction by DoT and DBCA on the location of temporary camp areas, the consequence to birds from noise is expected to be *Negligible*. Shorebirds may be official values of the protected area they occur in, and the impact to the protected area from noise is also considered *Negligible*.
Overall worst-case consequence level	I – Negligible

Key receptors	Consequence Level
Spill Response Operations – Atmospheric Emissions	
Threatened, migratory, or local fauna	Atmospheric emissions from spill response equipment will be localised; and impacts to even the most sensitive fauna, such as birds, are expected to be *Negligible*. Because of the emissions will be localised and low level, impacts to protected area values, physical environment and socio-economic receptors are predicted to be *Negligible*.
Physical environment or habitat	
Threatened ecological communities	
Protected areas	
Socio-economic receptors	
Overall worst-case consequence level	I – Negligible
Spill Response Operations – Operational Discharges and Waste	
Threatened, migratory, or local fauna	Operational discharges from vessels may create a localised and temporary reduction in marine water quality, which has the potential to impact shallow coastal habitats in particular; however, following the adoption of regulatory requirements for vessel discharges, which prevent discharges close to shorelines, discharges will have a *Negligible* impact to habitats, fauna or protected area values. Furthermore, washing of vessels and equipment will occur only in defined offshore hot zones preventing impacts to shallow coastal habitats. As a consequence of impacts to fauna, operational discharges from vessels have the potential to impact supported industries, such as tourism and commercial fishing; however, as impacts to fauna are considered *Negligible*, any indirect impacts on socio-economic receptors will also be *Negligible*. Onshore, the use of flushing water has the potential to damage sensitive shoreline and intertidal habitats, such as mangroves; however, low-pressure flushing only will be used, preventing further damage to habitats or erosion of sediments. For sensitive habitats, the deployment of booms will be considered to retain flushed hydrocarbons, if this presents a net benefit. Following these control measures, the use of flushing to clean shorelines and intertidal habitats is seen to have a *Negligible* additional impact to habitats, fauna or protected area values. The cleaning of contaminated vehicles and equipment onshore has the potential to spread oily waste and damage habitats if not contained. Decontamination units will be in used during the spill response, thus containing waste and preventing any secondary contamination. The consequence of cleaning discharges is therefore ranked as *Negligible* in terms of impacts to habitats, fauna or protected area values. Sewage, putrescible waste and municipal waste generated onshore will be stored and disposed of at approved locations. The storage, transport and disposal of hydrocarbon-contaminated waste arising from spill response operation actions, such as containment and recovery and shoreline clean up, will be managed by Santos' appointed waste management contractor; and dedicated waste containment areas will prevent the spreading or leaching of hydrocarbon contamination. The consequence of sewage discharges is therefore ranked as *Negligible* in terms of impacts to habitats, fauna or protected area values.
Physical environment or habitat	
Threatened ecological communities	
Protected areas	
Socio-economic receptors	
Overall worst-case consequence level	I – Negligible

Key receptors	Consequence Level
Spill Response Operations – Physical Presence and Disturbance	
Threatened, migratory, or local fauna Physical environment or habitat Threatened ecological communities Protected areas Socio-economic receptors	The use of vessels and nearshore booms has the potential to disturb benthic habitats, including sensitive habitats in coastal waters, such as corals, seagrass, macroalgae and mangroves. A review of shoreline and shallow water habitats and of bathymetry and the establishment of demarcated areas for access and anchoring will reduce the level of impact to *Negligible*. The use and movement of vehicles, equipment and personnel during shoreline response activities has the potential to disturb coastal habitats, such as dune vegetation, samphire and mangroves, and important habitats of threatened and migratory fauna, including nests of turtles and birds and bird roosting areas. Furthermore, clean-up can involve physical removal of substrates that could impact habitats and fauna and alter coastal hydrodynamics. As with vessel use, an assessment of appropriate vehicles and equipment to reduce habitat damage, along with the establishment of access routes, demarcation zones, and operational restrictions on equipment and vehicle use, will limit sensitive habitat damage and damage to important fauna areas. The establishment of temporary camp areas will be done under direction of DoT and DBCA with suitable advice sought if access is needed to culturally significant areas. Following these and other control measures, the resultant consequence to the physical environment and habitat is assessed as *Minor*, indicating there may be a detectable reduction in habitat area from response activities (as separate from spill impacts), but recovery will be relatively rapid once spill response activities cease. As with all spill response activities, this disturbance will only occur if there is a net benefit to accessing and cleaning shoreline areas. The main direct disturbance to fauna would be the hazing, capture, handling, transportation, cleaning and release of wildlife susceptible to oiling impacts, such as birds and marine turtles. This would only be done if this intervention were to deliver a net benefit to the species, but it may result in a *Minor* consequence. These habitats or environments are likely to be values of the protected area they occur in, and the impact to the protected areas from physical disturbance is therefore also considered *Minor*. The disturbance to marine and coastal natural habitat, as well as the potential for disruption to culturally sensitive areas, which may occur in specially protected areas, may have flow-on impacts to socio-economic values and industry (for example, tourism, fisheries). This impact is considered *Minor.*
Overall worst-case consequence level	II – Minor
Spill Response Operations – Disruption to Other Users of Marine and Coastal Areas and Townships	
Threatened, migratory, or local fauna Physical environment or habitat Threatened ecological communities Protected areas Socio-economic receptors	The use of vessels in the nearshore and offshore environment and spill response activities at shoreline locations and within townships may exclude general public and industry use. Note that this is distinct from the socio-economic impact of a spill itself, which would have a far greater detrimental impact to industry and recreation. Following the application of control measures, it is considered that the additional impact of spill response activities on affected industries would be *Minor*.
Overall worst-case consequence level	II – Minor

6.7.5 Demonstration of as low as reasonably practicable

A NEBA is the primary tool used during spill response to evaluate response strategies with the goal of selecting strategies that result in the least net impact to key environmental sensitivities. The NEBA process will identify and compare net environmental benefits of alternative spill response options. The NEBA will effectively determine whether an environmental benefit will be achieved through implementing a response strategy compared to undertaking no response. NEBA will be undertaken by the relevant Controlling Agency for the activity. For those activities under the control of Santos, the IMT Environmental Team Leader will be responsible for reviewing the priority receptors and selected response strategies identified within the OPEP and coordinating the NEBA for each operational period. This will mean that at the strategy level, the response operations reduce additional environmental impacts to ALARP.

Spill response activities will be conducted in offshore and coastal waters using vessels and aircraft. The greatest potential for additional impacts from implementing spill response is considered to be to wildlife in offshore waters from oiled wildlife response activities, and to shoreline habitats and fauna receptors within shallow waters or on shorelines from nearshore booming and shoreline clean-up activities.

Given the types of activities considered appropriate to responding to a worst-case spill and the scale of operations, standard control measures adopted by Santos for spill response to reduce the level of additional impacts are considered to reduce these impacts to ALARP. This includes working with the relevant Controlling Agency for spill response and applying the process and standards, for example, for oiled wildlife response as included within the WA Oiled Wildlife Response Plan and Pilbara Regional Oiled Wildlife Response Plan.

Santos considers the actions prescribed in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017) and Approved Conservation Advice for other threatened fauna (**Table 3-9**) relevant to spill responses for the activities to minimise noise and light impacts on marine cetaceans, fish and marine turtles. The proposed activity will not result in significant impacts on these species and implementation of identified control measures is in line with the relevant Conservation Advice and Recovery Plans. Pollution events (such as hydrocarbon spills) could impact on fauna (as described in **Section 7.6**), and the use of vessels and equipment during the spill response could result in potential impacts as described within this EP. Control measures in place for vessel and helicopter use as provided in **Section 8.4.1** will reduce potential impacts to marine fauna and these are consistent with current conservation advice. The assessed residual consequence for this impact is minor (II) and cannot be reduced further without disproportionate costs. It is considered therefore that the impact of the activities conducted are acceptable and ALARP.

The North-west Marine Parks Network Management Plan and North Marine Parks Network Management Plan state that actions required to respond to oil pollution incidents, including environmental monitoring and remediation, in connection with mining operations authorised under the OPGGS Act may be conducted in all zones of the marine parks identified with the EMBA (DNP, 2018) without an authorisation issued by the Director, provided that the actions are taken in accordance with an EP that has been accepted by NOPSEMA, and the Director is notified in the event of oil pollution within a marine park, or where an oil spill response action must be taken within a marine park, so far as reasonably practicable, prior to response action being taken.

6.7.6 Acceptability evaluation

Is the consequence ranked as I or II? **Is the risk ranked between Low to Medium?**	Yes – maximum consequence is II (Minor).
Is further information required in the consequence assessment?	No – potential impacts and risks well understood through the information available.
Are risks and impacts consistent with the principles of ESD?	Yes – activity evaluated in accordance with Offshore Division Environmental Hazard Identification and Assessment Guideline which considers principles of ESD.
Are risks and impacts consistent with relevant legislation, international agreements and conventions, guidelines and codes of practice (including species recovery plans, threat abatement plans, conservation advice and AMP zoning objectives)?	Yes – IUCN principles and strategic objectives of nearby reserves (Ashmore Reef AMP, the North-west Marine Parks Network Management Plan and North Marine Parks Network Management Plan) are met. Control measures implemented will minimise the potential impacts from spill response activities to protected areas and their values and to species identified in recovery plans and conservation advice as having the potential to be impacted. Consistent with relevant species recovery plans, conservation management plans and management actions set out in **Table 3-9**. Management consistent with EPBC Act Regulations (Part 8), MARPOL, Marine Orders (91, 96 and 97) and Australian Ballast Water Requirements.
Are risks and impacts consistent with Santos Environment, Health and Safety Policy?	Yes – aligns with Santos' Environment, Health and Safety Policy.
Are risks and impacts consistent with stakeholder expectations?	Yes – no concerns raised. During any spill response, a close working relationship with relevant regulatory bodies (for example, DoT, DBCA, AMSA) will occur and thus there will be ongoing consultation with relevant stakeholders on the acceptability of response operations. Wildlife response will be conducted in accordance with the WA Oiled Wildlife Response Plan and Pilbara Regional Oiled Wildlife Response Plan.
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – see ALARP above.

The implementation of response activities to reduce the potential impacts from a spill are required by legislation. The spill response options selected have been demonstrated to show a net environmental benefit, are standard industry practice, and are consistent with relevant standards and guidelines, including the National Plan for Maritime Environmental Emergencies (AMSA, 2019). No concerns from stakeholders have been raised regarding response activities, and the controls proposed reduce the consequences of the potential impacts to Minor (II) and ALARP. The controls used during spill response activities are therefore considered to reduce additional impacts and risks to an acceptable level.

7. Unplanned Activities Risk Assessment

OPGGS(E)R 2009 Requirements
Regulation 13(5)
The environment plan must include: (a) details of the environmental impacts and risks for the activity; and (b) an evaluation of all the impacts and risks, appropriate to the nature and scale of each impact or risk; and (c) details of the control measures that will be used to reduce the impacts and risks of the activity to ALARP and an acceptable level.
Regulation 13(6)
To avoid doubt, the evaluation mentioned in paragraph (5)(b) must evaluate all the environmental impacts and risks arising directly or indirectly from: (a) all operations of the activity; and (b) potential emergency conditions, whether resulting from accident or any other reason.
Regulation (13)(7)
The environment plan must: (a) set environmental performance standards for the control measures identified under paragraph (5)(c); and (b) set out the environmental performance outcomes against which the performance of the titleholder in protecting the environment is to be measured; and (c) include measurement criteria that the titleholder will use to determine whether each environmental performance outcome and environmental performance standard is being met.

Santos' environmental assessment identified four potential sources of environmental risks associated with the unplanned events for this activity. The results of the environmental assessment were found to be identical for each operational area, and are summarised in **Table 7-1**. A comprehensive risk and impact assessment for each of the unplanned events, and subsequent control measures proposed by Santos to reduce the risk and impacts to ALARP, are detailed in the following sub-sections.

Table 7-1: Summary of the environmental risks associated with unplanned events

EP Section	Unplanned event	Likelihood	Consequence	Residual risk level
7.1	Release of solid objects	d - Occasional	I – Negligible	Low
7.2	Introduction of IMS	a – Remote	III – Moderate	Very Low
7.3	Marine fauna interaction	b – Unlikely	II – Minor	Very Low
7.4	Hazardous liquid releases	b – Unlikely	I – Negligible	Very Low
7.6	Release of hydrocarbons	a – Remote	III – Moderate	Very Low

7.1 Release of solid objects

7.1.1 Description of event

Event	Solid objects such as those listed below can be accidentally released to the marine environment: + non-hazardous solid wastes, such as paper, plastics and packaging + hazardous solid wastes, such as batteries, fluorescent tubes, medical wastes, and aerosol cans + equipment and materials, such as hard hats, tools or infrastructure parts.
Extent	The event will only occur within the operational area, and all non-buoyant waste material or dropped objects are expected to remain within the operational area. Buoyant objects could potentially move beyond the operational area.
Duration	An unplanned release of solids may occur during VBA.

7.1.2 Nature and scale of environmental impacts

Potential Receptors: Physical environment (water quality and benthic habitats), threatened/migratory fauna (marine reptiles, sharks, fish and rays), socio-economic receptors (fisheries, tourism and recreation).

Solids such as plastics have the potential to affect benthic environments and to harm marine fauna through entanglement or ingestion. Marine turtles and seabirds are particularly at risk from entanglement. Marine turtles may mistake plastics for food; once ingested, plastics can damage internal tissues and inhibit physiological processes, which can both potentially result in fauna fatality. Floating, non-biodegradable marine debris has been highlighted as a threat to marine turtles, whales, whale sharks, and albatrosses and giant petrels in the relevant recovery plans and approved conservation advice (refer to **Table 3-9**). The recovery plans and approved conservation advice, as well as the Threat Abatement Plan for the Impacts of Marine Debris on the Vertebrate Wildlife of Australia's Coasts and Oceans (DoEE, 2018), have specified a number of recovery actions to help combat this threat. Of relevance to this event is the legislation for the prevention of garbage disposal from vessels. As the activity is of short duration, the risk of unplanned release of plastics is low.

Release of hazardous solids (for example, wastes such as batteries) may result in the pollution of the immediate receiving environment, leading to detrimental health impacts to marine flora and fauna. Physiological damage can occur through ingestion; or absorption may occur in individual fish and sharks, marine mammals, marine reptiles or seabirds.

The Recovery Plans and Approved Conservation Advices have specified a number of recovery actions to help combat this threat. Of relevance to this activity is the legislation for the prevention of garbage disposal from vessels, which Santos implements through adherence to MARPOL.

The AUVs and ROVs typically used for offshore surveys present limited capacity for seabed impact due to the equipment being tethered, or (in the case of AUVs) utilise acoustic doppler measurements to detect and prevent seafloor contact; and in the event of low power, they are designed to float to the surface and transmit their position for recovery. Therefore, it is unlikely this equipment would impact on the seabed during VBA; however, equipment dropped over the side of the vessel could impact on the seabed for example, accidentally dropped and not tethered.

The area of potential seabed disturbance due to release of a heavier non-hydrocarbon solid would be restricted to the operational area (for example, equipment). The habitat type in the operational area is widely distributed and well represented in the region.

While soft sediment benthic habits will not be destroyed, disturbance of the communities on and within them (in other words, the epifauna and infauna) will occur in the event of a dropped object; and depressions may remain on the seabed for some time after removal of the dropped object as they gradually infill over time. The seafloor of this bioregion is strongly affected by cyclonic storms, long-period swells and large internal tides, which can resuspend sediments within the water column and move sediment across the seafloor. In this context, any potential sediment movement caused by the event is likely to have minimal impacts.

Impacts to socio-economic receptors could occur should debris interfere with other marine users or their equipment (for example, fishing nets).

The area of potential disturbance due to a non-buoyant dropped object would be restricted to the operational area. The seabed within the operational area varies, but is generally made up of silts, sands and some small rubble/shell fragments and limited benthic faunal communities and no KEFs or protected seafloor features are identified in the operational area and therefore impacts would be negligible and likely recover quickly.

7.1.3 Environmental performance outcomes and control measures

The EPO relating to this hazard is:

+ No unplanned objects, emissions or discharges to sea or air (EPO-06).

The control measures for this activity are shown in **Table 7-3**. EPSs and MC for the EPOs are described in **Section 8**.

Table 7-2: Control measures evaluation for release of solid objects

CM Reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
Standard Control Measures				
SVA-CM04	Vessel planned maintenance system to maintain vessel DP, engines and machinery	Requires that lifting equipment is maintained and certified, and that lifting procedures are followed, reducing probability of dropped objects occurring.	Additional personnel costs of ensuring equipment is maintained and certified as appropriate and that procedures are in place and followed.	**Adopted** – Benefits of ensuring procedures are followed and equipment is compliant outweigh the minimal costs of personnel time.
SVA-CM14	Waste (garbage) management procedure	Reduces probability of garbage (waste) being accidentally discharged to sea, reducing potential impacts to marine fauna. Complies with Marine Order 95, Marine Pollution Prevention – Garbage.	Personnel cost of vessel audits and inspections, and in reporting discharge levels.	**Adopted** – Benefits of ensuring vessel is compliant outweigh the minimal costs of personnel time, and it is a legislated requirement.

CM Reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
SVA-CM16	Dropped object recovery	Requires dropped objects to be recovered (where safe and practicable to do so unless the environmental consequences are negligible).	Additional personnel and vessel costs to plan and undertake if safe and practicable to do so.	**Adopted** – Benefits of recovering dropped objects, where safe and practicable to do so (unless the environmental consequences are negligible), outweigh the costs.
SVA-CM17	Dropped object prevention procedures	Impacts to environment are reduced by preventing dropped objects.	Personnel costs involved in implementing procedures and in incident reporting.	**Adopted** – Benefits of ensuring procedures are followed and measures implemented outweigh the costs of personnel time.
Additional Control Measures				
N/A	Eliminate lifting in field	Reduces the risk of releasing solid objects to the marine environment due to dropped object.	Eliminating lifting would require support vessels storing more equipment and supplies on board, and/or additional trips to shore. Support vessels will not have enough deck space to store all required equipment, materials, and supplies needed for the duration of the activity, without incurring safety risks.	**Rejected** – Not feasible to eliminate lifting in the field.

7.1.4 Environmental impact assessment

Release of solid objects	
Receptors	Physical environment (benthic habitats), threatened/migratory fauna (marine mammals, marine reptiles, sharks, fish and rays), socio-economic receptors (fisheries, tourism and recreation)
Consequence	I – Negligible
Physical environment – Seabed disturbance In the event of a dropped object, there will be localised and short-term damage to the seabed. The extent of the impact is limited to the size of the dropped object; given the size of the equipment used, any impact is expected to be very small. Previous surveys in the region indicate the seabed is likely to comprise soft sediments with epifauna (**Section 3.2.1.2**). Consequently, any impacts are predicted to be short term in nature. Any impact to the seabed through dropped objects would result in a *Negligible* reduction in habitat area or function impacted.	
Marine fauna – Cetaceans, marine turtles, seabirds, fish and sharks In the event of loss of a solid object, the quantities would be limited by type of activities planned. The release could cause localised impacts to water quality and the benthic environment. If the solid object can be ingested by marine fauna, impacts would be restricted to a small number of individuals, if any. Relevant recovery plans and conservation advice (**Table 3-9**) have identified marine debris as a potential threat. There is a Threat Abatement Plan for the Impacts of Marine Debris on the Vertebrate Wildlife of Australia's Coasts and Oceans (DoEE, 2018). The limited quantities associated with this event indicate that, even in a worst-case release of solid waste, impacts to fauna would be limited to individuals and are not expected to result in a decrease of the local population size. The consequence level is therefore *Negligible*.	
Likelihood	D – Occasional
	A set of control measures and checks have been proposed to ensure that the risks of dropped objects, lost equipment or release of hazardous/ non-hazardous solid waste to the environment has been minimised. The likelihood of dropped objects in the operational area is limited and given the controls in place, the likelihood of releasing hazardous and non-hazardous solids to the environment resulting in a negligible consequence is considered to be occasional given the company experience.
Residual Risk	The residual risk associated with this hazard is Low

7.1.5 Demonstration of as low as reasonably practicable

Wastes generated and equipment used during the activity and managed through the proposed control measures. The control measures proposed are considered sufficient to reduce the risk of dropped objects to a level that is ALARP. No further feasible control measures were identified. If an object is dropped, the incident will be responded to in accordance with the implementation strategy for incident response. With the above controls in place, Santos considers the residual risk arising from a dropped object is ALARP.

7.1.6 Acceptability evaluation

Is the risk ranked between Very Low to Medium?	Yes – residual risk is ranked Low.
Is further information required in the consequence assessment?	No – potential impacts and risks well understood through the information available.
Are risks and impacts consistent with the principles of ESD?	Yes – activity evaluated in accordance with Santos' Environmental Hazard Identification and Assessment Procedure which considers principles of ESD.
Are risks and impacts consistent with relevant legislation, international agreements and conventions, guidelines and codes of practice (including species recovery plans, threat abatement plans, conservation advice and AMP zoning objectives)?	Yes – management consistent with MARPOL Annex III. Control measures implemented will minimise the potential impacts from the activity to species identified in recovery plans and approved conservation advice as well as the Threat Abatement Plan for the Impacts of Marine Debris on the Vertebrate Wildlife of Australia's Coasts and Oceans (DoEE, 2018) as having the potential to be impacted by non-hydrocarbon surface releases of solid objects. Consistent with relevant species recovery plans, conservation management plans and management actions set out in **Table 3-9**. Relevant species Recovery Plans, Conservation Management Plans and management actions, including: + Threat Abatement Plan for Impacts of Marine Debris on Vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018) + Recovery Plan for Marine Turtles in Australia (2017) + Recovery Plan for Threatened Albatrosses and Giant Petrels (DSEWPaC, 2011a) + Approved Conservation Advice for *Megaptera novaeangliae* (humpback whale) (2015a) + Approved Conservation Advice for *Rhincodon typus* (whale shark) (2015b) + Approved Conservation Advice for *Balaenoptera physalus* (fin whale) (2015c) + Approved Conservation Advice for *Balaenoptera borealis* (sei whale) (2015d) + Recovery Plan for the White Shark (*Carcharodon carcharias*) (2013) + Sawfish and River Sharks Multispecies Recovery Plan (2015a) + Commonwealth Conservation Advice on *Pristis zijsron* (green sawfish) (2008).
Are risks and impacts consistent with Santos Environment, Health and Safety Policy?	Yes – aligns with Santos' Environment, Health and Safety Policy.
Are risks and impacts consistent with stakeholder expectations?	Yes – no concerns raised.
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – see ALARP above.

With the controls in place to prevent accidental release of hazardous/non-hazardous solid waste or a dropped object, and the negligible impacts predicted, the risk to the marine environment is considered low and reduced to a level that is considered acceptable. The activity, undertaken with the controls, will be conducted in a manner that is acceptable under the relevant Recovery Plans and Approved Conservation Advice to prevent accidental release of hazardous/non-hazardous solid (marine debris) (**Table 3-9**).

7.2 Introduction of invasive marine species

7.2.1 Description of event

Event	Introduction of IMS may occur due to: + biofouling on vessels and external/internal niches (such as sea chests, seawater systems) + biofouling on equipment that is routinely submerged in water (such as survey equipment) + discharge of high-risk ballast water + cross-contamination between vessels. Once established, IMS have the potential to out-compete indigenous species and affect overall native ecosystem function.
Extent	Localised (seabed and water column within the operational area) to widespread if successfully translocated to new areas via ocean currents or project equipment transit.
Duration	Temporary to long-term (in the event of successful translocation).

7.2.2 Nature and scale of environmental impacts

Potential receptors: Marine ecosystem as a whole and commercial or recreational users of the marine environment.

IMS are marine flora and fauna that have been introduced into a region that is beyond their natural range but have the ability to survive, and possibly thrive (DAFF, 2011). The majority of climatically compatible IMS to the North Australian shelf are found in south-east Asian countries.

Some IMS pose a significant risk to environmental values, biodiversity, ecosystem health, human health, fisheries, aquaculture, shipping, ports and tourism (DAFF, 2011; Wells *et al*., 2009). When IMS achieve pest status, they are commonly referred to as introduced marine pests or IMPs. IMPs can cause a variety of adverse effects in a receiving environment, including:

+ over-predation of native flora and fauna;
+ out-competing of native flora and fauna for food;
+ human illness through released toxins;
+ depletion of viable fishing areas and aquaculture stock;
+ reduction of coastal aesthetics; and
+ damage to marine and industrial equipment and infrastructure.

The above impacts can result in flow on detrimental effects to marine parks, tourism and recreation.

Species of concern are those that are not native to the region, are likely to survive and establish in the region, and are able to spread by human-mediated or natural means. Species of concern vary from one region to another depending on various environmental factors, such as water temperature, salinity, nutrient levels and habitat type. These factors dictate their survival and invasive capabilities.

It is recognised that artificial, disturbed and polluted habitats in tropical regions are susceptible to introductions, which is why ports are often areas of higher IMS risk (Neil *et al*., 2005). However, in Australia there are limited records of detrimental impact from IMS compared to other tropical regions (such as the Caribbean).

Following their establishment, eradication of IMS populations is difficult, limiting management options to ongoing control or impact minimisation. However, this depends on the environmental conditions and species. For this reason, increased management requirements have been implemented in recent years by Commonwealth and State regulatory agencies.

Potential sources for the introduction of marine species into the operational area include biofouling on the vessels, including external niches (such as propulsion units, steering gear and thruster tunnels) and internal niches (such as sea chests, strainers, seawater pipe work, anchor cable lockers and bilge spaces).

Equipment that is submerged in water for periods of time (such as AUVs and ROVs) may acquire marine pest species, which can be spread if the equipment is not cleaned prior to use in pest-free areas.

Vessels based in local ports, such as Darwin or Onslow, do not carry the same quarantine risks as international vessels or out of State vessels, as they supply the same waters as those the operational area resides in. Given the depths at the operational area, establishment is considered unlikely to occur on the seabed.

7.2.3 Environmental performance outcomes and control measures

The EPO relating to this hazard is:

+ No introduction of marine pest species (EPO-07).

The control measures for this activity are shown in **Table 7-3**. EPSs and MC for the EPOs are described in **Section 8**.

Table 7-3: Control measures evaluation for introduction of invasive marine species

CM Reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
Standard control measures				
SVA-CM18	Compliance with the Biosecurity Act 2015	The risk of introducing IMS is reduced due to assessment procedure and management of ballast water.	Personnel costs involved in risk assessing vessels in accordance with the Invasive Marine Species Management Plan and DAWE requirements. Costs associating with reducing the vessel risk to 'low' (for example, dry docking, hull cleaning or additional costs due to inspections). Could lead to potential delays and therefore costs in vessel contracting process due to unavailability of vessels.	**Adopted** – Minimal personnel costs and potential delays or costs to project are considered outweighed by the benefits of reducing the risk of IMS.

CM Reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
SVA-CM19	Anti-foulant system	The risk of introducing IMS is reduced due to anti-foulant systems.	Could lead to potential delays and therefore costs, in vessel contracting process due to availability of vessels with appropriate anti-foulant systems.	**Adopted** – Minimal potential delays or costs to project are considered outweighed by the benefits of reducing the risk of IMS.
Additional Control measures				
N/A	Heat treatment of ballast water to eliminate IMS	Would reduce potential for IMS to establish by eliminating individuals present in ballast water.	High cost compared to existing risk; introduction of water at much higher temperature than surrounding marine environment would likely result in death of native marine species.	**Rejected** – Based on increased risk to marine environment compared to base case risk.
N/A	Restrict vessel operations to using vessels and equipment that have operated in local, State or National waters to reduce potential for IMS	Reduces potential for IMS to be transported into area since vessels would not have originated elsewhere.	Vessels and equipment suitable for the activity may not be available in State/National waters therefore work could not be completed.	**Rejected** – Not feasible without significant impact on survey objectives/ schedule.
N/A	Mandatory dry docking of vessels prior to entering field to clean vessel and/or equipment and remove biofouling	Demonstrates that no IMS were present on vessel or associated equipment.	Significant cost (grossly disproportionate to the risk) would lead to scheduling delays.	**Rejected** – Costs disproportionately high compared to environmental benefit given other controls in place already reduce the risk. Given other controls in place already reducing the risk, cost outweighs benefit.
N/A	Use an alternative ballast system to avoid uptake or discharge of water	Eliminates need for ballast water exchange, therefore decreasing risk of introducing IMS through ballast water.	Vessels suitable for the activity may not have options for alternative ballast system, therefore would require modification at significant cost.	**Rejected** – Costs disproportionately high compared to environment benefit.

CM Reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
N/A	Zero discharge of ballast water	Would reduce the potential for IMS by implementing a no ballast water exchange policy on support vessels.	Ballast water exchange required on the support vessels for stability.	**Rejected** – On the basis that ballast water exchange is a safety-critical activity for marine operations.

7.2.4 Environmental impact assessment

Description – Invasive Marine Species	
Receptors	Introduction of IMS – disruptions to other marine users Impact to marine primary producers – reduced access to fishing grounds Socio-economic impact
Consequence	III – Moderate
Ballast water is responsible for 20 to 30% of all marine pest incursions into Australian waters; however, research indicates biofouling (the accumulation of aquatic micro-organisms, algae, plants and animals on vessel hulls and submerged surfaces) has been responsible for more foreign marine introductions than ballast water (DAFF, 2011). IMS, if successfully established, can outcompete native species for food or space, prey on native species or change the nature of the environment and can subsequently impact on fisheries or aquaculture. If an IMS is introduced, the species has been known to colonise areas outside of the areas to which it is introduced. In the event that an invasive marine species is introduced into the operational area, given the lack of diversity and extensiveness of similar benthic habitat in the region, there would only be a minor reduction in the physical environment. No threatened ecological communities are present in the area that could be affected. The overall consequence level was assessed as *Moderate,* this also takes into consideration the proximity of the activity to protected areas (Ashmore Reef AMP) and the requirements of the North MPNMP which requires that vessel ballast water exchange is completed in accordance with the Australian Ballast Water Management Requirements.	
Likelihood	a – Remote
The pathways for IMS introduction are well known; consequently, standard preventive measures are proposed. The ability for invasive marine species to colonise a habitat depends on a number of environmental conditions. It has been found that highly disturbed environments (such as marinas) are more susceptible to colonisation than are open water environments where the number of dilutions and the degree of dispersal are high (Paulay *et al*., 2002). IMS are more likely to populate shallower areas with favourable substrates. Given that the depth of all the operational area is greater than 70 m, this creates an unfavourable habitat for colonisation (in other words, light limiting and low habitat biodiversity with sparse epibiota) and it is distant from shallow coastal habitats, there is a very low likelihood that IMS would be able to survive translocation and subsequently establish and colonise. With control measures in place to reduce the risk of introduction of IMS, the likelihood of introducing an IMS is considered *Remote*.	
Residual Risk	The residual risk associated with this event is *Very Low*

7.2.5 Demonstration of as low as reasonably practicable

Vessels and submersible equipment are required for the activity and no alternatives to vessels are feasible.

Ballast water exchange will be managed through Ballast Water Management actions consistent with the Australian Ballast Water Management Requirements (DAWE), and a vessel biosecurity risk assessment in accordance with the IMSMP (EA-00-RI-10172) will be undertaken to demonstrate vessels are low risk so IMS are not introduced.

Santos has adopted a risk-based approach to managing biofouling given it is not practicable or reasonable to inspect and/or clean every vessel before each voyage. Such an approach is consistent with other petroleum operators on the NWS and North Australia and is beyond that enforced on the majority of commercial and recreation vessels that regularly transit the same bioregion. International vessels are given the highest priority to prevent the introduction of IMS into Australian waters. However, domestic vessels (interstate and locally sourced) are also risk-assessed to reduce the likelihood of spreading marine pest species already established in Australian waters. The biofouling risk assessment approach adopted by Santos will ensure the *Aquatic Resources Management Act 2016* (as amended) and associated regulations prohibiting the introduction of non-endemic fish species will be met.

Typically, domestic vessels will be sourced for the proposed VBA, with international vessels more likely for geotechnical surveys. However, with the controls in place, vessel risk will be managed to ALARP, regardless of the vessel source location.

No other controls were identified to reduce the risk of introducing IMS. Therefore, with the above control measures in place, the risk of introducing IMS has been reduced to ALARP.

7.2.6 Acceptability evaluation

Is the risk ranked between Very Low to Medium?	Yes – introduction of IMS residual risk ranking is Very Low
Is further information required in the consequence assessment?	No – potential impacts and risks well understood through the information available.
Are risks and impacts consistent with the principles of ESD?	Yes – activity evaluated in accordance with Santos' Environmental Hazard Identification and Assessment Procedure which considers principles of ESD.
Are risks and impacts consistent with relevant legislation, international agreements and conventions, guidelines and codes of practice (including species recovery plans, threat abatement plans, conservation advice and AMP zoning objectives)?	Yes – management consistent with *Biosecurity Act 2015* and *National Biofouling Management Guidance for the Petroleum Production and Exploration Industry* (Marine Pest Sectoral Committee, 2018). Also consistent with the *Fish Resources Management Act 1994* (expected to be replaced by the *Aquatic Resources Management Act 2016*).
Are risks and impacts consistent with Santos Environment, Health and Safety Policy?	Yes – aligns with Santos' Environment, Health and Safety Policy.
Are risks and impacts consistent with stakeholder expectations?	Yes – no concerns raised.
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – see ALARP above.

The mobilisation of vessels and equipment to undertake offshore petroleum activities is industry standard practice, and the IMS risks are well understood and subject to regulation. The vessels and equipment that are internationally mobilised will meet Australian biosecurity requirements, and proposed management is consistent with *National Biofouling Management Guidance for the Petroleum Production and Exploration Industry* (Marine Pest Sectoral Committee, 2018).

Application of the proposed control measures and adherence to legislation and regulations reduce the likelihood of introducing IMS into the operational area, and the dispersive offshore location in the operational area reduces the probability of successful establishment in the unlikely event of introduction.

No stakeholder concerns have been raised regarding this aspect, and the proposed controls will reduce the residual level of risk to medium and ALARP. Therefore, the residual risk associated with IMS is considered by Santos to be environmentally acceptable.

7.3 Marine fauna interaction

7.3.1 Description of event

Event	There is the potential for vessels or equipment (for example, ROV, AUV) involved in VBA to interact with marine fauna, including potential strike or collision, potentially resulting in severe injury or mortality.
Extent	Within the operational area, in the immediate vicinity of the vessels or subsea equipment.
Duration	During the Activity.

7.3.2 Nature and scale of environmental impacts

Potential receptors: Threatened/migratory fauna (marine mammals, marine turtles, whale sharks, seabirds).

7.3.2.1 Vessels and equipment

Cetaceans are naturally inquisitive marine mammals that are often attracted to vessels underway; for example, dolphins commonly 'bow ride' with vessels.

Marine fauna in surface waters that are most at risk from vessel collision include marine mammals, marine turtles and whale sharks. As summarised in **Table 6-2**, the operational area overlaps with a foraging BIA for whale sharks and therefore they are likely to be encountered in the operational area. Boat strike is recognised by the Approved Conservation Advice for *Rhincodon typus* (whale shark) as one of the threats to the recovery of whale sharks. Other individual marine fauna may also be encountered as identified in the PMST search (**Table 3-7**). Approved Conservation Advice for *Megaptera novaeangliae* (humpback whale) indicates humpback whales are one of the most frequently reported whale species involved in vessel strikes worldwide (Laist *et al*., 2001; Jensen & Silber, 2003). The increase in vessel numbers (Silber & Bettridge, 2012) is not only a threat to humpback whales in relation to vessel strikes, but also in disturbance and displacement from key habitats.

The worst potential impact from vessel collision would be mortality or serious injury of an individual. Collisions between vessels and cetaceans are most frequent on continental shelf areas where high vessel traffic and cetacean habitat occur simultaneously (WDCS, 2004). There have been recorded instances of cetacean deaths as a result of vessel collisions in Australian waters (for example, a Bryde's whale in Bass Strait in 1992) (WDCS, 2004), though the data indicate this is likely to be associated with container ships and fast ferries. Whale and Dolphin Conservation Society (WDCS) (2004) also indicates some cetacean species, such as humpback whales, can detect and change course to avoid a vessel.

The most commonly sighted whale in continental shelf waters of the region is the humpback whale. The humpback whale migrates between calving grounds in the Kimberley region of WA to feeding grounds in Antarctica. Higher numbers may be encountered in the operational area during humpback whale southern migration, however significant numbers are not expected as there is no overlap with BIAs.

The reaction of whales to the approach of a ship is quite variable. Some species remain motionless when in the vicinity of a ship while others are known to be curious and often approach ships that have stopped or are slow moving, although they generally do not approach, and sometimes avoid, faster moving ships (Richardson *et al*., 1995).

Turtle/vessel interactions arising from increased vessel traffic is also recognised as one of a number of key impacts to marine turtles in the Recovery Plan for Marine Turtles in Australia (DoEE, 2017). In the recovery plan, vessel disturbance is identified as a risk to flatback turtles. Marine turtles are highly mobile and, given the low speeds of vessels used for operations, are likely to be able to move from an area where there is vessel activity. Marine turtles make extensive migrations through the region; and it is possible that individual turtles of any of the species known from the region may be encountered in the operational area.

Marine turtle mortality due to boat strike has been identified as an issue in Queensland waters in the Marine Turtle Recovery Plan (Commonwealth of Australia, 2017). However, turtles appear to be more vulnerable to boat strike in areas of high urban population where incidents of pleasure crafts are higher. WA turtle populations have not been highlighted as those most affected by boat strike, possibly due to the relatively low human population density of the North Australian coastline.

Whale sharks, other pelagic fish and demersal fish are likely to exhibit a short-term avoidance to vessels, divers or AUV/ROVs. This is likely to be initiated through the vibrations and underwater noise emitted from these activities (**Section 6.1**) rather than the physical presence. Such avoidance is likely to be temporary.

7.3.2.2 Helicopters

A number of protected species of marine birds have potential habitats or migratory routes in and around the operational area (**Table 3-8**). Seabirds may be attracted to the vessel due to increased feeding opportunities on pelagic fish. However, these behavioural changes are unlikely to alter population dynamics or significantly change the habitat use of birds.

Helicopter noise is expected to elicit a behavioural response in birds to avoid collision; and given the relatively low speeds helicopters would be flying at during take-off or landing, the risk of helicopter strike is not high.

7.3.3 Environmental performance outcomes and control measures

The EPO relating to this hazard is:

+ No injury or mortality to EPBC Act 1999 and *WA Biodiversity Conservation Act 2016* listed marine fauna during activities (EPO-01).

The control measures for this activity are shown in **Table 7-4**. EPSs and MC for the EPOs are described in **Section 8**.

Table 7-4: Control measures evaluation for marine fauna interaction

CM Reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
Standard Control measures				
SVA-CM01	Procedure for interacting with marine fauna	Reduces risk of physical and behavioural impacts to marine fauna from vessels because if they are sighted, then vessels can slow down, or move away.	Potential delay in vessel movement, increasing activity duration and costs to Santos. Personnel costs involved in reporting sightings to authorities.	**Adopted** – Benefits of reducing risk of impacts to marine fauna outweigh the costs. Implementing relevant EPBC Act procedures for interacting with EPBC Act-listed marine fauna complies with the EPBC Regulations 2000.
SVA-CM02	Watchkeeping maintained on bridge	Monitoring of surrounding marine environment to identify potential collision risks (and reducing harm) to cetaceans and other marine fauna.	No additional cost; industry practice and regulated by AMSA.	**Adopted** – Industry practice, benefits outweigh cost.
Additional Control Measures				
N/A	Adopt further measures to those outlined in 'EPBC Regulations 2000 — Part 8 Division 8.1 during peak periods of ecological sensitivity, for example, additional management considerations for vessels outlined in the Australian National Guidelines for Whale and Dolphin Watching (2017)	Potentially provideS an additional level of protection of marine fauna.	Administrative costs to update existing procedure. Operational costs through interruption to activities through implementation of controls developed for an industry trying to get close to marine fauna, when Santos activities aim to avoid fauna.	**Rejected** – The existing control '*procedure for interacting with marine fauna*' has been written in accordance with the EPBC Act and other relevant guidelines. A review of this procedure against the Australian National Guidelines for Whale and Dolphin watching found that there are no additional relevant controls in the Australian National Guidelines for Whale and Dolphin watching and therefore adopting this control is not ALARP.
N/A	Restrict the timing of activities to operate outside of	Reduce risk of collisions (causing harm) during environmentally	Protected Marine Fauna species are present year-round,	**Rejected** – Grossly disproportionate to the environmental

CM Reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
	sensitive periods only	sensitive periods for listed marine fauna.	meaning there are no non-sensitive periods to operate in and the operational area does not overlap with seasonal BIAs, such as for migration.	benefit and would severely limit operations which are required to occur 24 hours a day, seven days a week.
N/A	Dedicated MMO on vessels (EPBC Policy Statement 2.1 Part B)	Improved ability to spot and identify marine fauna at risk of collision (that may cause harm).	Additional cost of contracting MMO.	**Rejected** – Risk of animals being encountered is too low to justify additional cost of MMO; in other words, cost is disproportionate to environmental benefit.
N/A	Activities will only occur during daylight hours	Potential for a vessel-fauna collision occurring is decreased due to vessel being stationary when visibility is lower at night.	Lengthens the time of the activity – approximately double. Increased cost due to increased operation time (more than double the cost and therefore grossly disproportionate).	**Rejected** – Substantial additional cost due to doubling of operation duration.
N/A	Spotter planes/vessels sent ahead to planned night-time operational area	Eliminate/reduce likelihood and consequence of impact to marina fauna.	Marine fauna may have moved away from the area by the time the vessel arrives. Cost of specialist aircraft with good downward visibility, or cost of an additional spotter vessel additional MFOs required on board aircraft. Additional risks to environment through use of vessels/ airplanes, increased safety risks to personnel on board additional vessels/ airplanes.	**Rejected** – Cost is disproportionate to increase in environmental benefit.

7.3.4 Environmental impact assessment

Marine Fauna Interaction	
Key Receptors	Threatened/migratory fauna (marine mammals, marine reptiles, sharks and seabirds).
Consequence	II – Minor
In the event of a collision with marine fauna, there is the potential for injury or death to an individual. The number of receptors present at the operational area is expected to be limited to a small number of transient individuals. There are BIAs close to the operational area for marine turtles and pygmy blue whales but they do not overlap. Boat strike and vessel disturbance are identified as potential threats to marine fauna species in relevant recovery plans and conservation advice. The above information demonstrates that, with control measures in place, the activity will be conducted in a manner that reduces potential impacts to ALARP and an acceptable level. As such, there is the potential for death or injury of EPBC listed individual species; however, as they would represent a small proportion of the local population it is not expected that it would result in a decreased population size over what would usually occur due to natural variation, at a local or regional scale. It is expected that the loss of an individual would be a minor consequence.	
Likelihood	b – Unlikely
Marine fauna interaction is considered very unlikely given the small operational area for the VBA and short timeframe, slow vessel speeds (typically less than 5 knots), open-ocean environment and the tendency for fauna to move away. The International Whaling Commission has compiled a database of the worldwide occurrence of vessel strikes to cetaceans, within which Australia constitutes approximately 7% (35 reports) of the reported worldwide (approximately 471 reports) vessel strike records involving large whales (Peel *et al.,* 2018). No known aggregation areas occur within the operational area and therefore concentrations of milling individuals are unlikely. Vessels will be moving very slowly while inside the operational area, posing a low risk of collision with marine fauna. In addition, the noise generated from vessel operations may locally deter marine fauna from coming in close proximity to vessels. Consequently, the likelihood of a collision with marine fauna resulting in a minor consequence is considered to be unlikely.	
Residual Risk	The residual risk associated with this hazard is Very Low

7.3.5 Demonstration of as low as reasonably practicable

No alternative options to the use of vessels are possible in order to undertake the activity. Any impact caused by the physical presence of vessels is likely to be localised and temporary, with marine species expected to resume normal behavioural patterns in the open oceanic waters surrounding the operational area in a short time frame following completion of the VBA.

In the event that vessels come in close proximity to EPBC Act-listed marine fauna, such as whales and whale sharks, EPS (**Table 8-2**) have been implemented for limiting vessel operations, as well as for ensuring that the crew are aware through inductions of the risk posed by conducting the activity, in order to reduce the likelihood of a marine fauna collision to ALARP. Inductions for the crew of support vessels will include information about how to interact with cetaceans and whale sharks in accordance with the EPBC Regulations.

The inherent likelihood of encountering fauna in the operational area is limited by the short duration of the activities and the separation from areas of high surface-fauna density. With low vessel speeds and compliance with fauna interaction procedures, including Regulation 8 of the EPBC Regulations 2000, which

aim to prevent adverse interactions of vessels with marine megafauna, a fauna collision is considered very unlikely. With the controls adopted, the assessed residual risk for this impact is ALARP.

7.3.6 Acceptability evaluation

Is the risk ranked between Very Low to Medium?	Yes – maximum marine fauna interaction residual risk ranking is Very Low.
Is further information required in the consequence assessment?	No – potential impacts and risks well understood through the information available.
Are risks and impacts consistent with the principles of ESD?	Yes – activity evaluated in accordance with Santos' Environmental Hazard Identification and Assessment Procedure which considers principles of ESD.
Are risks and impacts consistent with relevant legislation, international agreements and conventions, guidelines and codes of practice (including species recovery plans, threat abatement plans, conservation advice and AMP zoning objectives)?	Yes – management consistent with Part 8 of the EPBC Regulations. Control measures implemented will minimise the potential risks and impacts from vessel strike from the activity to relevant species identified in recovery plans and conservation advice (**Table 3-9**). Relevant species Recovery Plans, Conservation Management Plans and management actions, including: + Threat Abatement Plan for Impacts of Marine Debris on Vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018) + Recovery Plan for Marine Turtles in Australia (2017) + Approved Conservation Advice for *Megaptera novaeangliae* (humpback whale) (2015a) + Approved Conservation Advice for *Rhincodon typus* (whale shark) (2015b) + Conservation Management Plan for the Blue Whale, 2015–2025 (2015b) + Approved Conservation Advice for *Balaenoptera borealis* (sei whale) (2015)(2015d) + Approved Conservation Advice for *Balaenoptera physalus* (fin whale) (2015c) + Recovery Plan for the White Shark (*Carcharodon carcharias*) (2013) + Sawfish and River Sharks Multispecies Recovery Plan (2015a).
Are risks and impacts consistent with Santos Environment, Health and Safety Policy?	Yes – aligns with Santos' Environment, Health and Safety Policy.
Are risks and impacts consistent with stakeholder expectations?	Yes – no concerns raised.
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – see ALARP above.

Application of the proposed management and adherence to applicable regulations in line with relevant actions prescribed in the Recovery Plans and Approved Conservation Advice, reduces the likelihood of vessel interactions with marine fauna. While the potential exists for a collision to occur, it is considered a rare

scenario. Vessels will be travelling at low speeds within the operational area, also reducing the likelihood of fauna strike. In the unlikely event an impact did occur, it would be highly probable that only a single individual would be contacted. It is thought that owing to the rare likelihood of a collision occurring, coupled with the potential impact being limited to a single individual, the risk is deemed acceptable.

7.4 Hazardous liquid releases

7.4.1 Description of event

Event	Causes for accidental liquid releases (other than diesel) include: + hydraulic fluids, lubricant oils and stored waste oils from: – ROV failure (including oil seal, hydraulic system hose and quick-disconnect system failures) (approximately 0.05 m^3 (50 L)) – stern tube oil (non-hydrocarbon-based lube oil) from the vessel thruster/propeller stern tube (approximately less than 1 m^3) – loss of primary containment (drums, tanks, IBCs) due to handling, storage and dropped objects (such as swinging load during lifting activities) – vessel pipework failure or rupture, hydraulic hose failure and inadequate bunding. + chemicals, including corrosion inhibitor, cleaning and cooling agents, recovered solvents, stored or spent chemicals, leftover paint materials and used greases, through: – spills or leaking machinery accidentally discharged overboard in deck drainage water – overflow of the open and closed drainage systems – loss of primary containment (drums, tanks, IBCs) due to handling, storage and dropped objects (such as swinging load during lifting activities). + oily water from vessels includes bilge water and deck drainage water. – in the event the oil discharge monitoring equipment fails, water containing hydrocarbons at more than 15 ppm could be accidentally discharged overboard. The vessel main engines and equipment, such as pumps, cranes, winches, power packs and generators, require diesel for fuel and a variety of hydraulic fluids and lubricating oils for efficient operation and maintenance of moving parts. These products are present within the equipment and also held in storage containers and tanks on vessels. Small hydrocarbon leaks could occur from loss of primary containment due to handling, storage and dropped objects (during lifting activities). Impacts associated with hydrocarbons are provided in **Sections 7.5** and **7.6**.
Extent	Volumes are likely to be small and limited to the volume of individual containers (such as IBCs, 44-gallon drums) stored on the deck of supply vessels. The credible spill for this scenario is considered to be the loss of an intermediate bulk container (1 m^3). The relative low volumes are expected to rapidly disperse into the marine environment. Concentrations below toxic or harmful thresholds are expected to occur at short distances from the release point. Should a spill occur, potential impacts beyond the operational area are not expected in the event of a worst-case spill.
Duration	Potentially toxic or harmful threshold concentrations limited to a very short period immediately following an instantaneous release.

7.4.2 Nature and scale of impacts

Potential receptors: Fish and sharks, marine mammals, marine reptiles and seabirds.

Hydraulic fluids and lubricating fluids behave similarly to marine diesel when spilt in the marine environment. Hydraulic fluids are oils of light to moderate viscosity and have a relatively rapid spreading rate. Like diesel,

they will dissipate quickly, particularly in high sea states, although lubricating oils are more viscous and so the spreading rate of a spill of these oils would be slightly slower.

Impacts associated with the unplanned discharge of hazardous liquids to the marine environment depend on the nature of the liquid released, the volume and its behaviour in the marine environment (in other words, whether it sinks, floats, disperses, etc.). In the event of a spill to the marine environment, these liquids would be subjected to rapid dispersion and dilution by the open ocean water conditions and prevailing currents and would remain within the surface waters.

Potential impacts include a temporary and highly localised decline in water quality. This would have limited potential for toxicity to marine fauna, due to the likely short duration of exposure and rapid dilution of the released hazardous liquids in the marine environment. Impacts are likely to be limited to the immediate vicinity of the spill and would not affect population viability of contacted species or ecosystem function. The greatest potential for impact would likely be for passive or low mobility fauna such as plankton, pelagic invertebrates and small pelagic fishes which may be exposed for the greatest periods of time and likely have a permanent presence within the operational area. Large, more mobile fauna are likely to be transient within the operational area and toxic impacts are unlikely to occur to these species in the event of a small liquid hazardous release.

7.4.3 Environmental performance and control measures

The EPO relating to this event is:

+ No unplanned objects, emissions or discharges to sea or air [EPO-06].

The control measures considered for this activity are shown in **Table 7-5**, with EPSs and MC for the EPOs described in **Table 8-2**.

Table 7-5: Control measures evaluation for hazardous liquid releases

CM Reference	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
Standard Controls				
SVA-CM04	Vessel PMS to maintain vessel DP, engines and machinery	Requires that equipment is maintained and certified, reducing probability of leaks of hydraulic fluid from the equipment.	Additional personnel costs of ensuring equipment is maintained and certified as appropriate and that procedures are in place and followed.	**Adopted** – Benefits of ensuring procedures are followed and equipment is compliant outweigh the minimal costs of personnel time.
SVA-CM13	Vessel oily water treatment system	Reduces potential impacts of discharge of oily water to the environment. Provides compliance with MARPOL Annex I and Marine Order 91, Marine Pollution Prevention – Oil.	Time and personnel costs in maintaining oil record book.	**Adopted** – Benefits of ensuring vessels are compliant outweigh the minimal costs of personnel time, and it is a legislated requirement.

CM Reference	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
SVA-CM15	Deck cleaning product selection	Improves water quality discharge (reduces toxicity) to the marine environment. Those deck cleaning products planned to be released to sea meet the criteria for not being harmful to the marine environment according to MARPOL Annex V.	Personnel costs of implementing. Potential additional cost and delays of deck cleaning product substitution.	**Adopted** – Benefits of ensuring vessels are compliant and that those deck cleaning products planned to be released to sea meet MARPOL criteria outweigh the cost.
SVA-CM20	Vessel spill response plans (shipboard oil pollution emergency plan (SOPEP)/ shipboard marine pollution emergency plan (SMPEP)	Implements response plans to deal with an unplanned release quickly and efficiently in order to reduce impacts to the marine environment.	Administrative costs of preparing documents and large costs of implementing response strategies.	**Adopted** – Benefits of ensuring procedures are followed and measures implemented and that the vessel is compliant outweighs the costs.
SVA-CM24	Chemical selection procedure	Aids in the process of chemical management that reduces the potential impact of unplanned chemical discharges to sea.	Cost associated with implementation of procedure. Range of chemicals reduced with potentially higher costs for alternative products.	**Adopted** – Environmental benefit of using lower toxicity chemicals outweigh procedural implementation costs.
SVA-CM25	Remotely operated vehicle inspection and maintenance procedures	Maintenance and pre-deployment inspection on ROV completed as scheduled to reduce the risk of hydraulic fluid releases to the marine environment.	Additional personnel costs of ensuring procedures in place and followed.	**Adopted** – Benefits of ensuring procedures are followed outweigh costs.
SVA-CM26	General Chemical Management Procedure	Potential impacts to the environment are reduced through following correct procedures for the safe handling and storage of chemicals.	Personnel costs associated with ensuring procedures are in place and implemented during handling and storage of chemicals.	**Adopted** – Benefits of ensuring procedures are followed and measures implemented outweigh the costs.

CM Reference	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
SVA-CM27	Hazardous Chemical Management Procedure	Reduces the risk of spills and leaks (discharges) to sea by controlling the storage, handling and clean-up.	Personnel cost associated with implementation of procedures and permanent or temporary storage areas.	**Adopted** – Benefits of ensuring procedures are followed and measures implemented outweigh costs.

7.4.4 Environmental impact assessment

Description – Hazardous Liquid Releases	
Receptors	Threatened, migratory, or local fauna. Physical environment or habitats
Consequence	I – Negligible

Threatened, migratory and local fauna

In the event of a minor hazardous liquid, the quantities would be very small (worst case identified to be limited to approximately 1 m^3 for the loss of the contents of an intermediate bulk container or 50 L for ROV hydraulic fluid). The small volumes and dilution and dispersion from natural weathering processes such as ocean currents are such that spills will be limited in area and duration. The number of receptors present at the activity location are expected to be limited to a small number of transient individuals.

Habitat degradation, deteriorating water quality and marine pollution are identified as potential threats to a number of marine fauna species, including turtles and some bird and shark species, in relevant recovery plans and conservation advice.

However, the potential releases of hazardous liquids are not expected to significantly impact the receiving environment, given the control measures proposed to prevent releases; therefore, the activity will be conducted in a manner that is considered acceptable.

Toxic impacts are not expected to the benthic community due to the water depths.

The susceptibility of marine fauna to hazardous materials is dependent on material, volume, type and exposure duration. However, given that exposures would be limited in extent and duration due to the small volumes the impacts to receptors is not significant.

For marine mammals that may be exposed to the more toxic aromatic components of the minor chemical spills, toxic effects are considered unlikely since these species are mobile and therefore will not be constantly exposed for extended durations that would be required to cause any major toxic effects. Any impact is expected to be at individual behavioural level only.

It is possible that individual turtles may come into contact with the release, however considering the water depths of the operational area compared to observed water depths of internesting turtles, large numbers of the species are not expected and significant impacts to population will not occur. Impacts may occur small proportion (individuals) of a local population with no consequences for conservation status or reproductive success.

Toxic impacts are not expected to the benthic community due to the water depths.

Deteriorating water quality is identified as a potential threat to turtles in the marine turtle recovery plan and to some bird and shark species (**Table 3-9**). However, the potential minor chemical releases are not expected to significantly impact the receiving environment, given the control measures proposed to prevent releases. Therefore, the activity will be conducted in a manner that is considered acceptable.

Given that a small hazardous liquid spill would not result in a decreased population size at a local or regional scale, it is expected that a spill of this nature would result in a *Negligible* consequence.

Physical Environment and Habitats The small volumes and dilution and dispersion from natural weathering processes such as ocean currents are such that spills will be limited in area and duration. Releases of hazardous liquids to the marine environment will impact local water quality for a short period of time whilst the release disperses. Impact to water quality will be *Negligible (I)*. Protected Areas No protected areas in the vicinity that could be impacted by these types of minor spills.	
Likelihood	b – Unlikely
Control measures proposed ensure that the risk of a release of hazardous materials to the environment has been minimised. The likelihood of transient marine fauna occurring in the operational area coincident with a release is limited and given the control measures in place, the likelihood of releasing hazardous liquids to the environment resulting in a negligible consequence is considered unlikely.	
Residual Risk	The residual risk associated with this event is *Very Low*

7.4.5 Demonstration of as low as reasonably practicable

Storage and use of hydraulic and lubricating oils or fluids for equipment and machinery, including for ROV operations, are required to undertake the activity, so their removal from the activity is not viable.

Only volumes of hazardous materials as required for maintaining vessel capabilities will be stored or handled on-board the vessels. The vessels will implement safeguards, as per relevant AMSA Marine Orders/MARPOL requirements. Such safeguards may include (but not limited to) designated storage and handling areas, correct stowage, accurate labelling and marking, Safety Data Sheet (SDS) information, spill clean-up equipment and containment.

In addition, administrative controls, such as all vessels being required to have a Garbage Management Plan that describes the on-board controls for preventing unplanned discharges, will minimise the risk of the hazardous liquid being accidentally discharged through mishandling or poor storage.

Other management controls that have been implemented include vessel maintenance systems, chemical management procedures, spill clean-up equipment and SMPEP/OPEPs not only to minimise the risk of an accidental release, but also to reduce the impact if a release does occur.

Containment of small spills from bunding, inherent in the design of vessels and from spill containment kits onboard these vessels (detailed in the SMPEP) provides a barrier to any spills reaching the marine environment. The inspection and maintenance of bunding and drainage systems and of spill response kits provides assurance that these are available to contain spills in the event of a small leak. It is considered that barriers in place to contain spills would prevent spills from reaching the marine environment and thus it is considered that there are no further controls that would offer a further benefit to the environment.

A thorough set of control measures has been proposed to ensure the risks of minor hazardous liquid spills and leaks occurring and subsequent impacts are minimised. The resulting impacts to marine fauna that could potentially result from a spill of this size would be minor, with impacts restricted to a small number of individuals within a localised area.

The control measures proposed are in line with applicable actions described in relevant recovery plans and conservation advice to reduce the risk of habitat degradation and deteriorating water quality (for example, from pollution) to a level considered to be ALARP by Santos. The assessed residual risk for this impact is low and cannot be reduced further. It is considered therefore that the impact of the activities conducted is ALARP.

7.4.6 Acceptability evaluation

Is the risk ranked between Very Low to Medium?	Yes – maximum minor hydrocarbon spill residual risk is ranked Low.
Is further information required in the consequence assessment?	No – potential impacts and risks well understood through the information available.
Are risks and impacts consistent with the principles of ESD?	Yes – activity evaluated in accordance with Santos' Environmental Hazard Identification and Assessment Procedure which considers principles of ESD.
Are risks and impacts consistent with relevant legislation, international agreements and conventions, guidelines and codes of practice (including species recovery plans, threat abatement plans, conservation advice and AMP zoning objectives)?	Yes – management consistent with International Convention of the SOLAS 1974 and *Navigation Act 2012*, MARPOL Annex I – Oil. Consistent with relevant species recovery plans, conservation management plans and management actions set out in (**Table 3-9**). Relevant species Recovery Plans, Conservation Management Plans and management actions, including: + Recovery Plan for Marine Turtles in Australia (2017) + Approved Conservation Advice for *Megaptera novaeangliae* (humpback whale) (2015a) + Approved Conservation Advice for *Rhincodon typus* (whale shark) (2015b) + Conservation Management Plan for the Blue Whale, 2015–2025 (2015b) + Approved Conservation Advice for *Balaenoptera borealis* (sei whale) (2015d) + Approved Conservation Advice for *Balaenoptera physalus* (fin whale) (2015c) + Recovery Plan for the White Shark (*Carcharodon carcharias*) (2013) + Sawfish and River Sharks Multispecies Recovery Plan (2015a).
Are risks and impacts consistent with Santos Environment, Health and Safety Policy?	Yes – aligns with Santos' Environment, Health and Safety Policy.
Are risks and impacts consistent with stakeholder expectations?	Yes – no concerns raised.
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – see ALARP above.

With the control measures in place to prevent an accidental release of hazardous liquids and the negligible impacts predicted from unplanned spills, the risk to the marine environment is considered low. Potential risks are unlikely to be greater than those caused by other commercial marine vessels or offshore petroleum activities in deep water.

Hazardous liquids will be managed in accordance with relevant legislation and industry standards and Santos procedures. The small volume negates the need for any further contingencies to be in place that are included for some of the larger spill scenarios associated with the activity.

With the control measures in place to prevent accidental spills and the negligible impacts predicted from a spill of this size, the environmental risk of using and handling the required chemicals is considered acceptable.

7.5 Overview of unplanned release of hydrocarbons

There is the potential for loss of containment of marine diesel oil (MDO) as a result of a vessel collision event or refuelling occurring during the activity. Diesel spill trajectory modelling was utilised to predict the potential extent of a worst-case spill event. Spill modelling was commissioned for the operational area for the worst case credible scenario of a loss of diesel from a tank during a vessel collision (**Figure 1-1**, GHD, 2021).

7.5.1 Spill scenario selection

7.5.1.1 Refuelling

A minor spill (approximately 37.5 m^3) of diesel could occur during vessel refuelling resulting in a loss of hydrocarbons to the marine environment at sea surface. Spills during refuelling can occur through several pathways, including fuel hose breaks, coupling failure or tank overfilling.

Spills resulting from overfilling will be contained within the vessel drains and slops tank system. In the event that the refuelling hose is ruptured, the fuel bunkering activity will cease by turning off the pump; the fuel remaining in the transfer line will escape to the environment as well as fuel released prior to the transfer operation being stopped. The AMSA (2015) Technical Guidelines for Preparing Contingency Plans for Marine and Coastal Facilities provides guidance for calculating a maximum credible spill volume for a refuelling spill. The guidance provided by AMSA (2015) for a refuelling spill under continuous supervision is considered appropriate given refuelling will be constantly supervised. The maximum credible spill volume during refuelling is calculated as: transfer rate (150 m^3/hr) times by 15 minutes of flow. The detection time of 15 minutes is seen as conservative but applicable after failure of multiple barriers, followed by manual detection and isolation of the fuel supply.

7.5.1.2 Vessel collision

It is considered credible that a release of diesel to the marine environment could occur from a collision between the activity vessel and a third-party vessel. Such events could have sufficient impact to result in the rupture of a diesel tank (loss of integrity). This is considered credible, given the diesel tanks may not be protected or double-hulled, and fuel tank ruptures resulting in a hydrocarbon release have occurred before.

The AMSA (2015) Technical Guidelines for Preparing Contingency Plans for Marine and Coastal Facilities recommend that the spill scenario for modelling and impact assessment should be based on the largest single fuel tank volume. The specific vessel to undertake the VBA is yet to be confirmed; a review of available vessels indicated the largest single fuel tank is likely to be up to approximately 120 m^3 in capacity. Although the likely vessel's largest fuel tank will be smaller, a conservative modelled spill volume of 329 m^3 has been used for this EP.

7.5.2 Spill modelling overview

To determine the spatial extent of impacts from a potential hydrocarbon spill from the proposed VBA at all locations, modelling was completed for the vessel collision scenario (GHD, 2021). A surface spill of diesel during refuelling is considered relatively small in comparison to a surface spill of diesel during a vessel collision. It is therefore assumed that the extent of a hydrocarbon spill during refuelling would remain within the extent of the worst-case spill trajectory of diesel from a vessel collision; therefore, modelling of a smaller spill was not conducted.

Far-field spill modelling was performed with OSCAR. The model was configured in stochastic mode to simulate a range of environmental conditions. The start dates for the stochastic simulations were staggered approximately every four days across five years of hydrodynamic and wind data. A total of 400 individual 'realisations' made up the full stochastic simulation set for each of the spill scenarios.

OSCAR spatially tracked the surface oil, total submerged oil in the water column, dissolved oil and oil on shorelines. The 'total submerged oil' is comprised of dissolved oil and entrained oil (or droplets), and therefore provides a conservative (over) representation of the NOPSEMA (2019) thresholds for entrained oil.

The outputs of this modelling showed a number of different possible spill outcomes of a spill, which were then analysed to determine the concentrations of hydrocarbon at each grid cell of the model, providing information about the probability of contact and concentration at contact of hydrocarbons across the EMBA (**Figure 3-1**).

7.5.3 Hydrocarbon characteristics

International Tanker Owners Pollution Federation (2011) and Australian Marine Oil Spill Centre (2011) categorise diesel as a light 'group II' hydrocarbon. In the marine environment, a 5% residual of the total quantity of diesel spilt will remain after the volatilisation and solubilisation processes associated with weathering.

In the marine environment, diesel is expected to behave as follows:

+ Diesel will spread rapidly in the direction of the prevailing wind and waves;
+ Evaporation will be the dominant process contributing to the fate of spilled diesel from the sea surface and will account for 60 to 80% reduction of the net hydrocarbon balance;
+ The evaporation rate of diesel will increase in warmer air and sea temperatures; and
+ Diesel residues usually consist of heavy compounds that may persist longer and will tend to disperse as oil droplets into the upper layers of the water column.

A surface release of 329 m^3 of diesel was modelled from the vessel. Upon release, the diesel is forecast to spread rapidly out to a thin film on the sea surface, and evaporation is forecast to remove approximately 50% of the released volume within several days of release. The diesel will also become increasingly subject to entrainment into the water column as the density increases after losing the lighter components through evaporation (APASA, 2013).

A summary of the representative characteristics of diesel, as assessed in this EP, is provided in **Table 7-6**.

Table 7-6: Summary of diesel characteristics

Oil Name	API Gravity	Specific Gravity	Wax Content (%)	Pour Point (°C)	Asphaltene (%)	Viscosity (cSt)
Diesel	36.4	0.843	0.05	-36	0.05	3.9 @20°C

Source: GHD (2021)

7.5.3.1 Marine diesel weathering

A preliminary analysis of hydrocarbon weathering for MDO was undertaken with the SINTEF Oil Weathering Model (OWM) (GHD, 2021). The OWM predicts the fate of spilled hydrocarbons under steady-state met-ocean conditions. OWM simulations were run for sustained wind speeds of 1 m/s (low winds), 5 m/s (moderate winds) and 10 m/s (high winds). The OWM simulations are based on a test case of 100 m^3 of hydrocarbon released instantaneously onto the sea surface.

The results of the weathering analyses are presented in **Figure 7-1**. MDO is a moderate weight and moderately persistent oil in the marine environment. Under low winds (1 m/s), 60% of the surface slick is predicted to remain after 120 hours (five days). Under moderate winds (5 m/s), 40% of the initial surface slick is predicted to remain a surface oil after 24 hours, decreasing further to approximately 10% after 48 hours and approximately 1% after 72 hours. With high winds (10 m/s), the surface slick is predicted to almost entirely evaporate (approximately 20 to 25%) and disperse (approximately 75 to 80%) after 12 hours. MDO has a very low tendency for emulsion formation with only approximately 1% water content entrained into the surface slick after 120 hours across the three constant wind assessment conditions.

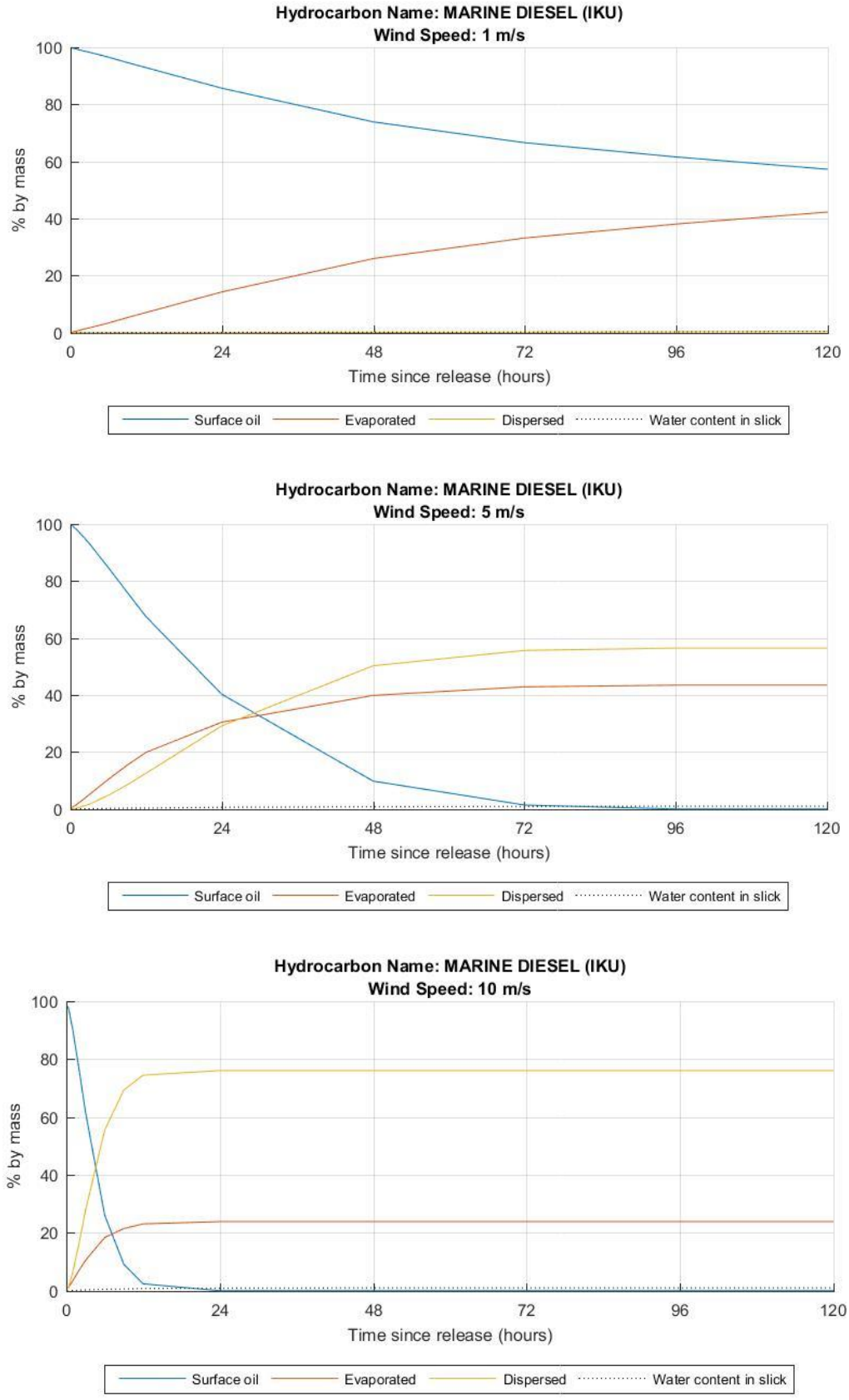

Figure 7-1: Simulated weathering of the SINTEF marine diesel oil (IKU) hydrocarbon for constant wind speeds of 1 m/s (top), 5 m/s (middle) and 10 m/s (bottom) (GHD, 2021)

7.5.4 Hydrocarbon exposure values

To inform the impact assessment, it is important to understand the profile of the concentrations of hydrocarbons after a spill. To do this, NOPSEMA recommends identifying hydrocarbon exposure values that broadly reflect the range of consequences that could occur at certain concentrations (NOPSEMA, 2019). The exposure values that have been applied to this EP are described below.

The EMBA shown in **Figure 3-1** was identified using low exposure values. These low exposure values are not considered to be representative of a biological impact, but they are adequate for identifying the full range of environmental receptors that might be contacted by surface and/or subsurface hydrocarbons (NOPSEMA, 2019) and a visible sheen.

To inform impact assessment, exposure values that may be representative of biological impact have also been identified. These are called 'moderate exposure values' and 'high exposure values'. Moderate and high exposure values are modelled for each fate of hydrocarbon to identify what contact is predicted for surface (floating oil), subsurface (entrained oil and dissolved aromatic hydrocarbons) and shoreline accumulation of hydrocarbon at sensitivities.

Determining exposure values that may be representative of biological impact is complex since the degree of impact will depend on the sensitivity of the receptors contacted, the duration of the exposure and the toxicity of the hydrocarbon type making the contact. The toxicity of a hydrocarbon will also change over time, due to weathering processes altering the composition of the hydrocarbon. To identify appropriate exposure values, Santos has considered the advice provided by NOPSEMA Bulletin #1 Oil Spill Modelling (April 2019) and scientific literature. The selected hydrocarbon exposure values are discussed in **Table 7-7**, **Table 7-8**, **Table 7-9** and **Table 7-10**; these tables explain how the exposure value is relevant to the risk evaluation and provides context on how that exposure value is used to inform response planning (which is addressed further in the OPEP).

Table 7-7: Floating hydrocarbons exposure values

Surface Oil Concentration (g/m^2)	Exposure Value	Description
1	Low	**Risk Evaluation** It is recognised that a lower floating oil concentration of 1 g/m^2 (equivalent to a thickness of 0.001 mm or 1 ml of oil per m^2) is visible as a rainbow sheen on the sea surface. Although this is lower than the exposure value for ecological impacts, it may be relevant to socio-economic receptors and has been used as the exposure value to define the spatial extent of the environment that might be contacted (EMBA) from floating oil. **Response Planning** Contact at 1 g/m^2 (as predicted by oil spill trajectory modelling) is used as a conservative trigger for activating scientific monitoring plans as detailed in the OPEP.
10	Moderate	**Risk Evaluation** There is a paucity of data on floating oil concentrations with respect to impacts to marine organisms. Hydrocarbon concentrations for registering biological impacts resulting from contact of surface slicks have been estimated by different researchers at about 10 to 25 g/m^2 (French *et al*., 1999; Koops *et al*., 2004; NOAA, 1996). The impact of floating oil on birds is better understood than on other receptors. A conservative exposure value of 10 g/m^2 has been applied to impacts from surface hydrocarbons (floating oil) in this EP. Although based on birds, this hydrocarbon exposure value is also considered appropriate for turtles, sea snakes and marine mammals (NRDAMCME, 1997). **Response Planning** Contact at 10 g/m^2 is not specifically used for spill response planning.
50	High	**Risk Evaluation** At greater thicknesses the potential for impact of surface oil to wildlife increases. All other things being equal, contact to wildlife by surface oil at 50 g/m^2 is expected to result in a greater impact. **Response Planning** Containment and recovery effectiveness drops significantly with reduced oil thickness (McKinney *et al*., 2017; NOAA, 2014). McKinney *et al*. (2017) tested the effectiveness of various oil skimmers at various oil thicknesses. Their results showed that the oil recovery rate of skimmers dropped significantly when oil thickness was less than 50 g/m^2 (less than Bonn Agreement Code 4). Hence, 50 g/m^2 has been set as a guide for planning effective containment and recovery operations. Similarly, surface oil greater than 50 g/m^2 (Bonn Agreement Code 4/5 and equivalent to oil observed as discontinuous or continuous true colour) is considered to be a lower limit for effective dispersant operations and is therefore considered for planning.

Table 7-8: Shoreline hydrocarbon accumulation exposure values

Shoreline Accumulation (g/m^2)	Exposure Value	Description
10	Low	**Risk Evaluation** An accumulated concentration of oil above 10 g/m^2 on shorelines is considered to represent a level of socio-economic effect (NOPSEMA, 2019). For example, reduction in visual amenity of shorelines. This value has been used in previous studies to represent a low contact value for interpreting shoreline accumulation modelling results (French-McCay, 2005, 2006). **Response Planning** Not specifically used for response planning because below the limit that can be effectively cleaned.
100	Moderate	**Risk Evaluation** The impact exposure value for exposure to hydrocarbons stranded on shorelines is derived from levels likely to cause adverse impacts to marine or coastal fauna and habitats. These habitats and marine fauna known to use shorelines are most at risk of exposure to shoreline accumulations of oil, due to smothering of intertidal habitats (such as mangroves and emergent coral reefs) and coating of marine fauna. Environmental risk assessment studies (French-McCay, 2009) report that an oil thickness of 0.1 mm (100 g/m^2) on shorelines is assumed as the lethal exposure value for invertebrates on hard substrates (rocky, artificial or man-made) and sediments (mud, silt, sand or gravel) in intertidal habitats. Therefore, a conservative exposure value for impacts of 100 g/m^2 has been applied to impacts from shoreline accumulation of hydrocarbons. **Response Planning** A shoreline concentration of 100 g/m^2, or above, is likely to be representative of the minimum limit that the oil can be effectively cleaned according (AMSA, 2015; NOPSEMA, 2019) and is therefore used as a guide for shoreline clean-up planning. This exposure value equates to approximately ½ a cup of oil per square metre of shoreline contacted.
1,000	High	**Risk Evaluation** At greater thicknesses, the potential for impact of accumulated oil to shoreline receptors increases. All other things being equal, accumulation of oil above 1000 g/m^2 is expected to result in a greater impact. **Response Planning** As oil increases in thickness the effectiveness of oil recovery techniques increases. This value can therefore be used to prioritise oil recovery efforts, assuming oil recovery is deemed to have an environmental benefit.

Table 7-9: Dissolved aromatic hydrocarbon exposure values

Dissolved hydrocarbons (ppb)	Exposure Value	Description
6	Low	**Risk Evaluation** Dissolved Aromatic Hydrocarbons (DAH) include the monoaromatic hydrocarbons (MAHs) (compounds with a single benzene ring such as BTEX [benzene, toluene, ethyl benzene, and xylenes]) and polycyclic aromatic hydrocarbons [PAHs] (compounds with multiple benzene rings such as naphthalenes and phenanthrenes). These compounds have a greater bioavailability that other components of oil and are considered to be main contributors to oil toxicity. The toxicity of DAHs is a function of the concentration and the duration of exposure by sensitive receptors, with greater concentration and exposure time causing more sever impacts. Typically tests of toxicity done under laboratory conditions measure toxicity as a proportion of test organisms affected (for example, 50% mortality or LC50) at the end of a set time period, often 48 or 96 hours. French-McCay (2002), in a review of literature, reported LC50 for dissolved PAHs with 96 h exposure ranges between 30 ppb for sensitive species (2.5th-percentile species) and 2,260 ppb for insensitive species (97.5th-percentile species), with an average of about 250 ppb. The range of LC50s for PAHs obtained under turbulent conditions (this includes fine oil droplets) was 6 ppb to 410 ppb with an average of 50 ppb (French-McCay, 2002). The dissolved hydrocarbon 10 ppb exposure value has been used to inform the EMBA within **Section 7.6**. An exposure value of 10 ppb is appropriate as it is concentration that could have some potential negative effect. **Response Planning** Contact at 10 ppb (as predicted by oil spill trajectory modelling) is used as a trigger for activating scientific monitoring plans as detailed in the OPEP. Establishes planning area for scientific monitoring based on potential for exceedance of water quality triggers (NOPSEMA, 2019).
50	Moderate	**Risk Evaluation** Approximates potential toxic effects, particularly sublethal effects to sensitive species (refer to above text). Consistent with NOPSEMA (2019). **Response Planning** Encompassed by response to 10 ppb. There is nothing different for higher exposure values.
400	High	**Risk Evaluation** Approximates toxic effects including lethal effects to sensitive species (NOPSEMA, 2019). **Response Planning** Encompassed by response to 10 ppb. There is nothing different for higher exposure values.

Table 7-10: Entrained hydrocarbon exposure values

Entrained hydrocarbons (ppb)	Exposure Value	Description
10	Low	**Risk Evaluation** Entrained hydrocarbons, as opposed to DAHs, are oil droplets suspended in the water column and insoluble. Entrained hydrocarbons are not as bioavailable to marine organisms compared to DAHs and on that basis are considered to be less toxic, especially over shorter exposure time frames. Entrained hydrocarbons still have potential effects on marine organisms through direct contact with exposed tissues and ingestion (NRC, 2005); however, the level of exposure causing effects is considered to be considerably higher than for DAHs. Much of the published scientific literature does not provide sufficient information to determine if toxicity is caused by entrained hydrocarbons, but rather the toxicity of total oils which includes both dissolved and entrained components. Variations in the methodology of the total water accommodated fraction (entrained and dissolved) may account for much of the observed wide variation in reported exposure values, which also depend on the test organism types, duration of exposure, oil type and the initial oil concentration. Total oil toxicity acute effects of total oil as LC50 for molluscs range from 500 to 2,000 ppb (Clark *et al*., 2001; Long and Holdway, 2002). A wider range of LC50 values have been reported for species of crustacea and fish from 100 to 258,000,000 ppb (Gulec *et al*., 1997; Gulec and Holdway, 2000; Clark *et al*., 2001) and 45 to 465,000,000 ppb (Gulec and Holdway, 2000; Barron *et al*., 2004), respectively. The 10 ppb exposure value represents the very lowest concentration and corresponds generally with the lowest trigger levels for chronic exposure for entrained hydrocarbons in the Australian and New Zealand Environment and Conservation Council (2019) water quality guidelines. This is consistent with NOPSEMA (2019) guidance. **Response Planning** Contact at 10 ppb (as predicted by oil spill trajectory modelling) is used as a trigger for activating scientific monitoring plans as detailed in the OPEP. Establishes planning area for scientific monitoring based on potential for exceedance of water quality triggers (NOPSEMA, 2019).
100	Moderate[12]	**Risk Evaluation** The 100 ppb exposure value is considered to be more representative of sub-lethal impacts to most species and lethal impacts to sensitive species based on toxicity testing as described above. This is considered conservative as toxicity to marine organisms from oil is likely to be driven by the more bioavailable dissolved aromatic fraction, which is typically not differentiated from entrained oil in toxicity tests using water accommodated fractions (WAFs). Given entrained oil is expected to have lower toxicity than dissolved aromatics, especially over time periods where these

[1] Note that NOPSEMA does not define a moderate exposure value for entrained oil, and 100ppb is defined as the high exposure value. However, Santos have adopted 100ppb as the moderate exposure level for impact assessment purposes in the absence of a NOPSEMA defined moderate value and based on existing literature.

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Entrained hydrocarbons (ppb)	Exposure Value	Description
		soluble fractions have dissolved from entrained oil, the higher Moderate exposure value for entrained oil over DAH (100 versus 50 ppb) is considered appropriate. **Response Planning** Encompassed by response to 10 ppb. There is nothing different for higher exposure values.

Hydrocarbon exposure values for surface oil, entrained oil, DAH and hydrocarbons ashore have been used to define the spatial extent of the EMBA (see also **Section 3.1**), as shown in **Figure 3-1**.

7.5.5 Spill risk assessment approach

The spill risk assessment approach adopted is based on Santos' Oil Spill Risk Assessment and Response Planning Procedure (SO-91-II-20003).

A consistent risk assessment approach is applied to the unplanned hydrocarbon release scenario. The spill risk assessment approach is based on Santos' Oil Spill Risk Assessment and Response Planning Procedure (SO-91-II-20003). The procedure describes the spill risk assessment process as follows:

1. Identify the spatial extent of the EMBA This has been completed for this EP as part of the assessment of the existing environment and receptors that are known to occur or may occur within the EMBA are described in **Section 3** and **APPENDIX C**.
2. Identify areas of high environmental value (HEV) within the EMBA (HEVs are described in **Section 7.5.5.2**).
3. Identify and then risk assess hotspots. Hotspots are effectively a subset of HEVs, and their determination is described in **Section 7.5.5.3**.
4. Identify priorities for protection (for consideration of spill response strategies in the OPEP).

7.5.5.1 Spill environment that may be affected

Defining the EMBA by an oil spill is the first step in oil spill risk assessment. For activities where there is the potential for multiple spill scenarios, the spill scenario, or combination of spill scenarios, resulting in the greatest spatial extent of impacts is used to define the overall EMBA for the activity. The EMBA is further described in **Section 3.1**.

7.5.5.2 Areas of high environmental value

Santos has predetermined areas of HEV (**Figure 7-2**) along the WA coastline by ranking these areas based on:

+ Protected area status – This is used as an indicator of the biodiversity values contained within that area, where a World Heritage Area, RAMSAR Wetland and Marine Protected Area will score higher than areas with no protection assigned; and
+ BIAs of LTS – These are spatially defined areas where aggregations of individuals of a species are known to display biologically important behaviour, such as breeding, feeding, resting or migration. Each one of these within the predefined areas contributes to the score.

Further input to determine areas of HEV included:

+ sensitivity of habitats to impact from hydrocarbons in accordance with the guidance document Sensitivity Mapping for Oil Spill Response produced by IPIECA, the International Maritime Organisation and International Association of Oil and Gas Producers;
+ sensitivities of receptors with respect to hydrocarbon-impact pathways;
+ status of zones within protected areas (in other words, IUCN (1a) and sanctuary zones compared to IUCN (VI) and multiple use zones);
+ listed species status and predominant habitat (surface versus subsurface); and
+ social values; in other words, socio-economic and heritage features (such as commercial fishing, recreational fishing, amenities, aquaculture).

Tallied scores for each predefined area along the Western Australian coastline were then ranked from 1 to 5, with an assignment of 1 representing areas of the highest environmental value and those with 5 representing the areas of the lowest environmental value.

7.5.5.3 Hotspots

While the entire EMBA will be considered during risk assessment and spill response planning, it is best practice to concentrate greatest effort and level of detail on those parts of the EMBA that have the:

+ greatest intrinsic environmental value – in other words, HEV areas ranked 1 to 3;
+ highest probability of contact by oil (either floating, entrained or dissolved aromatic); and
+ greatest potential concentration or volume of oil arriving at the area.

These areas are termed ‘hotspots’. Defining hotspots is typically the first step in undertaking detailed spill risk assessment and spill response planning. Hotspots are a subset of HEV areas that:

+ have the highest probability of contact (at least higher than 5%) above the impact assessment exposure value for surface hydrocarbons and shoreline accumulation based on modelling results; and
+ receive the greatest concentration or volume of oil, either floating or stranded oil, entrained oil or DAH above contact exposure values described in **Section 7.5.4**.

7.5.5.4 Priorities for protection

For the purposes of a spill response preparedness strategy, it is not necessary for all hotspots to have detailed planning. For example, wholly submerged hotspots may only be contacted by entrained oil, and the response would be largely to implement scientific monitoring to determine impact and recovery. Hotspots with features that are not wholly submerged (in other words, emergent features) should have specific spill response planning conducted. This final determination of ‘Priority for Protection’ sites, for the oil spill response strategy, is based on the worst-case estimate of floating oil concentration, shoreline loading and minimum contact time at exposure value concentrations. An assessment of each protection priority will be undertaken to determine the most appropriate spill response strategies based on the type of oil and the values of the protection priority area. This can be done through a strategic NEBA approach.

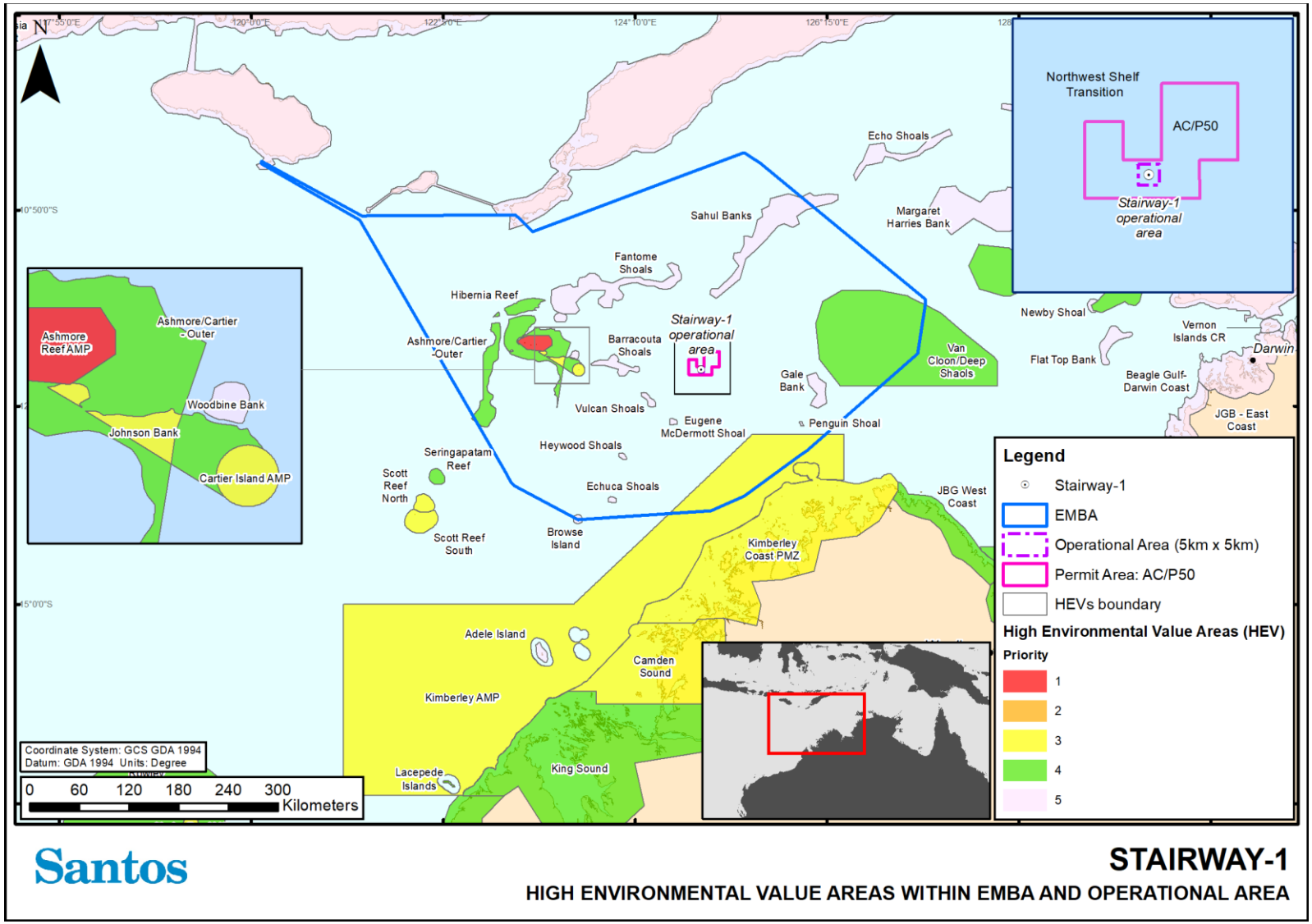

Figure 7-2: High environmental values within the environment that may be affected

7.5.5.5 Potential hydrocarbon impact pathways

To help inform the hydrocarbon spill risk assessment, receptors within the EMBA and potential impact pathways have been defined (**Table 7-11**). The potential impact pathways consider physical and chemical pathways. Physical pathways include contact from floating oil, accumulated shoreline oil, or entrained oil droplets. Chemical pathways include ingestion, inhalation or contact from any hydrocarbon phase. These are summarised in **Table 7-11** and the information is drawn upon within the hydrocarbon risk assessment for the spill scenario. **Table 7-12** further describes the nature and scale of the hydrocarbon spills for this activity on marine fauna and socio-economic receptors found within the EMBA and moderate exposure value.

Table 7-11: Physical and chemical pathways for hydrocarbon exposure and potential impacts to receptors

Receptor	Physical pathway	Potential impacts	Chemical pathway	Potential impacts
Rocky shorelines	Shoreline loading and attachment may result in thin and sporadic coating of hydrocarbon residues. Degree of oil coating is dependent upon the energy of the shoreline area, the type of the rock formation and continual biodegradation of the oil.	Impacts to flora (mangroves) and fauna further described below.	Chemical pathway to fauna and flora via adsorption through cellular membranes and soft tissue, ingestion, irritation/burning on contact and inhalation.	Impacts to flora (mangroves) and fauna further described below.
Sandy beaches	Shoreline loading and water movement may allow hydrocarbon residue to filter down into sediments, continue to biodegrade on the surface or remobilise into surf zone. Degree of loading is dependent upon the energy and tidal reach of the shoreline, the type of the sandy shore and continual weathering of the oil.	Indirect impacts to nesting and foraging habitats for birds and turtles. Direct impacts to infauna.	Chemical pathway to fauna and flora via adsorption through 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.
Intertidal platforms	Shoreline loading and water movement may allow hydrocarbon residue to filter down into sediments (for example, within wetlands) or continue to biodegrade on the surface or remobilise into surf zone. Degree of loading is dependent upon the energy and tidal reach of the shoreline, the type of the substrate and continual weathering of the oil.	Indirect impacts to foraging habitats for birds and turtles. Direct impacts to infauna.	Chemical pathway to fauna and flora via adsorption through cellular membranes and soft tissue, ingestion, irritation/ burning on contact and inhalation.	Indirect impacts to foraging habitats for birds. Direct impacts (mortality) to infauna through toxic effects and smothering.

Receptor	Physical pathway	Potential impacts	Chemical pathway	Potential impacts
Shallow sub-tidal soft sediments	Hydrocarbon residue in the shallow waters adjacent to shorelines may settle to filter down into sediments. Degree of loading is dependent upon the energy and tidal reach of the shoreline, the type of the substrate and continual weathering of the oil.	Indirect impacts to foraging habitats for turtles and fish. Direct impacts to infauna.	Adsorption via cellular membranes and soft tissue, ingestion, irritation/burning on contact and inhalation.	Indirect impacts to foraging habitats for turtles and fish. Direct impacts (mortality) to infauna through toxic effects and smothering.
Mangroves	Coating of root system reducing air and salt exchange. Degree of coating is dependent upon the energy and tidal reach of the shoreline, the type of the substrate and continual weathering of the oil.	Yellowing of leaves. Defoliation. Increased sensitivity to stressors. Tree death. Reduced growth. Reduced reproductive output. Reduced seed viability.	External contact by oil and adsorption across cellular membranes.	Yellowing of leaves. Defoliation. Increased sensitivity to stressors. Tree death. Reduced growth. Reduced reproductive output. Reduced seed viability. Growth abnormalities.
Seagrasses and macroalgae	Coating of leaves/ thalli reducing light availability and gas exchange. Degree of coating depends upon the energy and tidal reach of the shoreline, the type of the receptor and continual weathering of the oil.	Bleaching or blackening of leaves. Defoliation. Reduced growth.	External contact by oil and adsorption across cellular membranes.	Mortality. Bleaching or blackening of leaves. Defoliation. Disease. Reduced growth. Reduced reproductive output. Reduced seed/ propagule viability.

Receptor	Physical pathway	Potential impacts	Chemical pathway	Potential impacts
Hard corals (coral reefs)	Coating of polyps, shading resulting in reduction on light availability. Degree of coating is dependent upon the metocean conditions, dilution, if corals are emergent at all and continual weathering of the oil.	Bleaching. Increased mucous production. Reduced growth.	External contact by oil and adsorption across cellular membranes.	Mortality. Cell damage. Reduced metabolic capacity. Reduced immune response. Disease. Reduced growth. Reduced reproductive output. Reduced egg/larval success. Growth abnormalities.
Non-coral benthic invertebrates	Coating of adults, eggs and larvae. Degree of coating is dependent upon the energy and tidal reach of the shoreline, the type of the receptor and continual weathering of the oil.	Mortality. Behavioural disruption. Impaired growth.	Ingestion and inhalation. External contact and adsorption across exposed skin and cellular membranes. Uptake of DAH across cellular membranes. Reduced mobility and 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. Behavioural disruption.

Receptor	Physical pathway	Potential impacts	Chemical pathway	Potential impacts
Sharks, rays and fish	Coating of adults but primarily eggs and larvae – reduced mobility and capacity for oxygen exchange.	Mortality. Oxygen debt. Starvation. Dehydration. Increased predation. Behavioural disruption.	Ingestion. External contact and adsorption across exposed skin and cellular membranes. Uptake of DAH across cellular membranes (for example, gills).	Mortality. Cell damage. Flesh taint. Reduced metabolic capacity. Reduced immune response. Disease. Reduced growth. Reduced reproductive output. Reduced egg/larval success. Growth abnormalities. Behavioural disruption.
Birds (seabirds and shorebirds)	Degree of coating is dependent upon the energy and tidal reach of the shoreline, the type of the receptor and continual weathering of the oil.	Feather and skin irritation and damage.	Ingestion (during feeding or preening). External contact and adsorption across exposed skin and membranes.	Mortality. Cell damage, lesions. Secondary infections. Reduced metabolic capacity. Reduced immune response. Disease. Reduced growth. Reduced reproductive output. Growth abnormalities. Behavioural disruption.

Receptor	Physical pathway	Potential impacts	Chemical pathway	Potential impacts
Marine reptiles	Degree of coating is dependent upon the energy and tidal reach of the shoreline, the type of the receptor and continual weathering of the oil.	Behavioural disruption particularly during turtle nesting periods.	Inhalation. Ingestion. External contact and adsorption across exposed skin and membranes.	Mortality. Cell damage, lesions. Secondary infections. Reduced metabolic capacity. Reduced immune response. Disease. Reduced growth. Reduced hatchling success. Reduced reproductive output. Growth abnormalities. Behavioural disruption.
Marine mammals	Fur damage and matting, reduced mobility and buoyancy (for applicable species). Coating of feeding apparatus in some species (in other words, baleen whales).	Behavioural disruption such as deviation from migration pathways and commonly frequented feeding grounds. For smooth skinned marine mammals more susceptible to chemical pathways than physical pathways.	Inhalation. Ingestion. External contact and adsorption across exposed skin and membranes.	Mortality. Cell damage, lesions. Secondary infections. Reduced metabolic capacity. Reduced immune response. Disease. Reduced growth. Reduced reproductive output. Growth abnormalities. Behavioural disruption.
Plankton	Coating of feeding apparatus. Reduced mobility and capacity for oxygen exchange.	Mortality. Behavioural disruption (for example, reduced mobility).	Inhalation. Ingestion. External contact.	Mortality. Impairment of biological activities (for example, feeding, respiration). Reduced mobility.

Receptor	Physical pathway	Potential impacts	Chemical pathway	Potential impacts
Water quality and sediment quality	Presence of hydrocarbon residue in the water, which may filter down to sediments or continue to biodegrade on the surface. Degree of loading in the water column is dependent upon the influence of wave energy and tidal range.	Impacts to flora and fauna, as discussed in rows above.	Adsorption via cellular membranes and soft tissue, ingestion, irritation/burning on contact and inhalation. Impacts to flora and fauna, as discussed in rows above.	Impacts to flora and fauna, as discussed in rows above.
Protected areas	Coating of benthic habitats, shoreline habitats and marine fauna/flora within protected areas as discussed in rows above.	Mortality, injury or behavioural disruption to marine fauna. Death or impairment of habitats within protected areas. Reduction in the quality of the marine environment within protected areas. Environmental value of protected areas is degraded.	Impacts to flora and fauna, as discussed in rows above.	Mortality, injury or behavioural disruption to marine fauna. Death or impairment of habitats within protected areas. Reduced growth of benthic habitats. Reduction in the quality of the marine environment within protected areas. Environmental value of protected areas is degraded.
Socio-economic environment (fisheries, tourism, shipping, defence, shipwrecks, Indigenous users, oil and gas)	Presence of hydrocarbon residue in the water, which may filter down to sediments or continue to biodegrade on the surface. Coating of benthic habitats, shoreline habitats and marine fauna/flora within protected areas as discussed in rows above.	Degradation of cultural or maritime heritage sites. Disruption to tourism, recreation or shipping activities. Reduction in resource available for commercial and recreational fisheries.	Impacts to flora, fauna and the physical environment as discussed in rows above. Commercial/recreational fish species – refer to 'fish' as discussed above.	Degradation of cultural or maritime heritage sites. Disruption to tourism, recreation or shipping activities. Reduction in resource available for commercial and recreational fisheries.

Table 7-12: Nature and scale of hydrocarbon spills on environment and socio-economic receptors within the environment that may be affected

Receptor	Impacts of hydrocarbon spills	
	Entrained and dissolved aromatic hydrocarbons in the water column	Surface hydrocarbons
Threatened/Migratory fauna		
Plankton (including zooplankton; fish and coral larvae)	There is potential for localised mortality of plankton due to reduced water quality and toxicity. Also, through physical contact of small oil droplets, plankton mobility, feeding and/or respiration may be impaired. Plankton could include the eggs and larvae of marine invertebrates and fish and therefore entrained oil could impact on recruitment of invertebrate/fish species. Effects will be greatest in the upper 10 m of the water column and areas close to the spill source where hydrocarbon concentrations are likely to be highest.	Plankton using the sea surface layer could be impacted by floating oil.
	Plankton could include the eggs and larvae of marine invertebrates and fish and therefore impact on recruitment of invertebrate/fish species. The operational area has the potential to overlap with spawning of some fish species, given the year-round spawning of some species. In the unlikely event of a spill occurring, fish larvae may be impacted by hydrocarbons entrained in the water column. Following a hydrocarbon release a portion of the slick will rapidly evaporate and disperse in the offshore environment, reducing the concentration and toxicity of the spill. Maximum entrained oil concentrations were predicted within around 150 km of the spill location and above the moderate threshold at Eugene McDermott Shoal, Barracouta Shoals and Vulcan Shoals. Plankton using the sea surface layer, as well as pelagic invertebrates, could be impacted from floating oil. Exposure to entrained oils and DAHs may result in lethal or sub-lethal impacts to plankton or pelagic invertebrates through a direct contact pathway. Such contact could impair the mobility, feeding and respiration of these fauna and exchange of chemicals could occur.	
Marine mammals	Lethal or sub-lethal physical and toxic effects such as irritation of eyes/mouth and potential illness.	At risk of direct contact with surface hydrocarbons due to chance of surfacing within slick. Effects include irritation of eyes/mouth and potential illness. Surface respiration could lead to accidental ingestion of hydrocarbons or result in the coating of sensitive epidermal surfaces. Potential impact to feeding apparatus of some species; in other words, baleen whales.
	Ten migratory marine mammal species were identified by the PMST as occurring within the EMBA. Of these, one is listed as endangered (blue whale) and three as vulnerable (humpback whale, fin whale and sei whale). The EMBA overlaps with blue whale and dugong BIAs (**Figure 3-7** and **Figure 3-8**). For further information about environmental impacts to marine mammals from hydrocarbon exposure and increased toxicity, refer to **Table 7-11**. Other migratory marine mammals may encounter either surface or water column hydrocarbons in the EMBA. Dugongs may be particularly susceptible to surface slicks, a reduction of seagrass habitat for foraging and/or ingestion of seagrass coated with oil. Dugongs occur throughout the shallow waters	

Receptor	Impacts of hydrocarbon spills	
	Entrained and dissolved aromatic hydrocarbons in the water column	Surface hydrocarbons
	between the Pilbara offshore islands and the mainland. The closest BIA (foraging) is at Ashmore Reef located approximately 176 km from the operational area.	
Marine reptiles	Lethal or sub-lethal physical and toxic effects such as irritation of eyes/mouth and potential illness. The Recovery Plan for Marine Turtles in Australia: 2017–2027 (Commonwealth of Australia, 2017) highlights acute chemical discharge as one of several threats to marine turtles.	At risk of direct contact with surface hydrocarbons due to chance of surfacing within slick. Effects include irritation of eyes/mouth and potential illness. Surface respiration could lead to accidental ingestion of hydrocarbons or result in the coating of sensitive epidermal surfaces. Contact with hydrocarbons that have accumulated on shorelines particularly at nesting beaches. Oiling of eggs/hatchlings may occur. Shoreline hydrocarbons are expected to be less toxic than fresh oils due to weathering processes such as photo oxidation and biodegradation reducing the levels of lighter chain hydrocarbons which are generally more toxic.
	Eight species of threatened marine reptile were identified as possibly being impacted by a spill: Short-nosed and leaf-nosed sea snakes, flatback, hawksbill, leatherback, green, Olive-Ridley and loggerhead turtles which are widely dispersed across the North Australian and NWS and in the unlikely event of a hydrocarbon spill occurring, individuals traversing open water may come into contact with water column or surface hydrocarbons. The EMBA overlaps with BIAs for four turtle species (flatback, green, hawksbill and Olive Ridley) as shown in **Figure 3-9**, **Figure 3-10**, **Figure 3-11** and **Figure 3-12**. Migratory saltwater crocodiles may also be encountered within the EMBA. Critical habitat including important nesting beaches for turtle species are present within the EMBA at Ashmore Reef and Cartier Island, including locations where spill modelling indicated the accumulation of hydrocarbons on shorelines. Shoreline accumulations, above the 100 g/m² exposure value, were predicted at Ashmore Reef and Cartier Island only with very low probability. In the event of a spill, the presence of hydrocarbons on beaches would disrupt behaviour and potentially threaten turtle populations. For further detailed environmental impacts to marine reptiles from hydrocarbon exposure and increased toxicity, refer to **Table 7-11**.	

Receptor	Impacts of hydrocarbon spills	
	Entrained and dissolved aromatic hydrocarbons in the water column	Surface hydrocarbons
Birds (seabirds and shorebirds)	Lethal or sub-lethal physical and toxic effects such as irritation of eyes/mouth and potential illness. May encounter entrained hydrocarbons while diving and foraging.	Particularly vulnerable to surface slicks. As most fish survive beneath floating slicks, they will continue to attract foraging seabirds, which typically do not exhibit avoidance behaviour. Smothering can lead to reduced water proofing of feathers and ingestion while preening. In addition, direct contact with hydrocarbons can erode feathers causing chemical damage to the feather structure that subsequently affects ability to thermoregulate and maintain buoyancy on water. Shorebirds may be impacted by the presence of hydrocarbons accumulated on shorelines which may result in exposure to eggs and ingestion by foraging individuals. Shoreline hydrocarbons are expected to be less toxic than fresh oils due to weathering processes such as photo oxidation and biodegradation reducing the levels of lighter chain hydrocarbons which are generally more toxic.
	Twenty-eight threatened or migratory species of seabirds and shorebirds were identified within the EMBA by the PMST (**Table 3-7**). Of these, only 11 species were identified within the operational area. The closest BIAs for these seabirds and shorebirds to the operational area were located more htan 86 km away (**Figure 3-13**) therefore, species may be impacted by surface and entrained hydrocarbons while foraging (dive and skim feeding) with higher numbers expected during the breeding periods. Birds (seabirds and shorebirds) are highly susceptible to hydrocarbon spills, with impacts primarily attributed to oiling of birds at the sea surface from slicks and oil on shorelines. Given the worst-case surface oil at moderate exposure (100 g/m^2) could extend up to 200 km from the operational area, impacts to birds may include coating by oil when floating in open water, diving into open and coastal waters to feed on fish, wading and foraging on shallow intertidal mud/sand flats/wetlands (at Ashmore reef and Cartier Island) or roosting on oil affected sandy beaches. Other impacts could include behavioural impacts whereby birds avoid important nesting and migratory stop-over areas including RAMSAR wetlands or reduced food availability if important foraging areas are impacted. For further information about environmental impacts to seabirds/shorebirds through hydrocarbon exposure and toxicity effects, refer to **Table 7-11**.	

Receptor	Impacts of hydrocarbon spills	
	Entrained and dissolved aromatic hydrocarbons in the water column	Surface hydrocarbons
Sharks, Rays and Fish	Hydrocarbon droplets can physically affect fish, sharks and rays exposed for an extended duration (weeks to months). Smothering through coating of gills can lead to the lethal and sub-lethal effects of reduced oxygen exchange, and coating of body surfaces may lead to increased incidence of irritation and infection. Fish may also ingest hydrocarbon droplets or contaminated food leading to reduced growth. There is potential for localised mortality of fish eggs and larva due to reduced water quality and toxicity. Effects will be greatest in the upper 10 m of the water column and areas close to the spill source where hydrocarbon concentrations are likely to be highest and therefore demersal fish communities (including those associated with the Carbonate Bank and Terrace System of the Sahul Shelf KEF located approximately 9 km from the operational area may be exposed. For further information about environmental impacts to fish/sharks/rays from hydrocarbon exposure and toxicity effects, refer to **Table 7-11**.	While fish, sharks and rays do not generally break the sea surface, individuals may feed at the surface. For condensate/diesel spills where a slick is expected to quickly disperse and evaporate, prolonged exposure to surface hydrocarbons by fish, shark and ray species is unlikely. However, for diesel the surface slick may extend 200 km from the release location at the 100 g/m² exposure value and will weather at the sea surface over time with little entrainment into the water column. Due to the filter-feeding nature of whale sharks they may be susceptible to ingesting surface hydrocarbons, both fresh and weathered (tar balls) if feeding at the sea surface particularly from diesel spills.
	The NWS and North Australia support a diverse assemblage of fish, particularly in shallower water near the mainland and islands. Threatened species identified by the PMST include the white shark, whale shark, sawfishes (freshwater, dwarf, green, narrow), giant manta ray and reef manta ray, Northern river shark, mako sharks, and oceanic white tip sharks which may be present in the EMBA. However, given the absence of critical habitat for most of these species, significant numbers are not expected to be exposed to hydrocarbons in the event of a spill. These threatened and migratory fish and sharks could be present at low densities all year round within the operational area and EMBA; however, the absence of any known feeding, resting or breeding areas means significant numbers are unlikely to be impacted if an unplanned release were to occur. The whale shark foraging BIA is presented in **Figure 3-6** and overlaps the operational area and EMBA. The EPBC Act-listed whale shark may occur in the EMBA and is known to feed in surface waters. There is, therefore, the potential for this species to ingest oil from surface slicks with resultant damage to gills, other tissues and organs. For further information about environmental impacts to fish/sharks/rays from hydrocarbon exposure and toxicity effects, refer to **Table 7-11**.	
Socio-economic		
Commercial, Recreational and Traditional Fisheries	Hydrocarbons in the water column can have toxic effects on fish (as outlined above) potentially reducing catch rates and rendering fish unsafe for human consumption.	In addition to the effects of entrained and DAHs, exclusion zones surrounding a spill can directly impact fisheries by restricting access for fishermen. Weathered diesel slicks may form tar balls which may result in oiling of nets and fishing infrastructure.

Receptor	Impacts of hydrocarbon spills	
	Entrained and dissolved aromatic hydrocarbons in the water column	Surface hydrocarbons
	A number of commercial fisheries operate within the EMBA (**Section 3.2.4**). Impacts to these fisheries and traditional Indonesian fishermen from a spill may range from disruption of fishing activities caused by the physical presence of the slick, loss of (or loss of function of) coastal intertidal habitat (for example, seagrass meadows, mangrove communities, intertidal mudflats) which may provide nursery habitat for fishery species (for example, fish and crustaceans) and contact of surface and entrained hydrocarbons with the eggs and larvae of commercially important species. Exposure to entrained and DAHs could result in the accumulation of oil in fish tissues to the extent that could result in hydrocarbon taint of fish flesh. Connell and Miller (1981) compiled a summary of studies listing the exposure value concentrations at which tainting occurred for hydrocarbons. The results contained in their review indicate that tainting of fish occurs when fish are exposed to ambient concentrations of 4 to 300 ppm (4,000-300,000 ppb) of hydrocarbons in the water, for durations of 24 hours or more, with response to phenols and naphthenic acids being the strongest. Given that entrained hydrocarbons are predicted to exceed the moderate threshold at some locations in the EMBA, hydrocarbon taint is possible in fish flesh although it is difficult to assess how long fish might be exposed for; small, less mobile fishes would be more susceptible. It is possible that impacts could be detected to fisheries on a stock level, although it is more likely that natural variation in fish abundance would be on a greater scale than any impacts attributable to a hydrocarbon spill. This would most likely be the case for fisheries species that use shallow waters around the Ashmore Reef and Cartier Islands and could occur through direct impacts to fish or to fish habitats (for example, seagrass, coral reef, mangrove habitats). The same negative impacts could also occur to important recreational fish species and the recreational fisheries they support although impacts to commercial fisheries could result in the additional impact of loss of income for commercial fishers.	
Recreation and Tourism	The only areas potentially used for tourism within the EMBA are Ashmore Reef and Cartier Island, and Indonesian shorelines. A number of areas with high diversity or which have unique ecological values are protected within AMPs. As well as reducing the visual amenity of these areas, a surface slick could impact the habitats and marine fauna of these areas thereby impacting the environmental values of these tourism areas. Depending upon the extent of impact, loss of revenue to coastal towns and communities could also occur.	
Shipping	Hydrocarbons in the water column will have no effect on shipping.	Exclusion zones surrounding a spill will reduce access for shipping vessels for the duration of the response undertaken for spill clean-up (if applicable); vessel may have to take large detours leading to potential delays and increased costs.
Defence	There are no defence operations within the vicinity of the operational area or the EMBA, therefore the level of defence activities performed in the vicinity of operational area is low. Interference of defence activities due to a hydrocarbon spill is expected to be minimal.	
Shipwrecks	Shipwrecks may be of important heritage value and/or act as dive sites. Surface hydrocarbons will have no impact on shipwrecks. Hydrocarbons in the water column either as entrained oil or DAHs may extend hundreds of kilometres from the release location. The potential for in-water hydrocarbons to impact on shipwrecks is poorly documented however it has been proposed that exposure to oil may alter bacterial community composition (biofilms) inhabiting shipwrecks possibly altering corrosion potential (Salerno *et al.,* 2016).	

Receptor	Impacts of hydrocarbon spills	
	Entrained and dissolved aromatic hydrocarbons in the water column	Surface hydrocarbons
Indigenous users and traditional fishing	Marine resource use by Indigenous people is generally restricted to coastal waters. Fishing, hunting and the maintenance of maritime cultures and heritage through ritual, stories and traditional knowledge continue as important uses of the nearshore region and adjacent areas. The level of activities undertaken by indigenous users is expected to be low, given that no native title claims, ethnographic or archaeological sites or records of aboriginal occupation are listed for the surrounding marine waters (**Section 3**). Therefore, interference due to a hydrocarbon spill are expected to be minimal. Ashmore lagoon at Ashmore Reef is used as a rest/staging area for traditional Indonesian fishers and therefore could be impacted in the event of a spill.	
Existing oil and gas activity	A number of oil and gas operators operate within the EMBA with existing projects and infrastructure in place as well as continuing drilling and exploration programs. A surface slick has the potential to disrupt activity, potentially halting production or exploration with associated economic impact. Exclusion zones surrounding spills or access restrictions in the event of spill response/clean-up activities (if applicable) will reduce access, potentially resulting in delays to work schedules with possible subsequent financial implications.	
Protected Areas		
Marine Parks and Commonwealth Heritage Areas	Protected areas are described in **Section 3.2.2**. These areas provide key habitats that support an array of marine flora and fauna along with unique natural phenomena.	
	These protected areas support all the habitats and faunal groups described above and support unique/protected habitats/marine fauna or ecological features. Impacts to the habitat/fauna receptors described above therefore have an impact on the values of these reserves, which could have flow-on effects to tourism revenue for coastal communities that provide access to these marine reserves. The protected areas may also support nursery, feeding and aggregation areas for fisheries species and therefore may assist in maintaining healthy fish stocks and commercial/recreational fisheries.	
RAMSAR wetlands	RAMSAR wetlands at Ashmore Reef are described in **Section 3.2.2**. These areas provide key habitats that support a high diversity and abundance of migratory birds and various wetland habitats.	
	These wetlands support the majority of the habitats listed above and are particularly important to seabirds and shorebirds described above. Impacts to the habitat/fauna receptors described above therefore have an impact on the values of these wetland areas, some of which are within marine parks.	
KEFs	Five KEFs overlap the EMBA as described in **Section 3.2.2**.	
	While the features associated with the KEFs are subtidal and will not be directly contacted by a surface slick, they all may support increased productivity or abundance of marine fauna that use surface waters above the features (including plankton, pelagic invertebrates and fish, marine mammals, marine reptiles and seabirds) which may be impacted by floating oil. Impacts to these marine fauna are described above. In the case of Continental Slope Demersal Fish Communities, the planktonic eggs and larvae of these demersal fish communities may be impacted by a spill.	

7.6 Release of hydrocarbons

7.6.1 Description of event

Event	A minor spill (approximately 37.5 m^3) of diesel could occur during vessel refuelling resulting in a loss of hydrocarbons to the marine environment at sea surface. Spills during refuelling can occur through several pathways, including fuel hose breaks, coupling failure or tank overfilling. The specific vessel to undertake the VBA is yet to be confirmed; a review of available vessels indicated that the largest single fuel tank is likely to be up to 120 m^3 in capacity. Although the likely vessel's largest fuel tank will be smaller, a conservative modelled spill volume of 329 m^3 has been used for this EP.
Extent	Diesel spill trajectory modelling (GHD, 2021) indicated that there was some probability of a 329 m^3 marine diesel oil (MDO) spill extending as follows (using the moderate exposure thresholds): + Shoreline loading was predicted to occur within 220 km. + Surface oil was predicted to occur within approximately 200 km. + Total submerged oil was predicted to occur within approximately 150 km. + Dissolved hydrocarbons were predicted to occur within approximately 150 km.
Duration	A 329 m^3 release of diesel was modelled for a release over 0.5 hours, replicating the potential duration of a spill arising from a significant collision.

7.6.2 Nature and scale of environmental impacts

Hydrocarbon spills will cause a decline in water quality and may cause chemical (for example, toxic) and physical (for example, coating of emergent habitats, oiling of wildlife at sea surface) impacts to marine species. The severity of the impact of a hydrocarbon spill depends on the magnitude of the spill (in other words, extent, duration) and sensitivity of the receptor. The nature and scale of a hydrocarbon spill is described throughout this chapter for a vessel collision scenario, given smaller hydrocarbon spills (from refuelling) will impact a smaller area than a vessel collision.

Potential Receptors: Plankton (including zooplankton and fish and coral larvae), marine mammals, marine reptiles, seabirds and shorebirds, shallow benthic, intertidal and shoreline habitats, fish and sharks, fisheries, tourism, protected and significant areas (marine parks, heritage areas, KEFs, RAMSAR wetlands), shipping, defence, shipwrecks, indigenous and existing oil and gas activity.

A surface release of MDO to the marine environment would result in a localised reduction in water quality in the upper surface waters of the water column near the location of the spill. Potential impact pathways (physical and chemical) of hydrocarbon exposure for receptors are summarised in **Table 7-11** and potential impacts to receptors found within the EMBA are further described in **Table 7-12**.

7.6.3 Spill modelling results

The modelling results (GHD, 2021) are presented for the fate of hydrocarbon from a vessel collision at the exposure values defined in **Section 7.5.4** and have been provided for the purposes of risk evaluation, displaying in **Table 7-13** the parameters of:

+ minimum time to contact from moderate and high exposure value;
+ maximum hydrocarbon concentration from high exposure value;
+ maximum oil loading on shoreline from moderate and high exposure value; and

+ length of shoreline oiled.

Further parameters required to inform spill response strategies are described further in the OPEP.

7.6.3.1 Shoreline accumulation

Shoreline accumulation at the low threshold was predicted to occur for two realisations out of 400, with five and 12 tonnes predicted. Specific details of shoreline accumulation are provided below in the context of the low, moderate and high exposure values.

Low

Shoreline loading above the low threshold (more than 10 g/m²) was predicted to only occur up to 600 km northwest and at Cartier Island AMP, Ashmore Reef AMP Browse Island and Indonesia East.

Moderate and High

Shoreline accumulation at either the moderate (100 g/m^2) or high (1000 g/m^2) thresholds were predicted to occur at Ashmore Reef and Cartier Island AMPs only up to 220 km away.

7.6.3.2 Floating oil

Low

Surface oil above the low threshold (1 g/m^2) was predicted to extend up to around 480 km to the northwest, and around 270 km to the east of the release location.

Moderate and High

At the moderate threshold (10 g/m^2), surface oiling was reduced in spatial extent to within around 200 km of the release location. Exceedances of the high threshold (50 g/m^2) were limited in spatial extent to within around 110 km of the release site and no emergent or intertidal receptors were simulated to be contacted.

Surface oiling above the high threshold (greater than 50 g/m^2) occurred only at Vulcan Shoals (52 g/m^2) with a 0.5% contact probability and two day arrival time.

7.6.3.3 Total submerged oil (entrained plus dissolved oil)

Low

Total submerged oil at the low threshold (10 ppb) was predicted to occur within around 300 km of the spill site.

Moderate

At the moderate threshold (100 ppb), predicted contact was reduced in spatial extent to within around 150 km of the spill site.

Total submerged oil above the moderate threshold (100 ppb) was predicted to occur at Eugene McDermott Shoal, Barracouta Shoals and Vulcan Shoals with total contact probabilities of 0.5%, 0.8% and 2.3%, respectively, maximum time-averaged concentrations between 137 and 161 ppb, and minimum arrival times of 1.7 to two days.

Dissolved Oil

Low

Dissolved hydrocarbons at the low threshold (10 ppb) were predicted to extend a maximum distance of around 200 km to the west and east, around 150 km to the north and around 150 km to the south.

Moderate and High

At the moderate threshold (50 ppb), the spatial extent was within around 150 km of the release location. There was no predicted exceedance of the high threshold (400 ppb).

Dissolved oil above the moderate threshold (50 ppb) occurred at Eugene McDermott Shoal and Vulcan Shoals with contact probabilities of 0.5% and 1.3%, respectively, maximum time-averaged oil concentrations of 92.1 ppb 80.7 ppb, respectively, and minimum arrival times of around two days.

Table 7-13: Spill modelling results for surface release of hydrocarbons from a vessel collision at Stairway-1

Receptor	Receptor Type	Minimum time to contact (days)							Maximum Hydrocarbon Concentration							Maximum oil ashore (tonnes)	Maximum length of oiled shoreline (km)
		Moderate exposure values				High exposure values			Moderate exposure values				High Exposure Values				
		Shoreline accumulation 100 g/m²	Surface hydrocarbons (10 g/m²)	Dissolved hydrocarbons (50 ppb)	Entrained Hydrocarbons (100 ppb)	Dissolved hydrocarbons (400 ppb)	Shoreline accumulation (1000 g/m²)	Surface hydrocarbons (50 g/m²)	Shoreline accumulation (100 gm²)	Surface hydrocarbons (10 g/m²)	Dissolved hydrocarbons (50 ppb)	Entrained Hydrocarbons (100 ppb)	Dissolved hydrocarbons (400 ppb)	Shoreline accumulation (1000 g/m²)	Surface hydrocarbons (50 g/m²)	Shoreline accumulation (>100 g/m²)	Shoreline accumulation (>100 g/m²)
Cartier Island AMP	Emergent	4.5	NC	NC	NC	NC	8.2	NC	1254.4	NC	NC	NC	NC	1254.4	NC	5.3	2.1
Ashmore Reef AMP	Emergent	19.8	NC	NC	NC	NC	19.8	NC	2091.8	NC	NC	NC	NC	2091.8	NC	12.0	6.4
Sahul Banks	Submerged	n/a	4.9	NC	NC	NC	n/a	NC	n/a	19.4	NC	NC	NC	n/a	NC	n/a	n/a
Gale Bank	Submerged	n/a	10.9	NC	NC	NC	n/a	NC	n/a	18.4	NC	NC	NC	n/a	NC	n/a	n/a
Fantome Shoals	Submerged	n/a	6	NC	NC	NC	n/a	NC	n/a	34.7	NC	NC	NC	n/a	NC	n/a	n/a
Eugene McDermott Shoal	Submerged	n/a	3.2	1.8	1.7	NC	n/a	NC	n/a	42	92.1	137.1	NC	n/a	NC	n/a	n/a

Receptor	Receptor Type	Minimum time to contact (days)							Maximum Hydrocarbon Concentration							Maximum oil ashore (tonnes)	Maximum length of oiled shoreline (km)
		Moderate exposure values				High exposure values			Moderate exposure values				High Exposure Values				
		Shoreline accumulation 100 g/m²	Surface hydrocarbons (10 g/m²)	Dissolved hydrocarbons (50 ppb)	Entrained Hydrocarbons (100 ppb)	Dissolved hydrocarbons (400 ppb)	Shoreline accumulation (1000 g/m²)	Surface hydrocarbons (50 g/m²)	Shoreline accumulation (100 gm²)	Surface hydrocarbons (10 g/m²)	Dissolved hydrocarbons (50 ppb)	Entrained Hydrocarbons (100 ppb)	Dissolved hydrocarbons (400 ppb)	Shoreline accumulation (1000 g/m²)	Surface hydrocarbons (50 g/m²)	Shoreline accumulation (>100 g/m²)	Shoreline accumulation (>100 g/m²)
Barracouta Shoals	Submerged	n/a	1.8	NC	1.9	NC	n/a	NC	n/a	35	NC	141.6	NC	n/a	NC	n/a	n/a
Vulcan Shoals	Submerged	n/a	2.1	2.2	2	NC	n/a	2.1	n/a	52.3	80.7	160.9	NC	n/a	58.5	n/a	n/a
Heywood Shoals	Submerged	n/a	7.8	NC	NC	NC	n/a	NC	n/a	32.9	NC	NC	NC	n/a	NC	n/a	n/a
Kimberley AMP	Submerged	n/a	7.7	NC	NC	NC	n/a	NC	n/a	15.5	NC	NC	NC	n/a	NC	n/a	n/a
Van Cloon/Deep Shaols	Submerged	n/a	7.8	NC	NC	NC	n/a	NC	n/a	19	NC	NC	NC	n/a	NC	n/a	n/a

7.6.4 Environmental performance outcomes and control measures

The EPO relating to this hazard is:

+ No loss of containment of hydrocarbon to the marine environment (EPO-8).

Control measures applied to prevent a hydrocarbon spill from refuelling and vessel collision are shown in **Table 7-14** and corresponding EPSs and measurement criteria are described in **Section 8.4**.

Selection of oil spill response strategies and associated performance outcomes, control measures and performance standards, including those required to maintain preparedness and for response, are detailed within the OPEP. The OPEP contains an evaluation of oil spill preparedness arrangements to demonstrate that oil spills will be mitigated to ALARP.

Table 7-14: Control measures evaluation for release of hydrocarbons

CM Reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
Standard Control measures				
SVA-CM02	Watchkeeping maintained on bridge	Minimises risk of collision through visual identification and avoidance of other vessels.	Negligible costs	**Adopted** – Benefits considered to outweigh costs.
SVA-CM03	Lighting will be used as required for safe work conditions and navigational purposes	Ensures vessels meet minimum safety standards therefore reducing potential for vessel collision events with associated diesel spill to the environment. Marine Order Part 30: Prevention of Collisions, and with Marine Order Part 21: Safety of Navigation and Emergency Procedures requires vessels to have navigational equipment to avoid collisions. Requirement of the *Navigation Act 2012*.	Costs associated with personnel time in checking vessel certifications are in place. Negligible costs of operating navigational equipment.	**Adopted** – Benefits considered to outweigh costs.
SVA-CM04	Vessel PMS to maintain vessel DP, engines and machinery	Requires that equipment is maintained and certified, reducing probability of leaks of hydrocarbons during transfers.	Additional personnel costs of ensuring equipment is maintained and certified as appropriate and that procedures are in place and followed.	**Adopted** – Benefits of ensuring procedures are followed and equipment is compliant outweigh the minimal costs of personnel time.

CM Reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
SVA-CM05	Fuel oil quality	Use of diesel reduces the potential impacts to marine environment in the event of unplanned hydrocarbon spills or leaks during bunkering.	Additional personnel costs of ensuring vessels are using the required fuel.	**Adopted** – Benefits of ensuring procedures are followed outweighs the minimal costs of personnel time.
SVA-CM09	Seafarer Certification	Requires appropriately trained and competent personnel, in accordance with Marine Order 70, to navigate vessels to reduce interaction with other marine users. Requires appropriately trained and competent personnel to navigate vessels.	Costs associated with personnel time in obtaining qualifications.	**Adopted** – Benefits considered to outweigh costs.
SVA-CM20	Vessel spill response plans (SOPEP/ SMPEP)	Implements response plans on board vessels to deal with unplanned hydrocarbon releases and spills quickly and efficiently in order to reduce impacts to the marine environment.	Administrative costs of preparing documents. Generally undertaken by vessel contractor so time for Santos personal to confirm and check SOPEP/SMPEP in place.	**Adopted** – Benefits considered to outweigh costs.
SVA-CM21	Accepted Oil pollution emergency plan (OPEP)	Implements response plans to deal with an unplanned hydrocarbon release quickly and efficiently in order to reduce impacts to the marine environment.	Administrative costs of preparing documents and large costs of preparing for and implementing response strategies.	**Adopted –** Benefits of ensuring procedures are followed and measures implemented and that the vessels are compliant, outweighs the costs. Regulatory requirement must be adopted.

CM Reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
SVA-CM22	Marine assurance standard	Ensures vessels meet Marine assurance standards to reduce the likelihood of unplanned discharges.	Costs associated with personnel time in checking vessel.	**Adopted** – Benefits of ensuring procedures are followed and measures implemented and that the vessels are compliant, outweighs the costs. Regulatory requirement must be adopted.
SVA-CM28	Refuelling and chemical transfer procedure	Minimises risk of pollution to ALARP during hydrocarbon transfers between vessels. Refuelling will occur outside of AMPs minimising potential for impacts on values of the AMPs	Personnel costs associated with ensuring procedures are in place and implemented during refuelling and chemical transfers.	**Adopted** – Benefits of ensuring procedures are followed and measures implemented outweigh the costs.
Additional control measures				
N/A	Schedule activities to avoid coinciding with sensitive periods for marine fauna present in the operational area	Potential reduction in risk of a hydrocarbon spill to some sensitive receptors.	Impractical to schedule activities to avoid all listed marine fauna due to variability in timing of environmentally sensitive periods and the constant or unpredictable presence of some species. Short duration activity (in other words, a few days) that is low risk to marine fauna.	**Rejected** – Cost is disproportionate to increase in environmental benefit.
N/A	Require all support vessels involved in the activity to be double hulled	Reduces the likelihood of a loss of hydrocarbon inventory in the highly unlikely event of a vessel collision, minimising potential environmental impact.	Vessels are subject to availability and are required to meet Santos' standards during activities; requirement of a double hull on vessels would limit the number available to Santos; requiring vessels to be refitted to ensure double hulls would also be of high cost.	**Rejected** – Large costs associated with vessel selection and by having an activity schedule determined by vessel availability considered grossly disproportionate compared to low risk of a vessel collision and low risk of a large diesel spill.

CM Reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
N/A	No bunkering in the operational area	Eliminates the probability of a hydrocarbon spill or leak occurring during bunkering in the operational area.	Cost associated with vessel transits and risk transfer to Health and Safety issues with additional trips to port instead. Would significantly increase the schedule to include multiple trips.	**Not Adopted** – Cost outweighs the environmental benefit.

7.6.5 Environmental impact assessment

The below environmental impact assessment follows the risk assessment approach detailed in **Section 5**.

7.6.5.1 Identification of hotspots for consequence analysis

As described in **Section 7.5.5**, all HEVs within the EMBA (low exposure value) are listed in **Table 7-15**. The values and sensitivities associated with these HEVs have been described in **APPENDIX C**. Further to this, **Table 7-15** filters the HEVs to identify the hotspots where they meet the criteria in **Section 7.5.5**. This assessment has found that there are three hotspots.

Table 7-15: Identified high environmental value hotspot receptors in the environment that may be affected

Receptor	HEV Value	Exposure Value*			Hotspot
		Low	Moderate*	High*	
Ashmore Reef AMP	1	✓	✓	✓	Y
Cartier Island AMP	3	✓	✓	✓	Y
Kimberley AMP	3	✓	✓	x	
Johnson Bank	3	✓	x	x	
Van Cloon/Deep Shaols	4	✓	✓	x	
Ashmore/Cartier - Outer	4	✓	x	x	
Browse Island	5	✓	x	x	
Indonesia - East	5	✓	x	x	
Sahul Banks	5	✓	✓	x	
Gale Bank	5	✓	✓	x	
Penguin Shoal	5	✓	x	x	
Fantome Shoals	5	✓	✓	x	
Eugene McDermott Shoal	5	✓	✓	✓	
Barracouta Shoals	5	✓	✓	x	
Vulcan Shoals	5	✓	✓	✓	
Hibernia Reef	5	✓	x	x	
Woodbine Bank	5	✓	x	x	
Heywood Shoals	5	✓	✓	x	

**greater than 5% probability of contact*

Table 7-16 provides a summary of the consequence assessment results for each of the Hotspot areas. The consequence assessment was based on predicted contact and concentration of floating oil, accumulated oil, entrained oil and dissolved oil at the moderate threshold. For each hotspot area, the consequence to the key values were assessed using the methodology described in **Section 5**.

Table 7-16: Hotspot consequence assessment results from worst case vessel collision spill of 329 m³ of diesel

Receptor (Hotspot) Name	HEV Ranking	Values	Oil Spill Modelling Parameter NC = No Contact, NA = Not Applicable		Result	Consequence Category	Consequence Ranking	Final
Ashmore Reef AMP (emergent)	1	Habitats Only oceanic reef in the north-east Indian Ocean with vegetated islands (East, Middle and West Islands), Ashmore is also the largest of three emergent, oceanic reefs in the region. Reptiles Critical nesting and internesting habitat for green turtles Large and significant feeding populations of green, hawksbill and loggerhead turtles internationally significant for its abundance and diversity of sea snakes Marine mammals Small dugong population of less than 50 individuals Migratory pathway for pygmy blue whales Birds Supports some of the most important seabird rookeries on the North West Shelf important staging points/feeding areas for many migratory seabirds Protected areas Ashmore Reef and Cartier Island and surrounding Commonwealth waters KEF Continental slope demersal fish communities KEF Socio-economic and heritage values Ashmore lagoon as a rest/staging area for traditional Indonesian fishers Indonesian artefacts Grave sites Commonwealth heritage listing – Ashmore Reef Australian Marine Park Commercial tourism, recreation and scientific research are important socio-economic values	*Probability of contact by floating oil at 10 g/m²*	*(%)*	NC	Threatened/Migratory Fauna Physical Environment/ Habitat Protected Areas Socio-Economic Receptors	III II III III	III
			Minimum time to contact by floating oil 10 g/m²	*Time (days)*	NC			
			Maximum accumulated oil ashore >10 g/m²	*tonnes*	12.8			
			Maximum accumulated concentration >100 g/m²	*g/m²*	2092			
			Maximum length of shoreline oiled (>100 g/m²)	*(km)*	6.4			
			Maximum concentration of total submerged oil >100 ppb	*(ppb)*	NC			
			Maximum concentration of dissolved hydrocarbon >10 ppb	*(ppb)*	NC			
Cartier Island AMP (emergent)	3	Species at Ashmore Reef and Cartier Island include more than 225 reef-building corals, 433 molluscs, 286 crustaceans, 192 echinoderms, and the most diverse variety of fish of any region in Western Australia with 709 species Physical habitats Coral reef Seagrass Non-coral benthic habitats High coral and fish diversity Sandy beaches Marine fauna Invertebrates Cetaceans High density and diversity of sea snakes Nesting and foraging green and hawksbill turtles Migrating birds	*Probability of contact by floating oil at 10 g/m²*	*(%)*	NC	Threatened/Migratory Fauna Physical Environment/ Habitat Protected Areas Socio-Economic Receptors	III II III II	
			Minimum time to contact by floating oil 10 g/m²	*Time (days)*	NC			
			Maximum oil loading on shorelines >10 g/m²	*tonnes*	5.3			
			Maximum accumulated concentration >100 g/m²	*m²*	1254			

Receptor (Hotspot) Name	HEV Ranking	Values	Oil Spill Modelling Parameter NC = No Contact, NA = Not Applicable		Result	Consequence Category	Consequence Ranking	Final
		Finfish and rays Whale sharks High fish diversity (>700 species of fish) Protected areas Key Ecological Feature (Ashmore Reef and Cartier Island and Surrounding Commonwealth Waters) Socio-economic and heritage values Australian Marine Park Scientific research (in Marine Park)	*Maximum length of shoreline oiled (>100 g/m²)*	*(km)*	2.1			
			Maximum concentration of total submerged oil >100 ppb	*(ppb)*	NC			
			Maximum concentration of dissolved hydrocarbon >10 ppb	*(ppb)*	NC			

Description	
Key Receptors	Physical environment – water quality, shallow benthic, intertidal and shoreline habitats Threatened/migratory fauna – plankton, invertebrates, marine mammals, marine reptiles, sharks, rays and fish, birds (seabirds and shorebirds) Protected Areas – KEFs, RAMSAR Wetlands, Marine Parks and Commonwealth Heritage Areas Socio-economic – commercial, recreational and traditional fisheries, recreation and tourism, oil and gas industry)
Consequence	III – Moderate (refer **Table 7-16**)

A summary of the consequence assessment for each receptor category is presented below. Potential impact pathways (physical and chemical) of hydrocarbon exposure for receptors are summarised in **Table 7-11**, and potential impacts to receptors found within the EMBA are further described in **Table 7-12**.

Threatened/migratory fauna

A surface release of MDO to the marine environment would result in a localised reduction in water quality in the upper surface waters of the water column. As a light hydrocarbon, MDO undergoes rapid spreading and evaporative loss in warm waters, indicating that a surface slick will be temporary. Under moderate winds (5 m/s), 40% of the initial surface slick is predicted to remain as surface oil after 24 hours, decreasing further to approximately 10% after 48 hours and approximately 1% after 72 hours (GHD, 2021). The high rate of evaporation means that little MDO will become entrained and few aromatic hydrocarbons are predicted to become dissolved reducing impact to marine fauna. Surface oil, and entrained hydrocarbon in the sea surface layer, could have the physical effect of coating fauna interacting within and under the surface, including plankton, pelagic invertebrates and fishes, marine reptiles, marine mammals and seabirds, and may also affect some species through ingestion of oiled fish (as described in **Table 7-12**).

The EMBA overlaps breeding/resting BIAs for a number of seabirds. An unplanned release of MDO is not expected to interfere with their breeding activity, but could cause slight secondary effects through ingestion after preening or ingestion of oiled fish (as described in **Table 7-11** and **Table 7-12**).

The pygmy blue whale (distribution, migration and foraging) BIA and whale shark foraging BIA overlap the EMBA. An unplanned release of MDO is not expected to interfere with their migration activity. There is the potential for behavioural disruption to the local population as individuals traverse the area affected with potential for coating of baleen (in whales) and ingestion of oiled prey (plankton/fish) as described in **Table 7-11** and **Table 7-12**.

The EMBA overlap nesting/internesting and critical habitat BIAs for a number of turtles and therefore turtle behaviour could be disrupted with the potential to threaten turtle populations (as described in **Table 7-12**).

Deteriorating water quality/chemical and terrestrial discharge is identified as a potential threat to turtles in the marine turtle recovery plan, and some bird and shark species (**Table 3-9**). Habitat modification, degradation and disruption, pollution and/or loss of habitat are also identified as threats to sharks, birds, cetaceans and turtles in conservation management and recovery plans. Given the location of the release, and volume of potential hydrocarbon release there is the potential for modification to or a decrease in the availability of quality habitat (shorelines/subsurface) at Ashmore Reef and Cartier Island AMPs which are established to protect birds, fish and turtle habitats. Shoreline accumulation may present a major disruption to shoreline individuals (as described in **Table 7-12**). Volumes of accumulated hydrocarbon may result in a reduction in area available for seabirds and/or turtle species. The quality of habitat (shorelines/subsurface) may be reduced for a period, with recovery over the medium term (decades).

The potential impacts of a hydrocarbon release on seabird breeding and feeding areas (which includes wetland areas) are discussed in **Table 7-12**. Impacts in relation to human activities from responding to a spill are described in **Section 6.7**.

The consequence assessment undertaken at selected Hotspot areas (refer **Section 7.6.5.1**) revealed that the worst-case consequence to the physical environment and habitats from a vessel collision resulting in a worst-case

Description
unplanned hydrocarbon release was ranked as a III – Moderate based on the modelling results and the behaviour of diesel. **Physical environment and habitats** In the event of MDO release, hydrocarbons that reach nearshore environments have the potential to impact benthic coral reefs and mangrove areas and shoals can be affected if in shallow waters which may result in a decrease in ecological values given toxicity impacts associated with hydrocarbon exposure. The quality of habitat may be reduced for a significant period with recovery over the medium term (two to ten years). As described above, accumulated hydrocarbons on shorelines could impact marine fauna that use beaches such as shorebirds and turtles, dependent upon the timing of a spill. Beaches within Ashmore Reef and Cartier Island AMPs support critical habitats for nesting and breeding turtles and seabirds, and the shallow lagoons also support a small dugong population. Impacts to turtles and seabirds could occur from surface hydrocarbons if MDO accumulates on nesting beaches and wetland areas. Entrained hydrocarbon could also contact seagrass meadows, wetlands and sandy beaches at high tide. Such impacts would be most likely to female nesting turtles as they move up and down beaches, turtle hatchlings as they emerge from nests six to eight weeks after nesting, foraging and wading birds. The quality of habitat available to fauna will be reduced, with recovery over the medium term. The consequence assessment undertaken at selected Hotspot areas (refer **Section 7.6.2**) revealed the worst-case consequence to the physical environment and habitats from a vessel collision resulting in a worst-case unplanned hydrocarbon release was ranked as a II – Minor based on the modelling results and the behaviour of diesel. **Protected areas** The EMBA intersects several AMPs, Commonwealth Heritage Areas, RAMSAR wetlands and marine management areas (**Section 3.1**). Combined, these areas support all the habitats and faunal groups described above. Impacts to the habitat/fauna receptors described above therefore have an impact on the values of these reserves which could have flow-on effects to tourism revenue of coastal communities that provide access to these marine reserves. The consequence assessment undertaken at selected Hotspot areas (refer **Section 7.6.2**) revealed that the worst-case consequence to protected areas from a vessel collision resulting in a worst-case unplanned hydrocarbon release was ranked as a III – Moderate. **Socio-economic receptors** There is the potential for hydrocarbons to temporarily disrupt fishing activities if the surface or entrained hydrocarbon moves through fishing areas. However, the high rate of evaporation means that little MDO will become entrained and few aromatic hydrocarbons are predicted to become dissolved (**Table 3-11**). It is possible that there could be accumulation of oil in fish tissues to the extent that could result in hydrocarbon tainting of fish flesh. Connell and Miller (1981) compiled a summary of studies listing the exposure value concentrations at which tainting occurred for hydrocarbons. The results contained in their review indicate that tainting of fish occurs when fish are exposed to ambient concentrations of 4 to 300 ppm (4,000 to 300,000 ppb) of hydrocarbons in the water, for durations of 24 hours or more, with response to phenols and naphthenic acids being the strongest. Given the volume of oil that could potentially be released, it is possible impacts could be detected to fisheries on a stock level, although it is more likely natural variation in fish abundance would be on a greater scale than any impacts attributable to a hydrocarbon spill. This would most likely be the case for fisheries species that utilise shallow waters around Ashmore Reef and Cartier Island and could occur through direct impacts to fish or to fish habitats (for example, seagrass, coral reef, mangrove habitats). Entrained and surface oil could impact traditional Indonesian fishing that occurs at the AMPs and are a staging and resting point for these fishermen. A number of oil and gas operators operate within the EMBA with existing projects and infrastructure in place as well as continuing drilling and exploration programs (**Table 3-10**). An unplanned hydrocarbon release has the potential to disrupt these activities, with associated economic impact, albeit on a temporary basis.

Description	
Tourism could also be affected by a spill, either from reduced water quality/shoreline oiling preventing recreational activities or reducing aesthetic appeal or from impacts to habitats and marine fauna as described in **Table 7-11** and **Table 7-12**. The consequence assessment undertaken at selected Hotspot areas (refer **Section 7.6.5.1**) revealed that the worst-case consequence to socio-economic receptors from a vessel collision resulting in a worst-case unplanned hydrocarbon release, was ranked as a III – Moderate.	
Likelihood	A – Remote
A worst-case hydrocarbon release resulting from a vessel collision could result in major disruption and long-term effects on the receiving environment. Impacts could decrease local populations and result in loss of critical habitats; however, recovery would be expected within decades. With the proposed control measures in place to prevent releases, any decline in local populations or degradation of habitats is considered unlikely and therefore the activity will be conducted in a manner that is considered acceptable. The likelihood of a hydrocarbon release occurring due to a vessel collision/bunkering is limited given the set of mitigation and management controls in place and the remote location of the operational area. Subsequently the likelihood of a vessel collision releasing hydrocarbons to the environment resulting in a major consequence is considered to be remote (a).	
Residual Risk	The residual risk associated with this hazard is *Very Low*

7.6.6 Demonstration of as low as reasonably practicable

The use of vessels is integral to activity and therefore vessels and associated risks of unplanned hydrocarbon releases, cannot be completely eliminated.

Offshore refuelling is standard industry practice and oil pollution legislation (*Protection of the Sea (Prevention of Pollution from Ships) Act 1983* and MARPOL Annex I) has been developed to safeguard against the risk of a hydrocarbon spill occurring during refuelling. Other hydrocarbon types such as heavy fuel oil and intermediate fuel oil have specifically not been selected for this activity (only diesel will be used in the operational area) to ensure potential environmental impacts are reduced to ALARP.

The combination of the standard prevention control measures (**Section 7.6.4**) (which reduce the likelihood of the event happening), and the spill response strategies (which may reduce the consequence) together reduce the overall hydrocarbon spill risk.

No additional controls have been identified and given the controls in place detailed above, the assessed residual risk for this impact is Very Low and cannot be reduced further. It is considered therefore that the impact of the activities conducted is reduced to ALARP.

In terms of spill response activities, Santos will implement oil spill response as specified within the OPEP. A detailed ALARP assessment on the adequacy of arrangements available to support spill response strategies and control measures is presented in the OPEP (SO-91-BI-20017).

The North-west and North MPMNPs state that actions required to respond to oil pollution incidents, including environmental monitoring and remediation, in connection with mining operations authorised under the OPGGS Act may be conducted in all zones of the marine parks identified with the EMBA (DNP, 2018) without an authorisation issued by the Director, provided that the actions are taken in accordance with an EP that has been accepted by NOPSEMA, and the Director is notified in the event of oil pollution within a marine park, or where an oil spill response action must be taken within a marine park, so far as reasonably practicable, prior to response action being taken.

7.6.7 Acceptability evaluation

Is the risk ranked between Very Low to Medium?	Yes – residual risk is ranked as Very Low.
Is further information required in the consequence assessment?	No – potential impacts and risks are well understood through the information available.
Are the activities and their risks and impacts consistent with the principles of ESD?	Yes – aligns with the principles of ESD where these natural resources are used in a sustainable manner with environmental and economic considerations factored into decision making.
Are performance standards consistent with industry standards, legal and regulatory requirements, including protected matters?	Yes – management consistent with the OPGGS(E)R and with International Convention of the SOLAS) 1974 and Navigation Act 2012, MARPOL Annex I – Prevention of Pollution from Ships, and relevant recovery plans. Santos has considered the values and sensitivities of the receiving environment, including: + IUCN principles and strategic objectives of nearby reserves (Ashmore Reef AMP, Kimberley AMP, Cartier Island AMP and the North-west and North Marine Parks Network Management Plan) are met + Relevant Species Recovery Plans, Conservation Management Plans and management actions, including but not limited to: – Threat Abatement Plan for Impacts of Marine Debris on Vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018) – Recovery Plan for Marine Turtles in Australia (2017) – Recovery Plan for Threatened Albatrosses and Giant Petrels (DSEWPaC, 2011a) – Approved Conservation Advice for *Megaptera novaeangliae* (humpback whale) (2015a) – Approved Conservation Advice for *Rhincodon typus* (whale shark) (2015b) – Approved Conservation Advice for *Balaenoptera physalus* (fin whale) (2015c) – Approved Conservation Advice for *Balaenoptera borealis* (sei whale) (2015d) – Recovery Plan for the White Shark (*Carcharodon carcharias*) (2013a) – Sawfish and River Sharks Multispecies Recovery Plan (2015a) – Commonwealth Conservation Advice on *Pristis zijsron* (green sawfish) (2008) – Blue Whale Conservation Management Plan 2015–2025 (2015b) – Wildlife Conservation Plan for Migratory Shorebirds (2015) – Conservation advices for various seabird species.

Are risks and impacts consistent with Santos Environment, Health and Safety Policy?	Yes – aligns with Santos' Environment, Health and Safety Policy.
Are risks and impacts consistent with stakeholder expectations?	Yes – no concerns raised.
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – see ALARP assessment above.

Given the control measures in place to prevent a vessel on vessel collision and refuelling incidents and the low frequency of significant volume diesel spills that occur in the industry, the likelihood of a loss of containment event during the activity is remote. The risks from diesel spills are well understood and the activities will be managed in accordance with relevant legislation and standards. The control measures proposed are consistent with applicable actions described in the relevant Recovery Plans and Approved Conservation Advice and no stakeholder concerns have been raised regarding this aspect.

With the implementation of industry standard and activity-specific control measures to reduce the chance of a diesel spill event (and minimise impacts), the residual risk is assessed to be Very Low and ALARP. Control measures will reduce the risk of impact from MDO spill to a level that is acceptable.

8. Implementation Strategy

OPGGS(E)R 2009 Requirements
Regulation 14(1)
The environment plan must contain an implementation strategy for the activity in accordance with this regulation.
Regulation 14(10)
The implementation strategy must comply with the Act, the regulations and any other environmental legislation applying to the activity.

The specific measures and arrangements that will be implemented in the event of an oil pollution emergency are detailed within the OPEP.

Stakeholder engagement is assessed separately for the requirements of the activity. Ongoing stakeholder management strategies are discussed in **Section 4**.

8.1 Environmental management system

OPGGS(E)R 2009 Requirements
Regulation 14(3)
The implementation strategy must contain a description of the environmental management system for the activity, including specific measures to be used to ensure that, for the duration of the activity: (a) the environmental impacts and risks of the activity continue to be identified and reduced to a level that is ALARP; and (b) Control measures detailed in the environment plan are effective in reducing the environmental impacts and risks of the activity to ALARP and an acceptable level; and (c) environmental performance outcomes and standards set out in the environment plan are being met.

Santos' Management System exists to support its moral, professional and legal obligations to undertake work in a manner that does not cause harm to people or the environment. The framework of policies, standards, processes, procedures, tools and control measures that, when used together by a properly resourced and competent organisation, result in:

+ A common HSE approach is followed across the organisation;
+ HSE is proactively managed and maintained;
+ The mandatory requirements of HSE management are implemented and are auditable;
+ HSE management performance is measured and corrective actions are taken;
+ Opportunities for improvement are recognised and implemented; and
+ Workforce commitments are understood and demonstrated.

The structure of this implementation strategy aligns with the HSE Management System structure and is designed to require that:

+ Environmental impacts and risks continue to be identified for the duration of the activity and reduced to ALARP;

- Control measures are effective in reducing environmental impacts and risks to ALARP and acceptable levels;
- Environmental performance outcomes and standards set out in this EP are met; and
- Stakeholder consultation is maintained throughout the activity as appropriate.

8.2 Environment, Health and Safety Policy

Santos' Environment, Health and Safety Policy (**APPENDIX A**) clearly sets out Santos' strategic environmental objectives and the commitment of the management team to continuous environmental performance improvement. This EP has been prepared in accordance with the fundamentals of this policy. By accepting employment with Santos, each employee and contractor is made aware during the recruitment process that he or she is responsible for the application of this policy.

8.3 Hazard identification, risk and impact assessment and controls

Hazards and associated environmental risks and impacts for the proposed activities have been systematically identified and assessed in this EP (refer to **Sections 6** and **7**). The control measures and EPS that will be implemented to manage the identified risks and impacts, and the EPOs that will be achieved, are detailed in **Section 8.4**.

To ensure that environmental risks and impacts remain acceptable and ALARP during the activity and for the duration of this EP, hazards will continue to be identified, assessed and controlled as described in **Section 8.10** (Document Management) and **Section 8.11** (Audits and Inspections).

Any new, or proposed amendment to a control measure, EPS or EPO will be managed in accordance with the MoC procedure (**Section 8.10.2**).

Oil spill response control measures and EPSs and EPOs are listed in the OPEP.

8.4 Environmental performance

To ensure environmental risks and impacts will be of an acceptable level, EPOs have been defined and are listed in

Table 8-1 for planned activities, those relating to oil spill response are listed in the OPEP.

Table 8-1: Environmental performance outcomes

Reference	Environmental Performance Outcomes
EPO-01	No injury or mortality to EPBC Act 1999 and *WA Biodiversity Conservation Act 2016* listed fauna during activities
EPO-02	Reduce impacts to marine fauna from lighting on vessels through limiting lighting to that required by safety and navigational lighting requirements
EPO-03	Reduce impacts to air and water quality from planned discharges and emissions from the activities
EPO-04	Seabed disturbance limited to planned activities and defined locations within the operational area
EPO-05	Reduce impacts on other marine users through the provision of information to relevant stakeholders such that they are able to plan for their activities and avoid unexpected interference
EPO-06	No unplanned objects, emissions or discharges to sea or air
EPO-07	No introduction of marine pest species
EPO-08	No loss of containment of hydrocarbon to the marine environment

8.4.1 Control measures and environmental performance

OPGGS(E)R 2009 Requirements
Regulation 13(7)
The environment plan must: (a) set environmental performance standards for the control measures identified under paragraph (5)(c); and (b) set out the environmental performance outcomes against which the performance of the titleholder in protecting the environment is to be measured; and (c) include measurement criteria that the titleholder will use to determine whether each environmental performance outcome and environmental performance standard is being met.

The control measures that will be used to manage identified environmental impacts and risks and the associated statements of performance required of the control measure (in other words, EPSs) are listed in **Table 8-2**. Measurement criteria outlining how compliance with the control measure and the expected environmental performance could be evidenced are also listed.

All control measures and EPS and associated measurement criteria relating to preparedness and response operations are contained within the VBA OPEP (SO-91-BI-20017).

Table 8-2: Control measures and environmental performance standards for the proposed activity

Control Measures	CM Reference	Environmental Performance Standard	EPS Reference No.	Measurement Criteria	Performance Objective Reference	Section
Procedure for interacting with marine fauna	SVA-CM-01	Vessels comply with Santos' Protected Marine Fauna Interaction and Sighting Procedure (EA-91-11-00003), which ensures compliance with Part 8 of the EPBC Regulations 2000, which includes controls for minimising the risk of collision with marine fauna.	SVA-CM01-EPS-01	Completed vessel statement of conformance.	EPO-01	**Section 6.1** **Section 7.3**
		Helicopter contractor procedures comply with Santos' Protected Marine Fauna Interaction and Sighting Procedure (EA-91-11-00003), which ensures compliance with Part 8 of the Environment Protection and Biodiversity Conservation Regulations 2000, which includes controls for minimising interaction with marine fauna.	SVA-CM01-EPS-02	Helicopter contractor procedures align with Santos' Protected Marine Fauna Interaction and Sighting Procedure (EA-91-11-00003).		
Watchkeeping maintained on bridge	SVA-CM02	Monitoring of surrounding marine environment is undertaken from vessel bridge.	SVA-CM02-EPS-01	Bridge log.	EPO-01 EPO-05	**Section 6.1** **Section 6.5** **Section 7.3**
Lighting will be used as required for safe work conditions and navigational purposes.	SVA-CM03	Vessel navigation lighting and equipment is compliant with COLREGS/Marine Order Part 30: Prevention of Collisions, and with Marine Order Part 21: Safety of Navigation and Emergency Procedures to minimise collision risk.	SVA-CM03-EPS-01	Vessel certification confirms compliance with applicable regulations.	EPO-02	**Section 6.2** **Section 6.3** **Section 6.5** **Section 7.6**
Vessel PMS to maintain vessel DP, engines and machinery	SVA-CM04	Documented maintenance program is in place for equipment on vessels that provides a status on the maintenance of equipment.	SVA-CM04-EPS-01	Planned maintenance system records.	EPO-03	**Section 6.3**
Fuel oil Quality	SVA-CM05	MARPOL-compliant (Marine Order 97) fuel oil (diesel) will be used during the activity.	SVA-CM05-EPS-01	Fuel bunkering records and/or relevant purchase records.	EPO-03	**Section 6.3**
		Intermediate fuel oil or heavy fuel oil will not be used during the activity.	SVA-CM05-EPS-02	Fuel bunkering records and/or relevant purchase records.	EPO-03	
Air Pollution Prevention Certification	SVA-CM06	Pursuant to MARPOL Annex VI, the vessel will maintain a current IAPP Certificate, as relevant to vessel class, which certifies that measures to prevent ozone-depleting substance (ODS) emissions, and reduce NOx, SOx, and incineration emissions during the activity are in place.	SVA-CM06-EPS-01	Current International Air Pollution Prevention Certificate.	EPO-03	**Section 6.3**
Waste incineration	SVA-CM07	Waste incineration on the vessel is managed in accordance with MARPOL Annex VI.	SVA-CM07-EPS-01	Completed waste record book or recording system.	EPO-03	**Section 6.3** **Section 7.6**
Equipment deployment management	SVA-CM08	If placement of equipment is required on the seabed, it will be placed only at Santos pre-approved locations within the operational area.	SVA-CM08-EPS-01	Incident database records show no placement of equipment occurred at non-approved locations. Survey Report	EPO-04	**Section 6.1** **Section 7.3**
Seafarer certification	SVA-CM09	Vessel crew are trained and competent, in accordance with Flag State regulations, to navigate vessels	SVA-CM09-EPS-01	Training records.	EPO-05	**Section 6.5**
Stakeholder consultation strategy	SVA-CM10	All correspondence with external stakeholders is recorded.	SVA-CM10-EPS-01	Saved consultation records	EPO-05	**Section 6.5**
		Santos' Consultation Coordinator is contactable before, during and after completion of the planned activity to ensure stakeholder feedback is evaluated and considered during the operational activity phases.	SVA-CM10-EPS-02	Consultation Coordinator contact details provided to relevant persons in all correspondence	EPO-05	
		Santos will notify all relevant stakeholders listed, or as revised, in **Table 8-4** of relevant activity details prior to commencement, including activity timing, vessel movements, proposed cessation date and vessel details.	SVA-CM10-EPS-03	Transmittal records.	EPO-05	
No fishing from vessel	SVA-CM11	Personnel are prohibited from recreational fishing activities on the vessel.	SVA-CM11-EPS-01	Induction records.	EPO-05	**Section 6.5**

Control Measures	CM Reference	Environmental Performance Standard	EPS Reference No.	Measurement Criteria	Performance Objective Reference	Section
Vessel sewage treatment system	SVA-CM12	Pursuant to MARPOL Annex VI, the vessels will have a current International Sewage Pollution Prevention (ISPP) Certificate which certifies that required measures to reduce impacts from sewage disposal are in place (as applicable to vessel class).	SVA-CM12-EPS-01	Current ISPP Certificate.	EPO-03	**Section 6.6**
		Preventive maintenance on sewage treatment equipment is completed as scheduled.	SVA-CM12-EPS-02	Maintenance records.		
		Sewage from vessels is discharged in accordance with MARPOL Annex IV.	SVA-CM12-EPS-03	Records demonstrate that sewage was appropriately discharged or retained.		
Vessel oily water treatment system	SVA-CM13	Oily mixtures (bilge water) only discharged to sea in accordance with MARPOL Annex I.	SVA-CM13-EPS-01	Oil record book.	EPO-03	**Section 6.6**
		Preventive maintenance on oil filtering equipment completed as scheduled.	SVA-CM13-EPS-02	Maintenance records.		
		Pursuant to MARPOL Annex I, vessel(s) will have an International Oil Pollution Prevention (IOPP) Certificate which certifies that required measures to reduce impacts of planned oil discharges are in place (as applicable to vessel class).	SVA-CM13-EPS-03	Current IOPP Certificate.		
Waste (garbage) management procedure.	SVA-CM14	Waste management procedure implemented to reduce the risk of unplanned release of waste to sea, in accordance with Marine Order 95. The procedure includes standards for: + bin types + lids and covers + waste segregation + bin storage + food waste.	SVA-CM14-EPS-01	Garbage record book. Audit records. Inspection records.	EPO-06	**Section 6.6** **Section 7.1**
		Pursuant to Marine Order 95, placards displayed to notify personnel of waste disposal restrictions.	SVA-CM14-EPS-02	Audit records. Inspection records.		
Deck cleaning product selection	SVA-CM15	Deck cleaning products planned to be released to sea meet the criteria for not being harmful to the marine environment according to MARPOL Annex V.	SVA-CM15-EPS-01	Safety Data Sheet (SDS) and product supplier supplementary data as required.	EPO-03	**Section 6.6**
Dropped object recovery	SVA-CM16	Objects dropped overboard are recovered to mitigate the environmental consequences from objects remaining in the marine environment, unless the environmental consequences are negligible, or safety risks are disproportionate to the environmental consequences.	SVA-CM16-EPS-01	Fate of dropped objects detailed in incident documents.	EPO-06	**Section 7.1**
Dropped object prevention procedures.	SVA-CM17	Vessel lifting procedures include the following control measures to reduce the risk of objects entering the marine environment: + lifting equipment certification and inspection + lifting crew competencies + heavy lift procedures + preventative maintenance on cranes.	SVA-CM17-EPS-01	Lifting equipment register. Permit to work records. Training records.	EPO-06	
Compliance with the Biosecurity Act 2015	SVA-CM18	Vessels are managed to low risk in accordance with the Santos IMSMP (EA-00-RI-10172) prior to movement or transit into or within the invasive marine species management zone, which requires: + assessment of applicable vessels using the IMSMP risk assessment + the management of immersible equipment to low risk.	SVA-CM18-EPS-01	Completed risk assessment demonstrating vessel and equipment is low risk.	EPO-07	**Section 7.2**

Control Measures	CM Reference	Environmental Performance Standard	EPS Reference No.	Measurement Criteria	Performance Objective Reference	Section
		Pursuant to the *Biosecurity Act 2015* and Australian Ballast Water Management Requirements 2017, support vessels carrying ballast water and engaged in international voyages shall manage ballast water so that marine pest species are not introduced.	SVA-CM18-EPS-02	Records show Ballast Water Management is implemented. Completed ballast water record book or log is maintained.	EPO-07	**Section 7.2**
		Vessel receives entry clearance from DAWE (Seaports) as necessary (or as applicable to their location and movements).	SVA-CM18-EPS-03	Records show a complete Questionnaire for Biosecurity Exemptions for Biosecurity Control Determination issued to Seaports at least one month in advance where practicable	EPO-07	**Section 7.2**
Anti-foulant system	SVA-CM19	Vessel anti-foulant system maintained in compliance with *International Convention on the Control of Harmful Anti-fouling Systems on Ships*	SVA-CM19-EPS-01	Current International Anti-Fouling System Certificate.	EPO-07	**Section 7.2**
Vessel spill response plans (SOPEP/SMPEP)	SVA-CM20	Support vessels have and implement a shipboard oil pollution emergency plan (SOPEP) or shipboard marine pollution emergency plan (SMPEP), which outlines steps taken to combat spills pursuant to MARPOL Annex I.	SVA-CM20-EPS-01	Audit records. Inspection records.	EPO-08	**Section 7.6**
		SOPEP or SMPEP spill response exercises conducted at least every three months to ensure personnel are prepared.	SVA-CM20-EPS-02	Spill exercise records or evidence of a spill exercise in an operational report		
Accepted Oil pollution emergency plan (OPEP)	SVA-CM21	In the event of a hydrocarbon spill to sea, the Santos OPEP requirements are implemented to mitigate environmental impacts.	SVA-CM21-EPS-01	Completed incident documentation.	EPO-08	**Section 7.6**
Marine assurance standard	SVA-CM22	Vessels selected and on-boarded in accordance with the *Offshore Marine Assurance Procedure* (SO-91-ZH-10001) to ensure contracted vessels are operated, maintained and manned in accordance with industry standards (for example, Marine Orders) and regulatory requirements (this EP) and the relevant Santos procedures mentioned in this EP	SVA-CM22-EPS-01	Completed documentation in accordance with procedure.	EPO-06 EPO-08	**Section 7.6**
Pre-start requirements	SVA-CM23	Prior to commencing start-up of geophysical survey equipment in-water, the following will be completed: + A trained crew member (refer **Section 8.6.2**) observing for marine mammals and whale sharks within 500 m of the vessel during daylight for 15 minutes prior to start-up (if no sightings, survey can commence). + If marine mammals or whale sharks are sighted within 500 m of the geophysical equipment prior to commencement of survey equipment, the operation will be delayed until the animal has moved at least 500 m away or 10 minutes has passed since the last sighting. + Soft-start procedures enacted over 30 minutes (if equipment allows). + Shut down procedures enacted if marine fauna within 500 m of the vessel during continuous operations. + Daylight operations continue into night providing no more than three marine fauna shutdowns in last 24 hours. + Night operations can commence if there were no more than three delays due to marine fauna in the preceding 24-hour period.	SVA-CM23-EPS-01	Geophysical survey checklist completed prior to survey equipment commencement.	EPO-01	**Section 6.1**
Chemical selection procedure	SVA-CM24	Geotechnical drilling chemicals potentially discharged to sea are CHARM Gold/Silver or non-CHARM D/ E rated through OCNS, or PLONOR substances listed by OSPAR, or have a completed risk assessment as per Santos Offshore Division Drilling Chemical Selection and Approval Process (EA-91-II-00007) so only environmentally acceptable products are used. The selection criteria for chemical preference through the risk assessment process as outlined in Santos Offshore Division Drilling Chemical Selection and Approval Process (EA-91-II-00007) is low aquatic toxicity (for example, EC50/LC50 > 100 mg/L), low bioaccumulation potential (for example, Log Pow <3) and readily biodegradable (for example, more than 60 in 28 days OECD 306).	SVA-CM24-EPS-01	Completed Santos risk assessment.	EPO-03	**Section 6.6**
	SVA-CM25	Preventive maintenance on ROV completed as scheduled to reduce the risk of hydraulic fluid releases to sea.	SVA-CM25-EPS-01	Maintenance records.	EPO-06	**Section 7.4**

Control Measures	CM Reference	Environmental Performance Standard	EPS Reference No.	Measurement Criteria	Performance Objective Reference	Section
Remotely operated vehicle inspection and maintenance procedures		ROV pre-deployment inspection completed to reduce the risk of hydraulic fluid releases to sea.	SVA-CM25-EPS-02	Completed pre-deployment inspection of hose integrity.		
General chemical management procedures	SVA-CM26	SDS available for all chemicals to aid in the process of hazard identification and chemical management.	SVA-CM26-EPS-01	Safety data sheet.	EPO-06	**Section 7.4**
		Chemicals managed in accordance with the SDS in relation to safe handling and storage, spill-response and emergency procedures, and disposal considerations.	SVA-CM26-EPS-02	Audit records. Inspection records.		
		Dangerous goods managed in accordance with the International Maritime Dangerous Goods Code to reduce the risk of an environmental incident, such as an accidental release to sea or unintended chemical reaction.	SVA-CM26-EPS-03	Site records.		
Hazardous chemical management procedures	SVA-CM27	For hazardous chemicals, including hydrocarbons, the following standards apply to reduce the risk of an accidental release to sea: + Storage containers closed when the product is not being used. + Storage containers managed in a manner that provides for secondary containment in the event of a spill or leak. + Storage containers labelled with the technical product name as per the safety data sheet. + Spills and leaks to deck, excluding storage bunds and drip trays, immediately cleaned up. + Storage bunds and drip trays do not contain free-flowing volumes of liquid. + Spill response equipment readily available.	SVA-CM27-EPS-01	Audit Records. Inspection Records.	EPO-06	**Section 7.4**
Refuelling and chemical transfer procedure	SVA-CM28	All vessels that are involved in at sea bunkering or chemical transfer will have appropriate procedure in place to reduce risk of spill to sea which may include requirements, as appropriate for vessel size, such as: + hose integrity: certified hoses are used + hose floatation: bulk hoses in the water fitted with floatation collars + hose connections: hoses used for hydrocarbons fitted with self-sealing (dry-break) connections and self-sealing break-away connections when two or more hoses are joined together + valve alignment: a vessel supervisor checks that all valves are lined up correctly + tank venting: air vents for hydrocarbon storage tanks bunded if there is a risk of spill to deck + supervision: dedicated hose watch person while pumping bulk fuel + communications: constant radio communications between two vessels + inventory control: a vessel supervisor monitors tank fill levels + emergency shutdown: vessel emergency pumping stop tested before each transfer operation	SVA-CM28-EPS-01	Audit Records. Inspection Records. Refuelling procedure.	EPO-06	**Section 7.4** **Section 7.6**
Recovery of all deployed equipment	SVA-CM29	All equipment deployed during the activity will be recovered at the end the VBA.	SVA-CM29-EPS-01	Survey records	EPO-04 EPO-06	**Section 6.4**

8.5 Leadership, accountability and responsibility

OPGGS(E)R 2009 Requirements
Regulation 14(4)
The implementation strategy must establish a clear chain of command, setting out the roles and responsibilities of personnel in relation to the implementation, management and review of the environment plan, including during emergencies or potential emergencies.

While Santos' Chief Executive Officer (CEO) has the overall accountability for the implementation of the Santos Management System and Environment, Health and Safety Policy, Santos' Manager – Offshore Drilling and Completions, is accountable for ensuring implementation, management and review of this EP.

The effective implementation of this EP requires collaboration and cooperation among Santos and its contractors. The chain of command and accountabilities of personnel in relation to the implementation, management and review of the EP is outlined in **Table 8-3**. It is also outlined in the OPEP for oil spill response.

Table 8-3: Chain of command, key leadership roles and responsibilities

Role	Responsibilities
Manager – Offshore Drilling & Completions	+ Ensures Santos' policies and standards are adhered to and communicated to all employees and contractors. + Promotes HSE as a core value integral with how Santos does its business. + Empowers personnel to 'stop-the-job' due to HSE concerns. + Provides resources for HSE management. + Ensures a high level of HSE performance and drives improvement opportunities. + Ensures emergency response plans are in place. + Maintains communication with company personnel, government agencies and the media. + Approves MoC documents, if acceptable and ALARP. + Ensures the annual HSE improvement plan is completed.
Company Site Representative	Has responsibility for: + implementing EP commitments + ensuring personnel competency + ensuring compliance with procedures and work instructions + being site focal point for onshore/offshore communications + reporting all incidents and potential hazards + leading site-based incident response + implementing corrective actions from environmental incidents and audits.

Role	Responsibilities
Vessel Master	Has overall responsibility for: + implementation and compliance with relevant environmental legislative requirements, EP commitments and operational procedures on the vessel + maintaining clear communication with personnel on board + communicating hazards and risks to the workforce + monitoring daily activities on the vessel to ensure that the relevant environmental legislative requirements, EP commitments and operational procedures are being followed + maintaining vessels to all regulatory and class requirements + maintaining their vessel in a state of preparedness for emergency response + reporting environmental incidents to PIC and ensuring subsequent actions are performed.
Santos HSE Manager	Has overall responsibility for: + ensuring incident preparedness and response arrangements meet Santos and regulatory requirements + approving the OPEP + providing ongoing resources to maintain compliance with the OPEP and other Santos incident response requirements.
Santos HSE Team Leader, Drilling and Completions	Has overall responsibility for: + Provide advice to ensure compliance with the Santos Environment Health and Safety Policy and this EP; + Providing operational HSE oversight and advice; + Facilitating the development and implementation of environmental management of change documents; + Ensuring EP-required reporting is accurate and timely; + Ensuring environmental incidents are appropriately investigated; + Ensuring that appropriate enforcement mechanisms to prevent breaches of this EP are implemented; and + Providing advice to ensure environmental incident reporting meets regulatory requirements (as outlined in the EP) and the Santos internal incident reporting and investigation procedure.

Role	Responsibilities
Senior Stakeholder Adviser	+ Ensures relevant stakeholders are identified throughout the life of the EP + Maintains a stakeholder contact and information database + Maintains a Stakeholder Notification Log specific to the EP + Maintains records of all stakeholder correspondence specific to the EP + Prior to commencement of the activity and on advice of HSE Team Lead, provides a notification to all relevant stakeholders listed, or as revised, in Table 8 4. The notification will include information on activity timing, vessel movements and vessel details + On advice of HSE Team Lead, provide cessation notifications to relevant stakeholders identified in Table 8.4 + Is available before, during and after the activity to ensure opportunities for stakeholders to provide feedback are available Prepares and distributes quarterly consultation updates to relevant stakeholders
Santos HSE Coordinator(s)	+ Ensures the EP is managed and reviewed: monitors conformance with EPOs and EPSs, and the implementation strategy in the EP. + Prepares, maintains and distributes the environmental compliance register. + Completes regular HSE reports, inspections and audits. + Completes HSE inductions and promotes general awareness. + Collates HSE data and records. + Contributes to HSE incident management and investigations. + Provides operational HSE oversight and advice. + Facilitates the development and implementation of MoC documents. + Provides incident reports, compliance reports and notifications to NOPSEMA. + Ensures stakeholder consultation and communication requirements have been fulfilled. + Ensures subcontractors are communicated the EP requirements.
HSE Team Lead – Security and Emergency Response	Has overall responsibility for: + overarching incident and crisis management responsibility + managing the Crisis Management Team and IMT personnel training program + reviewing and assessing competencies for Crisis Management Team, IMT, and field-based Incident Response Team members + managing the Duty roster system for Crisis Management Team and IMT personnel + managing the maintenance and readiness of incident response resources and equipment.
Senior Oil Spill Response Advisor	Has overall responsibility for: + providing upfront and ongoing guidance, framework, and direction on preparation of this OPEP + developing and maintaining arrangements and contracts for incident response support from third-parties + developing and defining objectives, strategies and tactical plans for response preparedness defined in this OPEP and IRP + undertaking assurance activities on arrangements outlined within the OPEP.

8.6 Workforce training and competency

OPGGS(E)R 2009 Requirements
Regulation 14(5)
The implementation strategy must include measures to ensure that each employee or contractor working on, or in connection with, the activity is aware of his or her responsibilities in relation to the environment plan, including during emergencies or potential emergencies, and has the appropriate competencies and training.

This section describes the mechanisms that will be in place, so each employee and contractor is aware of his or her responsibilities in relation to the EP and has appropriate training and competencies.

8.6.1 Inductions

All personnel on vessels will complete an induction which will include a component addressing their EP responsibilities. Induction attendance records for all personnel will be maintained. Inductions will include information about:

+ Environment, Health and Safety Policy;
+ regulatory regime (NOPSEMA regulations);
+ EPBC Act Policy Statement 2.1 and how it applies to the activity; in other words, control measures SVA-CM01 and SVA-CM23;
+ operating environment (for example, nearby protected marine areas);
+ activities with highest risk;
+ EP commitments (for example, **Table 8-2**);
+ incident reporting and notifications;
+ regulatory compliance reporting;
+ MoC process for changes to EP activities; and
+ oil pollution emergency response (for example, OPEP requirements).

8.6.2 Training and competency

All members of the workforce on the vessels will complete relevant training and/or hold relevant qualifications and certificates for their roles.

Trained Crew undertaking marine fauna observations prior to survey commencement must have proven experience in whale observation, distance estimation and reporting (as per Part A2 of the EPBC Act Policy Statement 2.1, noting that the policy statement allows for a trained crew member to undertake this role, as opposed to a marine mammal observer).

Santos and its contractors are individually responsible for ensuring that their personnel are qualified and trained. The systems, procedures and responsible persons will vary and will be managed through the use of online databases, staff on-boarding process and training departments, etc.

Personnel qualification and training records will be sampled before and/or during an activity. Such checks will be performed during the procurement process, facility acceptance testing, inductions, crew change, and operational inspections and audits.

8.6.3 Workforce involvement and communication

Daily operational meetings will be held at which HSE will be a standing agenda item. It is a requirement that supervisors attend daily operational meetings and that all personnel attend daily toolbox or pre-shift meetings. Toolbox or pre-shift meetings will be held to plan jobs and discuss work tasks, including HSE risks and their controls.

HSE performance will be monitored and reported during the activity, and performance metrics (such as the number of environmental incidents) will be regularly communicated to the workforce. Workforce involvement and environmental awareness will also be promoted by encouraging offshore personnel to report marine fauna sightings and marine pollution (for example, oil on water, dropped objects).

8.7 Emergency preparedness and response

OPGGS(E)R 2009 Requirements
Regulation 14(8)
The implementation strategy must contain an oil pollution emergency plan and provide for the updating of the plan.

Vessels are required to have and implement incident response plans, such as an emergency response plan and SMPEP or SOPEP. Regular incident response drills and exercises (for example, as defined in an emergency response plan, SMPEP or SOPEP) are performed to refresh the crew in using equipment and implementing incident response procedures.

Santos will implement the activity OPEP (SO-91-BI-20017) in the event of a hydrocarbon spill. The OPEP details how Santos will prepare and respond to a spill event and meets the requirement of the OPGGS(E)R 2009.

8.8 Incident reporting, investigation and subsequent

OPGGS(E)R 2009 Requirements
Regulation 14(2)
The implementation strategy must: (a) state when the titleholder will report to the Regulator in relation to the titleholder's environmental performance for the activity; and (b) provide that the interval between reports will not be more than 1 year. Note: Regulation 26C requires a titleholder to report on environmental performance in accordance with the timetable set out in the environment plan.
Regulation 14(7)
The implementation strategy must provide for sufficient monitoring of, and maintaining a quantitative record of, emissions and discharges (whether occurring during normal operations or otherwise), such that the record can be used to assess whether the environmental performance outcomes and standards in the environment plan are being met.

All personnel will be informed through inductions and daily operational meetings of their duty to report HSE incidents and hazards. Reported HSE incidents and hazards will be shared during daily operational meetings

and will be documented in the incident management systems as appropriate. Significant HSE incidents will be investigated using root cause analysis.

Environmental recordable and reportable incidents will be reported to NOPSEMA as required, in accordance with **Section 8.9**. The incident reporting requirements will be provided to all crew on board the facilities and support vessels with special attention to the reporting time frames to provide for accurate and timely reporting.

For the purposes of this activity, in accordance with OPGGS(E) Regulations:

+ a recordable incident, for an activity, means a breach of an EPO or EPS, in the EP that applies to the activity, that is not a reportable incident; and
+ a reportable incident, for an activity, means an incident relating to the activity that has caused, or has the potential to cause, moderate to significant environmental damage.

For the purposes of this EP, a reportable incident is an incident that is assessed to have an environmental consequence of moderate or higher in accordance with the Santos environmental impact and risk assessment process outlined in **Section 5**. Of the planned and unplanned events assessed within this EP, the following were identified to have a potential consequence level of Moderate or higher if the event were to occur and would therefore be a reportable incident:

+ Introduction of invasive marine species (Moderate); and
+ Hydrocarbon release (marine diesel oil) (Moderate).

8.9 Reporting and notifications

OPGGSR 2009 Requirements
Regulation 14(2)
The implementation strategy must: (a) state when the titleholder will report to the Regulator in relation to the titleholder's environmental performance for the activity; and (b) provide that the interval between reports will not be more than 1 year.
Regulation 14(7)
The implementation strategy must provide for sufficient monitoring of, and maintaining a quantitative record of, emissions and discharges (whether occurring during normal operations or otherwise), such that the record can be used to assess whether the environmental performance outcomes and standards in the environment plan are being met.

8.9.1 Notifications and compliance reporting

Regulatory, other notification and compliance reporting requirements are summarised in **Table 8-4**.

Table 8-4: Activity notification and reporting requirements

Initiation	Required Information	Timing	Type	Recipient
Before the activity				
Consultation with AMSA (refer **Table 4-2**)	Notification to AMSA's JRCC of proposed start and end dates and any other relevant information for the Notice to Mariners to be issued. AMSA's JRCC requires the: + vessel details (including name, callsign and Maritime Mobile Service Identity) + satellite communications details (including INMARSAT-C and satellite telephone numbers) + area of operation + requested clearance from other vessels + any other information that may contribute to safety at sea + when operations start and end.	At least 24 to 48 hours before operations commence.	Written	AMSA's JRCC
Consultation with AMSA (refer **Table 4-2**)	Contact the AHO at datacentre@hydro.gov.au no less than four weeks before operations, with details relevant to the operations. The AHO will promulgate the appropriate Notice to Mariners, which will ensure other vessels receive information about activities	No less than four weeks before operations.	Written	AHO
Consultation (refer **Table 4-2**) with: DMIRS DBCA	Notification of proposed start and end dates for each VBA.	No less than four working weeks before operations.	Written	DMIRS DBCA

Initiation	Required Information	Timing	Type	Recipient
Consultation	The activity will be included in the Quarterly Consultation Update until the activity has ended.	Quarterly	Written	The Quarterly Consultation Update is circulated to a broad group of Santos stakeholders, including many of the stakeholders identified in **Section 4**
Department of Agriculture, Water and the Environment (DAWE) – Biosecurity (vessels, aircraft and personnel) (refer **Table 4-2**)	In addition to completing an IMS Risk Assessment in accordance with SVA-CM 18, Santos will: + pursuant to the *Biosecurity Act 2015* and the *Biosecurity (Exposed Conveyances – Exceptions from Biosecurity Control) Determination 2016*, undertake a vessel biosecurity risk and be assessed as 'low' by the Commonwealth Department of Agriculture prior to interacting with domestic support vessels and aircraft + undertake pre-arrival approval for the vessels (where applicable) using the Maritime Arrivals Reporting System (MARS) to meet the DAWE biosecurity reporting obligations.	At least one month prior to activity commencement. MARS reporting at least 12 hours prior to arrival.	Written	DAWE Biosecurity (vessels, aircraft and personnel)
<u>OPGGS(E) Regulation 29 & 30 – Notifications</u> NOPSEMA must be notified that the activity is to commence	Complete NOPSEMA's Regulation 29 Start or End of Activity Notification form prior to each VBA campaign.	At least ten days before the activity commences.	Written	NOPSEMA

Initiation	Required Information	Timing	Type	Recipient
During the activity				
OPGGS(E) Regulation 26B – Recordable Incidents NOPSEMA must be notified of a breach of an EPO or EPS, in the environment plan that applies to the activity that is not a reportable incident	Complete NOPSEMA's Recordable Environmental Incident Monthly Report form.	The report must be submitted as soon as practicable after the end of the calendar month, and in any case, not later than 15 days after the end of the calendar month.	Written	NOPSEMA
OPGGS(E) Regulation 16(c), 26 & 26A – Reportable Incident NOPSEMA must be notified of any reportable incidents For the purposes of Regulation 16(c), a reportable incident is defined as: + an incident relating to the activity that has caused, or has the	The oral notification must contain: + all material facts and circumstances concerning the reportable incident known or by reasonable search or enquiry could be found out + any action taken to avoid or mitigate any adverse environmental impacts of the reportable incident + the corrective action that has been taken, or is proposed to be taken, to stop, control or remedy the reportable incident.	As soon as practicable, and in any case not later than two hours after the first occurrence of a reportable incident, or if the incident was not detected at the time of the first occurrence, at the time of becoming aware of the reportable incident.	Oral	NOPSEMA
	A written record of the oral notification must be submitted. The written record is not required to include anything that was not included in the oral notification.	As soon as practicable after the oral notification.	Written	NOPSEMA NOPTA

Initiation	Required Information	Timing	Type	Recipient
potential to cause, moderate to significant environmental damage	A written report must contain: + all material facts and circumstances concerning the reportable incident known or by reasonable search or enquiry could be found out + any action taken to avoid or mitigate any adverse environmental impacts of the reportable incident + the corrective action that has been taken, or is proposed to be taken, to stop, control or remedy the reportable incident + the action that has been taken, or is proposed to be taken, to prevent a similar incident occurring in the future. Consider reporting using NOPSEMA's Report of an Accident, Dangerous Occurrence or Environmental Incident form.	Must be submitted as soon as practicable, and in any case not later than three days after the first occurrence of the reportable incident unless NOPSEMA specifies otherwise. Same report to be submitted to NOPTA and DMIRS within seven days after giving the written report to NOPSEMA.	Written	NOPSEMA NOPTA
<u>AMSA Reporting</u> Under the Memorandum of Understanding between Santos and AMSA	Titleholder agrees to notify AMSA of any marine pollution incident[3].	Within 2 hours of incident.	Oral	AMSA
	POLREP and SITREP available online (refer OPEP).	POLREP as requested by AMSA following verbal notification. SITREP as requested by AMSA within 24 hours of request.	Written	AMSA

[3] For clarity and consistency across Santos regulatory reporting requirements Santos will meet the requirement of reporting marine oil pollution by reporting oil spills assessed to have an environmental consequence of moderate or higher in accordance with Santos' environmental impact and risk assessment process outlined in **Section 5**.

Initiation	Required Information	Timing	Type	Recipient
Director of National Parks Reporting Notification of the event of oil pollution within a marine park or where an oil spill response action must be taken within a marine park (requested through consultation)	The DNP should be made aware of oil/gas pollution incidences which occur within a marine park or are likely to impact on a marine park as soon as possible. Notification should be provided to the 24-hour Marine Compliance Duty Officer on 0419 293 465. The notification should include: + titleholder details + time and location of the incident (including name of marine park likely to be affected) + proposed response arrangements as per the OPEP (such as dispersant, containment, etc.) + confirmation of providing access to relevant monitoring and evaluation reports when available + contact details for the response coordinator. Note that the DNP may request daily or weekly Situation Reports, depending on the scale and severity of the pollution incident.	So far as reasonably practicable prior to response action being written.	Oral and written	Director of National Parks
DPIRD Reporting If marine pests or disease are suspected this must be reported to DPIRD	Notification of any suspected marine pests or diseases including any organism listed in the Western Australian Prevention List for Introduced Marine Pests and any other non-endemic organism that demonstrates invasive characteristics.	Within 24 hours.	Oral	DPIRD FishWatch
DAWE Reporting Any harm or mortality to EPBC Act- listed threatened marine fauna Marine Fauna Sighting Data	Notification of any harm or mortality to an EPBC listed species of marine fauna whether attributable to the activity or not.	Within seven days to EPBC.permits@environment.gov.au.	Written	DAWE
	Marine fauna sighting data recorded in the marine fauna sighting database.	As soon as practicable, in any case no later than three months after the end of each campaign.	Written	DAWE

Initiation	Required Information	Timing	Type	Recipient
Any harm or mortality to fauna listed as threatened under the *WA Biodiversity Conservation Act 2016*	Notification of any harm or mortality to fauna listed as a threatened species under the *WA Biodiversity Conservation Act 2016* as a result of Santos activities.	A fauna report will be submitted to DBCA Within seven days to fauna@dbca.wa.gov.au.	Written	DBCA
Australian Marine Mammal Centre Reporting Any ship strike incident with cetaceans will also be reported to the National Ship Strike database	Ship strike report provided to the Australian Marine Mammal Centre: https://data.marinemammals.gov.au/report/shipstrike.	As soon as practicable.	Written	DAWE
DBCA Reporting Impacts to marine mammals or turtles in reserves	Notification of any incidence of entanglement, boat collisions and stranding of marine mammals in the reserves and any incident of turtle mortality and incidents of entanglement in the reserves as detailed in the Management Plan for the Montebello/Barrow Islands Marine Conservation Reserves.	Within 48 hours.	Written	DBCA
Department of Transport Reporting All actual or impending MOP incidents that are in, or may impact, State waters resulting from an offshore petroleum activity	Notification of actual or impending spillage, release or escape of oil or an oily mixture that is capable of causing loss of life, injury to a person or damage to the health of a person, property or the environment.	Within two hours.	Oral	DoT
	WA DoT POLREP and SITREP available online (refer OPEP).	As requested by DoT following verbal notification.	Written	DoT
Consultation with AMSA (refer **Table 4-2**)	Notification of updates to both the AHO and the JRCC on progress and, importantly, any changes to the intended operations.	As soon as possible.	Written	AMSA's JRCC AHO

Initiation	Required Information	Timing	Type	Recipient
End of each campaign				
OPGGS(E) Regulation 26C – Environmental Performance NOPSEMA must be notified of the environmental performance at the intervals provided for in the EP	Report must contain sufficient information to determine whether or not EPO and EPS in the EP have been met.	An environmental performance report will be submitted within three months of completion the activity	Written	NOPSEMA
OPGGS(E) Regulation 29 – Notifications NOPSEMA must be notified that the activity is completed	Complete NOPSEMA's Regulation 29 Start or End of Activity Notification form.	Within ten days after finishing the activity	Written	NOPSEMA
OPGGS(E) Regulation 25A EP ends when titleholder notifies completion and the Regulator accepts the notification NOPSEMA must be notified that the activity has ended and all EP obligations have been completed	Notification advising NOPSEMA of end of all activities to which the EP relates and that all obligations have been completed.	Within six months of the final Regulation 29 (2) notification.	Written	NOPSEMA
AMSA Consultation	Notification to AMSA (JRCC) that activity has completed.	Within ten days of completion.	Written	JRCC
AMSA Consultation	Notification to AHO that activity has completed	Within ten days of completion	Written	AHO
DMIRS DBCA	Notification that activity has completed.	Within ten days of completion.	Written	DMIRS DBCA

Consultation requirements	Santos will include the activity in Quarterly Consultation Update until activity ends.	Quarterly	Written	The Quarterly Consultation Update is circulated to a broad group of Santos stakeholders, including many of the stakeholders identified in **Section 4**

8.9.2 Monitoring and recording of emissions and discharges

OPGGS(E)R 2009 Requirements
Regulation 10A(e)
Includes an appropriate implementation strategy and monitoring, recording and reporting arrangements;
Regulation 14 (7)
The implementation strategy must provide for sufficient monitoring of, and maintaining a quantitative record of, emissions and discharges (whether occurring during normal operations or otherwise), such that the record can be used to assess whether the environmental performance outcomes and standards in the environment plan are being met.

Vessel-based discharges to the marine environment, associated with this activity will be recorded and controlled in accordance with requirements under relevant marine orders.

Santos and support vessel contractors will maintain records so that emissions and discharges can be determined or estimated. Such records will be maintained for a period of five years. Contractors are required to make these records available upon request. Santos records discharges or emissions (where practicable), to the environment as described in **Table 8-5**.

Table 8-5: Monitoring methods for emissions and discharges

Discharge/emission	Parameter	Quantitative Record	Recording frequency
Chemicals (discharged to marine environment as per Section 6.6)	Volume	Chemical Risk Assessment. Volumes used will be estimated based on known inventories	For every chemical use with a fate to the marine environment
Oily water	Volume and location	Oil Record Book* or equivalent report	For every discharge
Garbage (including food scraps)	Volume and location	Garbage Record Book*	For every discharge
Sewage	Volume and location	Sewage Record Book*	For every discharge
Ballast Water	Volume and location	Ballast water record book or log**	For every discharge
Unplanned discharge of solid objects	Volume	Incident report	For every discharge
Unplanned discharge of hazardous liquids	Volume	Incident report	For every discharge
Unplanned hydrocarbon release	Volume	Incident report	For every discharge

*Maintained as per vessel class in accordance with relevant Marine Orders

** Maintained as per Australian Ballast Water Management Requirements 2017

8.10 Document management

8.10.1 Information management and document control

This EP and the associated OPEP, as well as any approved MoC documents, are controlled documents and current versions will be available on the Santos intranet. Vessel contractors are also required to maintain current versions of these documents.

EPOs and EPSs will be measured based on the measurement criteria listed in **Table 8-3**. Such records will be maintained for a period of five years. Contractors are required to make these records available upon request.

8.10.2 Management of change

Proposed changes to this EP and OPEP will be managed in accordance with the Santos Environment Management of Change Procedure (EA-91-IQ-10001). The MoC process provides a systematic approach to initiate, assess, document, approve, communicate and implement changes to EPs and OPEPs.

The MoC process considers Regulations 7, 8 and 17 of the OPGGS(E)R 2009 and determines if a proposed change can proceed and the manner in which it can proceed. The MoC procedure will determine whether a revision of the EP is required and whether that revision is to be submitted to NOPSEMA. For a change to proceed, the associated environmental impacts and risks must be demonstrated to be acceptable and ALARP. Additional stakeholder consultation may be required, depending on the nature and scale of the change. Additional information about the MoC process is provided in **Figure 8-1**.

The MoC procedure also allows for the assessment of new information that may become available after EP acceptance, such as new management plans for AMPs, new recovery plans or conservation advice for species, and changes to the EPBC Protected Matters Search results. If a review identifies new information, this is treated as a “Change that has an impact on EP”, and the MoC process is followed accordingly.

Accepted MoCs become part of the in-force EP or OPEP, are tracked on a register and are made available on Santos’ intranet. Where appropriate, the EP compliance register will be updated so that control measure or EPS changes are communicated to the workforce and implemented. Any MoC will be distributed to the management people identified in **Table 8-3** (excluding the CEO and Directors); and the most relevant management position will ensure the MoC is communicated and implemented, which may include crew meetings, briefings or communications as appropriate for the change.

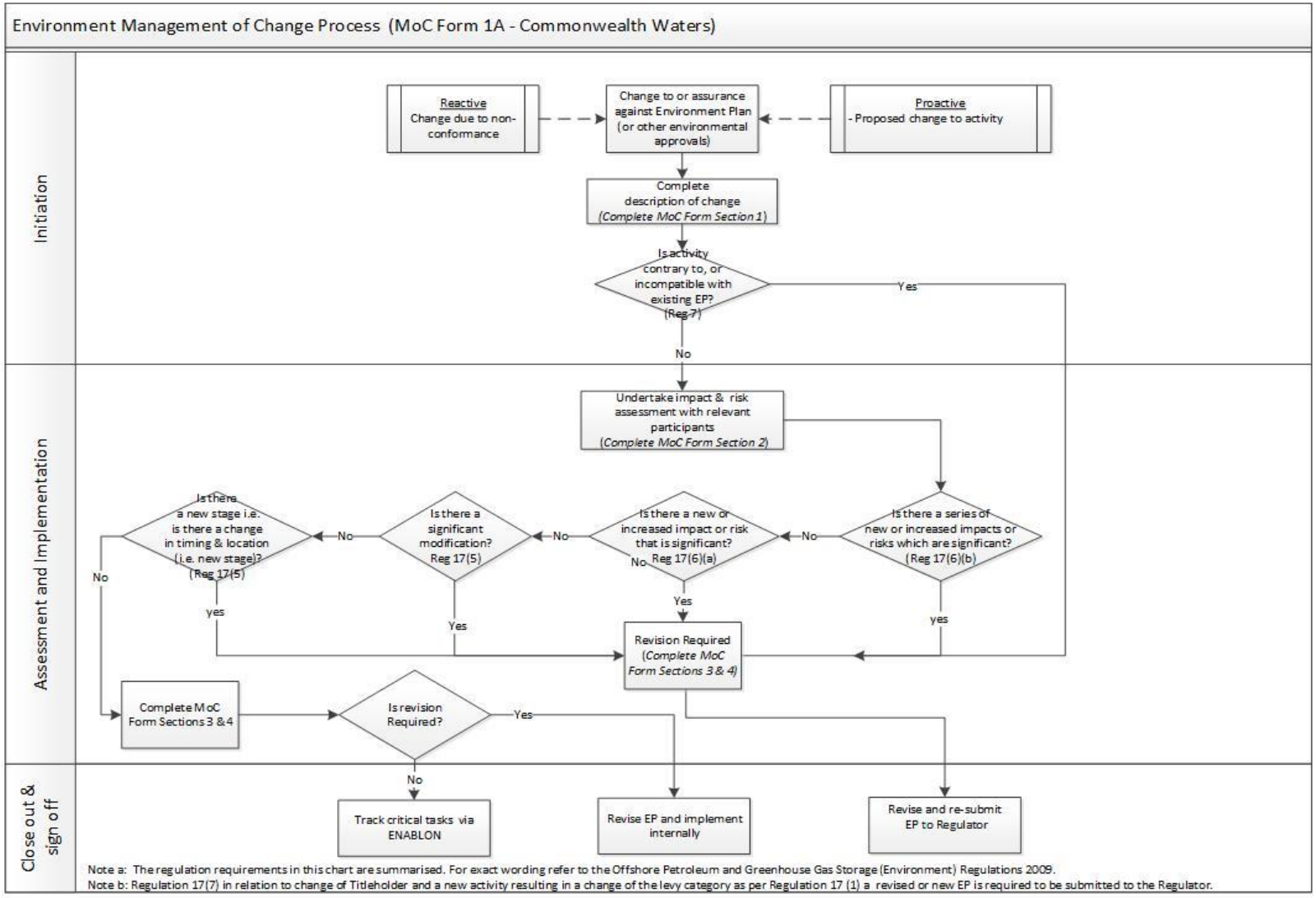

Figure 8-1: Environment management of change process (Commonwealth Waters)

8.10.3 Reviews

This EP includes an assessment of impacts and risks across the entire operational area, during any time of the year for planned and unplanned events given the nature of the 24/7 operations.

It is recognised that the following may change over the validity of the EP:

+ Legislation;
+ businesses conditions, activities, systems, processes and people;
+ industry practices;
+ science and technology; and
+ societal and stakeholder expectations.

To ensure Santos maintains up to date knowledge of the industry, legislation and conservation advice, the following tasks are undertaken:

+ Maintaining membership of APPEA, which provides a mechanism for communicating potential changes in legislation, industry practice and other issues that may affect EP implementation to relevant personnel in Santos;
+ Undertaking annual spill response exercises to check spill response arrangements and capability are adequate;
+ Identifying stakeholders prior to the activity commencing under this EP via the mechanisms outlined in **Section 4;**
+ Reviewing the Values and Sensitivities within the EMBA which includes completing a new EPBC Protected Matters Search, reviewing **APPENDIX C** against relevant legislation to capture and review any relevant updates and incorporate as required, and reviewing any recently known published relevant scientific papers;
+ Subscribing to various regulator updates; and
+ Having regular liaison meetings with Regulators.

Through maintenance of up to date knowledge, these changes are identified. If the changes have an impact on the activity or risks described and assessed in this EP, the EP will be reviewed and any changes required documented in accordance with Santos' MoC procedure (**Section 8.10.2**).

8.11 Audits and inspections

OPGGS(E)R 2009 Requirements
Regulation 14(6)
The implementation strategy must provide for sufficient monitoring, recording, audit, management of nonconformance and review of the titleholder's environmental performance and the implementation strategy to ensure that the environmental performance outcomes and standards in the environment plan are being met.

8.11.1 Audits

Santos audit plans and schedules are reviewed and updated at the beginning of each calendar year and cover all Santos facilities and activities. Santos' audit schedule may be amended to accommodate operational priorities, activity risk, personnel availability or high audit demand during certain periods (for example,

regulatory audits, contractor audits). Santos will determine if a vessel audit is required following contract award and vessel confirmation.

Audit criteria are typically a selection of control measures and environmental performance standards and outcomes, however, may also include parts of the activity description, stakeholder consultation and implementation strategies.

Audit findings may include opportunities for improvement and non-conformances. Audit non-conformances are managed as described in **Section 8.11.3**.

8.11.2 Inspections

During an activity, HSE inspections (desktop or vessel based) may be conducted during the activity to identify hazards, incidents and EP non-conformances. Any in-field opportunities for improvement or corrective actions will be discussed during the inspection with the Vessel Master.

8.11.3 Non-conformance management

EP non-conformances will be addressed and resolved by a systematic corrective action process as outlined in Santos Management System. Non-conformances arising from audits and inspections will be entered into Santos' incident and action tracking management system. Once entered, corrective actions, time frames and responsible persons (including action owners and event validators) will be assigned. Corrective action 'close out' will be monitored using a management escalation process.

8.11.4 Continuous improvement

For this EP, continuous improvement will be driven by the list below and may result in a review of the EP, with changes applied in accordance with **Section 8.10.2**:

+ Improvements identified from the review of business-level HSE key performance indicators;
+ Actions arising from Santos and departmental HSE improvement plans;
+ Corrective actions and feedback from HSE audits and inspections, incident investigations and after-action reviews;
+ Opportunities for improvement and changes identified during pre-activity reviews and MoC documents; and
+ Actions taken to address concerns and issues raised during the ongoing stakeholder management process (**Section 4**).

Identified continuous improvement opportunities will be assessed in accordance with the MoC process (**Section 8.10.2**) to ensure any potential changes to this EP or the OPEP are managed in accordance with the OPGGS(E)R and in a controlled manner.

9. References

ABARES (Australian Bureau of Agricultural and Resource Economics and Sciences) (2010). Fisheries Status Reports 2010. Australian Government.

ABARES (2018). Fisheries Status Reports 2018. Australian Government. Available from: http://www.agriculture.gov.au/SiteCollectionDocuments/abares/publications/fsr2018.pdf.

AMOSC (2011). Oil pollution emergency plan: guidelines for the Australian marine petroleum exploration and production industry. Prepared by the Australian Marine Oil Spill Centre, November 2011.

AMSA (2020). Shipping fairways network. Data provided through consultation.

AMSA (2015). Technical guidelines for preparing contingency plans for Marine and Coastal Facilities. Available from: https://www.amsa.gov.au/sites/default/files/2015-04-np-gui012-contingency-planning.pdf.

APASA (2013). Oil Spill Risk Assessment for VI Hub. Prepared for Apache Energy Ltd by Asia-Pacific Applied Science Associates, Perth, Western Australia, August 2013.

APASA (2019). Reindeer – Devil Creek Quantitative Oil Spill Risk Assessment. Report prepared by Asia-Pacific Applied Science Associates (APASA) for AEL. J0280. Reprocessed results, delivered 2019 for Santos.

Austin, M., A. McCrodan, and J. Wladichuk (2013). Underwater Sound Measurements. *In* Reider, H.J., L.N. Bisson, M. Austin, A. McCrodan, J. Wladichuk, C.M. Reiser, K.B. Matthews, J.R. Brandon, K. Leonard*, et al.* (eds.). *Marine mammal monitoring and mitigation during Shell's activities in the Chukchi Sea, July–September 2013: 90-Day Report*. Report Number P1272D–2. Technical report by LGL Alaska Research Associates Inc., Anchorage, AK, USA and JASCO Applied Sciences, Victoria, BC, Canada for Shell Gulf of Mexico, Houston, TX, USA, National Marine Fisheries Service, and US Fish and Wildlife Services. 198 pp, plus appendices. http://www.nmfs.noaa.gov/pr/pdfs/permits/shell_chukchi_openwater_90dayreport.pdf.

Austin, M.E., G.A. Warner, and A. McCrodan (2012). *Underwater Sound Propagation Acoustics Technical Report: Maersk Oil Kalaallit Nunaat A/S 2012 3D Seismic Program Block 9 (Tooq)*. Version 2.0. Technical report by JASCO Applied Sciences for Golder Associates A/S and Golder Associates Ltd. http://naalakkersuisut.gl/approximately /media/Nanoq/Files/Hearings/2012/Offentliggorelse%202011%2015/Answers/Bilag/M%C3%A6rsk%20EIA%20ENG%20Appendix%20D%201.pdf.

Baker, C, Potter, A, Tran, M & Heap, AD (2008). Sedimentology and Geomorphology of the North West Marine Region of Australia, Geoscience Australia Record 2008/07, Geoscience Australia, Canberra.

Bartol, M.S. and Musick, J.A. (2003). Sensory biology of sea turtles. In: Lutz, P.L., Musick, J.A., Wyneken, J. (eds) Biology of sea turtles, Vol II. CRC Press, Boca Raton, FL, p. 79-102.

Bartol, S.M. and D.R. Ketten (2006). *Turtle and tuna hearing*. *In*: Swimmer, Y. and R. Brill. Volume December 2006. NOAA Technical Memorandum NMFS-PIFSC-7. 98-103 p. http://www.sefsc.noaa.gov/turtles/TM_NMFS_PIFSC_7_Swimmer_Brill.pdf#page=108.

Bartol, S.M. (2008). A review of auditory function of sea turtles. *Bioacoustics* 17: 57-59. https://doi.org/10.1080/09524622.2008.9753763.

BHPB (2005). Pyrenees Development: Draft EIS. BHP Billiton, Perth, Western Australia.

CALM, MPRA (2005). Management Plan for the Ningaloo Marine Park and Muiron Islands Marine Management Area 2005–2015. Management Plan No. 52. Department of Conservation and Land Management and Marine Parks and Reserves Authority, Perth, Western Australia.

Chorney, N.E., G.A. Warner, J.T. MacDonnell, A. McCrodan, T.J. Deveau, C.R. McPherson, C. O'Neill, D.E. Hannay, and B. Riddout (2011). *Underwater Sound Measurements*. *In*: Reiser, C.M., D.W. Funk, R. Rodrigues, and D.E. Hannay (eds.). Marine mammal monitoring and mitigation during marine geophysical surveys by Shell Offshore Inc. in the Alaskan Chukchi and Beaufort Seas, July-October 2010: 90-day report. LGL Report P1171E–1. Report from LGL Alaska Research Associates Inc. and JASCO Applied Sciences for Shell Offshore Inc., National Marine Fisheries Service (US), and US Fish and Wildlife Service. 240 pp plus appendices. http://www.nmfs.noaa.gov/pr/pdfs/permits/shell_90day_report2010.pdf.

Clark, C.W., W.T. Ellison, B.L. Southall, L.T. Hatch, S.M. Van Parijs, A.S. Frankel, and D.W. Ponirakis (2009). Acoustic masking in marine ecosystems: Intuitions, analysis, and implication. *Marine Ecology Progress Series* 395: 201-222. https://doi.org/10.3354/meps08402.

Commonwealth of Australia (2020). National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds, Commonwealth of Australia 2020.

Connell, D.W. and Miller, G.J. (1981). Petroleum hydrocarbons in aquatic ecosystems – behaviour and effects of sub lethal concentrations. CRC report Critical reviews in environmental controls.

Crocker, SE and Fratantonio FD (2016). Characteristics of Sounds Emitted During High-Resolution Marine Geophysical Surveys. -NPT Technical Report 12,203. Available online: https://pdfs.semanticscholar.org/ae89/c4d56f2484a0f107af7119ed0c12c350bd70.pdf?_ga=2.226163610.1037607845.1588735571-1802879418.1588735571

DAFF (2011). Australian Ballast Water Management Requirements – Version 5. Viewed 26 march 2012, http://www.daff.gov.au/aqis/avm/vessels/quarantine_concerns/ballast/australian-ballast-water-management-requirements.l.

Day, RD, McCauley, RD, Fitzgibbon, QP, Hartmann, K and Semmens, JM. (2016). Assessing the Impact of Marine Seismic Surveys on Southeast Australian Scallop and Lobster Fisheries. Impacts of Marine Seismic Surveys on Scallop and Lobster Fisheries. University of Tasmania, Hobart, Fisheries Research & Development Corporation. FRDC Project No 2012/008: 159.

DEC (2007). Management Plan for the Montebello/Barrow Islands Marine Conservation Reserves 2007–2017: Management Plan No. 55. Department of Environment and Conservation, Perth, Western Australia.

DEC, MPRA (2007). Management Plan for the Montebello/Barrow Islands Marine Conservation Reserves 2007–2017. Management Plan No. 55. Department of Environment and Conservation and Marine Parks and Reserves Authority, Perth, Western Australia.

DEWHA (2008a). The North-west Marine Bioregional Plan: Bioregional profile: A Description of the Ecosystems, Conservation Values and Uses of the North-West Marine Region. Department of the Environment Water, Heritage and the Arts, Canberra, ACT.

DEWHA (2008b). Approved Conservation Advice for Green Sawfish. Canberra: Department of the Environment, Water, Heritage and the Arts. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/68442-conservation-advice.pdf. In effect under the EPBC Act from 07-Mar-2008.

Director of National Parks (2018a). North-west Marine Parks Network Management Plan 2018, Director of National Parks, Canberra.

Director of National Parks (2018b). North Marine Parks Network Management Plan 2018, Director of National Parks, Canberra.

DoE (2012). Conservation Management Plan for the Southern Right Whale - A Recovery Plan under the *Environment Protection and Biodiversity Conservation Act 1999* 2011–2021, Commonwealth of Australia, 2012.

DoE (2013). Recovery Plan for the White Shark (*Carcharodon carcharias*) 2013. Commonwealth of Australia.

DoE (2014). Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) 2014. Commonwealth of Australia.

DoE (2015a). Sawfish and River Sharks Multispecies Recovery Plan. DoEE, Canberra.

DoE (2015b). Conservation Management Plan for the Blue Whale—A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999. Commonwealth of Australia.

DoE (2015c). Conservation Advice *Calidris ferruginea* curlew sandpiper. Canberra: Department of the Environment. Available from: [http://www.environment.gov.au/biodiversity/threatened/species/pubs/856-conservation-advice.pdf]. In effect under the EPBC Act from 26-May-2015.

DoE (2015d). Conservation Advice *Numenius madagascariensis* eastern curlew. Canberra: Department of the Environment. Available from: [http://www.environment.gov.au/biodiversity/threatened/species/pubs/847-conservation-advice.pdf]. In effect under the EPBC Act from 26-May-2015.

Commonwealth of Australia (2017). Recovery Plan for Marine Turtles in Australia 2017–2027.

DoF (Department of Fisheries) (2012). Advice to Mr Coutts of Biofouling Solutions on "Marine Pest *Didemnum perlucidum* in Western Australian Waters". Unpublished letter dated 23 July 2012.

Dow Piniak W.E. (2012). Acoustic Ecology of Sea Turtles: Implications for Conservation. PhD thesis, Marine Science and Conservation Duke University. pp 136. Accessed online on 07/06/2019 at: https://dukespace.lib.duke.edu/dspace/bitstream/handle/10161/6159/Piniak_duke_0066D_11691.pdf?sequence=1.

DPIF (2015). Overview and Outlook 2015. Department of Primary Industry and Fisheries (DPI&F).

DSEWPaC (2012). Marine bioregional plan for the North-West marine region. Available online at: https://www.environment.gov.au/system/files/pages/1670366b-988b-4201-94a1-1f29175a4d65/files/north-west-marine-plan.pdf [Accessed 16/10/20].

Director of National Parks (DNP) (2018). North-west Marine Parks Network Management Plan 2018, Director of National Parks, Canberra. Available online: https://parksaustralia.gov.au/marine/pub/plans/north-west-management-plan-2018.pdf.

DSEWPaC (Department of Sustainability, Environment, Water, Population and Communities) (2011a). National recovery plan for threatened albatrosses and giant petrels 2011-2016. Commonwealth of Australia, Hobart.

DSEWPaC (2011b). Approved Conservation Advice for *Sternula nereis nereis* (Fairy Tern). Canberra, ACT: Department of Sustainability, Environment, Water, Population and Communities. Available from: [http://www.environment.gov.au/biodiversity/threatened/species/pubs/82950-conservation-advice.pdf]. In effect under the EPBC Act from 03-Mar-2011.

DSEWPaC (2013). Approved Conservation Advice for *Rostratula australis* (Australian painted snipe). Canberra: Department of Sustainability, Environment, Water, Population and Communities. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/77037-conservation-advice.pdf. In effect under the EPBC Act from 15-May-2013.

Ecotox Services Australia (2009). Toxicity Assessment of Weathered and Un-Weathered Brecknock-2, Calliance-1 and Torosa-4 Condensate Samples. Test Report for Woodside Energy Ltd. June 2009.

EPA (2010). Environmental Assessment Guideline for Protecting Marine Turtles from Light Impacts. Environmental Assessment Guideline No. 5. Environmental Protection Authority Western Australia. November 2010.

Ferrara, C.R., R.C. Vogt, R.S. Sousa-Lima, B.M.R. Tardio, and V.C.D. Bernardes. (2014). Sound communication and social behaviour in an Amazonian river turtle (*Podocnemis expansa*). *Herpetologica* 70(2): 149-156. https://doi.org/10.1655/HERPETOLOGICA-D-13-00050R2.

French-McCay, D.P. (2002). Development and Application of an Oil Spill Toxicity and Exposure Model, OilToxEx. Environmental Toxicology and Chemistry 21(10): 2080-2094.

French-McCay, D. (2009). *State-of-the-art and research needs for oil spill impact assessment modeling*, in: Proceedings of the 32nd AMOP Technical Seminar on Environmental Contamination and Response. Presented at the 32nd AMOP Technical Seminar on Environmental Contamination and Response, Environment Canada, Ottawa, pp. 601–653.

Fugro (2016). Noble Tom Prosser Geophysical Site Surveys, Roc-1 Field Report. Report No. GP1512_FR03. Issued to Quadrant Energy 08/07/15.

GHD (2021). Stairway-1 Diesel Spill Modelling Report. Report prepared for Santos Energy Limited. May 2021.

Gordon, J., Gillespie, D., Potter, J., Frantzis, A., Simmonds, M.P., Swift, R. and Thomson, D. (2004). A Review of the Effects of Seismic Surveys on Marine Mammals. Marine Technology Society Journal 37: 16–34.

Harewood, A. & Horrocks, J.A. (2008) Impacts of coastal development on hawksbill hatchling survival and swimming success during the initial offshore migration. Biological Conservation, 141, 394-401.

Heyward A, Pinceratto E, Smith L (1997) Big bank shoals of the Timor Sea: an environmental resource atlas.

Heyward, A., Moore, C., Radford, B., & Colquhoun, J. (2010). Monitoring program for the Montara well release Timor Sea: final report on the nature of Barracouta and Vulcan Shoals. Report prepared by the Australian Institute of Marine Science for PTTEP AA, Perth, Western Australia.

Australian Institute of Marine Science, Melbourne. Higgins PJ & Davies SJJF eds (1996). Handbook of Australian, New Zealand and Antarctic Birds. Volume Three - Snipe to Pigeons. Melbourne, Victoria: Oxford University Press.

Heyward, A., Jones, R., Meeuwig, J., Burns, K., Radford, B., Colquhoun, J., Cappo, M., Case, M., O'Leary, R., Fisher, R., Meekan, M., Stowar, M. (2012). Montara: 2011 offshore banks assessment survey (Monitoring Study No. S5 Banks & Shoals). Australian Institute of Marine Science, Townsville, Queensland.

Hu, Z., H. Hu, & Huang, Y. (2018) Association between nighttime artificial light pollution and sea turtle nest density along Florida coast: A geospatial study using VIIRS remote sensing data. Environmental Pollution, 239: 30-42.

ITOPF (2011). ITOPF Members Handbook 2011/12. Prepared by the International Tanker Owners Pollution Federation Ltd. http://www.itopf.com/news-and-events/documents/itopfhandbook2011.pdf (Accessed: 2 December 2011).

Jadestone Energy (2019). Summary of Montara Operations Environment Plan. Available online at: https://docs.nopsema.gov.au/A691526

Jenner, K.C.S., Jenner, M-N.M. and McCabe, K.A. (2001). Geographical and temporal movements of humpback whales in Western Australian waters. APPEA Journal 41: 749-765.

Jensen, A.S. and Silber, G.K. (2003). Large whale ship strike database. U.S. Department of Commerce. National Oceanic and Atmospheric Administration. Technical Memorandum NMFS-OPR-25. pp.37.

Kamrowski R.L., Limpus C., Pendoley K. & Hamann M. (2014) Influence of industrial light pollution on the sea-finding behaviour of flatback turtle hatchlings. Wildlife Research 41: 421-434.

Kebodeaux, T.R. (1994) Increased sea turtle sightings present no cause for concern. Underwater Magazine

Ketten, D.R. and S.M. Bartol (2005). *Functional measures of sea turtle hearing*. ONR project final report. Document Number ONR Award Number N00014-02-1-0510. Office of Naval Research (US).

Koops, W., Jak, R.G. and van der Veen, D.P. (2004). Use of dispersants in oil spill response to minimise environmental damage to birds and aquatic organisms. Trondheim, Norway: Interspill 2004.

Ladich, F. and R.R. Fay (2013). Auditory evoked potential audiometry in fish. *Reviews in Fish Biology and Fisheries* 23(3): 317-364. https://doi.org/10.1007/s11160-012-9297-z.

Laist, D.W., Knowlton, A.R., Mead, J.G., Collet, A.S. and Podesta, M. (2001). Collisions between ships and whales. Marine Mammal Science 17(1): 35–75.Last, P.R. and Stevens, J.D. (2009). Sharks and Rays of Australia (Second Edition). Collingwood, Victoria: CSIRO Publishing.

Lavender, A.L., S.M. Bartol, and I.K. Bartol (2012). Hearing capabilities of loggerhead sea turtles (*Caretta caretta*) throughout ontogeny. *In* Popper, A.N. and A.D. Hawkins (eds.). *The Effects of Noise on Aquatic Life*. Volume 730. Springer. pp. 89-92. https://doi.org/10.1007/978-1-4419-7311-5_19.

Lavender, A.L., S.M. Bartol, and I.K. Bartol (2014). Ontogenetic investigation of underwater hearing capabilities in loggerhead sea turtles (*Caretta caretta*) using a dual testing approach. *Journal of Experimental Biology* 217(14): 2580-2589. https://jeb.biologists.org/content/217/14/2580.

Lindquist, D.C., Shaw, R.F. and Hernandez Jr, F.J. (2005). Distribution patterns of larval and juvenile fishes at off shore petroleum platforms in the north central Gulf of Mexico. Estuarine, Coastal and Shelf Science 62: 655-665.

Limpus, CJ (1971). Sea turtle ocean finding behaviour. Search, vol. 2, pp. 385–387.

Limpus, C.J. (2007). A biological review of Australian marine turtle species. 5. Flatback turtle, Natator depressus (Garman). The State of Queensland. Environmental Protection Agency.

Limpus, C.J. (2008a). A biological review of Australian marine turtle species. 1. Loggerhead turtle, Caretta caretta (Linneaus). The State of Queensland. Environmental Protection Agency, Australia.

Limpus, C.J. (2008b). A biological review of Australian marine Turtles 2. Green Turtle Chelonia mydas (Linnaeus). The State of Queensland, Environmental Protection Agency, Australia.

Limpus, C.J. (2009a). A biological review of Australian marine turtle species. 3. Hawksbill turtle, Eretmochelys imbricata. The State of Queensland. Environmental Protection Agency, Australia.

Limpus, C.J. (2009b). A biological review of Australian marine turtle species. 6. Leatherback turtle, Dermochelys coriacea (Vandelli). The State of Queensland. Environmental Protection Agency, Australia.

Limpus, C. and Kamrowski, R.L. (2013). Ocean-finding in marine turtles: the importance of the low horizon elevation as an orientation cue. Behaviour, Vol. 150, issue 8.

Limpus, C.J., Parmenter, C.J. & Chaloupka, M. (2013) Monitoring of coastal sea turtles: Gap analysis 5. Flatback turtles, Natator depressus, in the Port Curtis and Port Alma region. Report produced for the Ecosystem Research and Monitoring Program Advisory Panel as part of Gladstone Ports Corporation's Ecosystem Research and Monitoring Program.

Lohmann, C.M.F. & Lohmann, K.J. (1992) Geomagnetic orientation by sea turtle hatchlings. In: Proceedings of the 12th International Symposium on Sea Turtle Biology and Conservation (eds. J.I. Richardson & T.H. Richardson), Jekyll Island.

Lorne, J.K. & Salmon, M. (2007) Effects of Exposure to Artificial Lighting on Orientation of Hatchling Sea Turtles on the Beach and in the Ocean. Endangered Species Research, 3: 23-30.

Martin, B., J.T. MacDonnell, N.E. Chorney, and D.G. Zeddies (2012). Appendix A: Sound Source Verification of Fugro Geotechnical Sources. *In ESS Group, Inc. Renewal Application for Incidental Harassment Authorization for the Non-Lethal Taking of Marine Mammals Resulting from Pre-Construction High Resolution Geophysical Survey*. For Cape Wind Associates, LLC. http://www.nmfs.noaa.gov/pr/pdfs/permits/capewind_iha_application_renewal.pdf.

Marquenie, J., Donners, M., Poot, H., Steckel, W. and de Wit, B. (2008). Adapting the spectral composition of artificial lighting to safeguard the environment. pp 1-6.

McCauley, R. (1998). Radiated underwater noise measured from the drilling rig Ocean General, rig tenders Pacific Ariki and Pacific Frontier, fishing vessel Reef Venture and natural sources in the Timor Sea, Northern Australia. (Report No. C98-20). Centre for Marine Science and Technology, Curtin University of Technology, Perth, Western Australia.

McCauley, R.D, Fewtrell, J., Duncan, A.J., Jenner, C., Jenner, M-N., Penrose, J.D., Prince, R.I.T., Adhitya, A., Murdoch, J., and McCabe, K. (2000). Marine Seismic Surveys- A Study of Environmental Implications, APPEA Journal, pp. 692-708.

McCauley, R.D. (2011). Woodside Kimberley sea noise logger program, Sept-2006 to June-2009: Whales, fish and man-made noise. Report produced for Woodside Energy Ltd, 86 pp.

McCauley, R.D., R.D. Day, K.M. Swadling, Q.P. Fitzgibbon, R.A. Watson, and J.M. Semmens (2017). Widely used marine seismic survey air gun operations negatively impact zooplankton. Nature Ecology & Evolution 1(7): 1-8. https://doi.org/10.1038/s41559-017-0195.

McPherson, C.R., J.E. Quijano, M.J. Weirathmueller, K.R. Hiltz, and K. Lucke (2019). *Browse to North-West-Shelf Noise Modelling Study: Assessing Marine Fauna Sound Exposures*. Document Number 01824, Version 2.0. Technical report by JASCO Applied Sciences for Jacobs. https://www.epa.wa.gov.au/sites/default/files/PER_documentation2/Appendix%20D%203.pdf.

McPherson, C. R. and M. A. Wood (2017). Otway Basin Geophysical Operations Acoustic Modelling: Acoustic Modelling for Assessing Marine Fauna Sound Exposures, Technical report by JASCO Applied Sciences for Lattice Energy. Appendix C of Beach Energy Environment Plan, Otway Geophysical and Geotechnical Seabed Assessment.

Meekan, M.G., Wilson, S.G., Halford, A. and Retzel, A. (2001). A comparison of catches of fishes and invertebrates by two light trap designs, in tropical NW Australia. Marine Biology 139: 373–381.

Milicich, M.J., Meekan, M.G. and Doherty, P.J. (1992). Larval supply: a good predictor of recruitment in three species of reef fish (Pomacentridae). Mar Ecol Prog Ser. 86: 153-166.

Neil, km, Hilliard, RW, Clark, P, Russell, B, Clark, R and Polglaze, J (2005) Situation and Gaps Analysis of Introduced Marine Species, Vectors, Nodes and Management Arrangements for the Northern Planning Area, Report published by the National Oceans Office (Marine Division, Department of Environment and Heritage), Canberra.

NRDAMCME (1997). The CERCLA Type A Natural Resource Damage Assessment Model for Coastal and Marine Environments (NRDAMCME) Technical Documentation Vol 4, 14 -42. http://www/doi.gov/oepc/oepcbb.html.

NMFS (National Marine Fisheries Service) (2014). *Marine Mammals: Interim Sound Threshold Guidance* (webpage). National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce. http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/threshold_guidance.html.

NMFS (National Marine Fisheries Service) (2018). 2018 Revision to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Department of Commerce, NOAA. NOAA Technical Memorandum NMFS-OPR-59.

NRC (2003). Ocean Noise and Marine Mammals. Summary Review for the National Academies National Research Council by the National Research Council. The National Academies Press, Washington D.C, United States.

Payne, JF., Andrews, CD., Fancey, LL., Guiney, J., Cook, A and Christian, JR. (2008). "Are seismic surveys an important risk factor for fish and shellfish?" Bioacoustics 17(1-3): 262-265.

Peel, D.S., Joshua N., Childerhouse S. (2018). Vessel Strike of Whales in Australia: The Challenges of Analysis of Historical Incident Data. Frontiers in Marine Science, Vol. 5 69pp. Available online: https://www.frontiersin.org/articles/10.3389/fmars.2018.00069/full.

Pendoley Environmental (2011). Varanus Island Marine Turtle Tagging Programme 2010–2011 Nesting Season. Report to Apache Energy by Pendoley Environmental Pty Ltd.

Piniak, W.E., D.A. Mann, S.A. Eckert, and C.A. Harms (2011). Amphibious hearing in sea turtles. *In*: Hawkins, T. and A.N. Popper (eds.). *2nd International Conference on the Effects of Noise on Aquatic Life*. 15-20 Aug 2010. Springer-Verlag, Cork, Ireland.

Poot, H., Ens, B. J., de Vries, H., Donners, M. A. H., Wernand, M. R. and Marquenie, J. M. (2008). Green light for nocturnally migrating birds. Ecology and Society 13(2): 47.

Prince, R.I.T. (2001). Aerial survey of the distribution and abundance of dugongs and associated macroinvertebrate fauna- Pilbara Coastal and Offshore Region, W.A. Report to Environment Australia.

Prince, R.I.T. and Chaloupka, M. (2011). Estimating demographic parameters for a critically endangered marine species with frequent reproductive omission: hawksbill turtles nesting at Varanus Island, Western Australia. Marine Biology 159(2): 355-363.

Richardson, W.J., Greene, C.R., Malme, C.I. and Thomson, D.H. (1995). Marine Mammals and Noise Academic Press, San Diego, California.

Ridgway, S.H., FOR EXAMPLE, Wever, J.G. McCormick, J. Palin, and J.H. Anderson (1969). Hearing in the giant sea turtle, *Chelonia mydas*. *Proceedings of the National Academy of Sciences* 64(3): 884-890. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC223317/pdf/pnas00113-0080.pdf.

Ripley, J.L. (2006). Effects of Environmental Factors on the Paternal Brood Pouch and Sound Production in Two Sympatric Pipefish Species from the Chincoteague Bay, Virginia. Dissertation submitted to the Eberly College of Arts and Sciences at West Virginia University. Department of Biology, Morgantown, West Virginia.

RPS (2008). Marine Baseline Studies - Apache Devil Creek Development Project, report prepared for Apache Energy Limited.

RPS (2019b). Draft Dorado Benthic Habitat Survey Report. Study commissioned by Santos WA.

Salerno, J., Little, B., Lee, J., Ray, R., and Hamdan, L.J. (2016). Conserving archaeological sites as biological and historical resources in the Gulf of Mexico: the effects of crude oil and dispersant on the biodiversity and corrosion potential of shipwreck bacterial biofilms. American Geophysical Union's Ocean Sciences Meeting. New Orleans, February 22, 2016.

Salmon, M. and Wyneken, J. (1994). Orientation by hatchling sea turtles: mechanisms and implications. Herpetological Natural History, vol. 2, pp. 13–24.

Salmon, M., & Witherington, B. (1995) Artificial lighting and seafinding by loggerhead hatchlings: Evidence for lunar modulation. Copeia, 1995: 931 – 938.

Salmon, M., (2003) Artificial night lighting and sea turtles. Biologist, 50: 163-168.

Shaw, R.F., Lindquist, D.C., Benfield, M.C., Farooqi, T. and Plunket, J.T. (2002). Offshore petroleum platforms: functional significance for larval fish across longitudinal and latitudinal gradients. Prepared by the Coastal Fisheries Institute, Louisiana State University. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2002-077, p. 107.

Silber, K,G., & S. Bettridge (2012). An assessment of the final rule to implement vessel speed restrictions to reduce the threat of vessel collisions with North Atlantic Right Whales. NOAA Technical Memorandum NMFS-OPR-48. February 2012.

Simmonds, M.P., Dolman, S.J. and Weilgart, L. (eds). (2004). Oceans of Noise [Online]. http://www.wdcs.org/submissions_bin/OceansofNoise.pdf. AWDCS Science Report Published by the Whale and Dolphin Conservation Society.

Southall, B.L., Bowles, A.E., Ellison, W.T., Finneran, J.J., Gentry, R.L., Greene Jr., C.R., Kastak, D., Ketten, D.R., Miller, J.H., Nachtigall, P.E., Richardson, W.J., Thomas, J.A. and Tyack, P.L. (2007). Marine mammal noise exposure criteria: Initial scientific recommendations. *Aquatic Mammals* 33(4):1–121.

Stapput, K. & Wiltschko, W. (2005). The sea-finding behaviour of hatchling olive ridley sea turtles, Lepidochelys olivacea, at the beach of San Miguel (Costa Rica). Naturwissenschaften, 92(5): 250-253.

Surman, C. (2002). Survey of the marine avifauna at the Laverda-2 appraisal well (WA-271-P) Enfield Area Development and surrounding waters. Report prepared for Woodside Energy Ltd., Perth.

Threatened Species Scientific Committee (2015a). Conservation Advice *Megaptera novaeangliae* humpback whale. Canberra: Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/38-conservation-advice-10102015.pdf. In effect under the EPBC Act from 01-Oct-2015.

Threatened Species Scientific Committee (2015b). Conservation Advice *Rhincodon typus* whale shark. Canberra: Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/66680-conservation-advice-01102015.pdf. In effect under the EPBC Act from 01-Oct-2015.

Threatened Species Scientific Committee (2015c). Conservation Advice *Balaenoptera physalus* fin whale. Canberra: Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/37-conservation-advice-01102015.pdf. In effect under the EPBC Act from 01-Oct-2015.

Threatened Species Scientific Committee (2015d). Conservation Advice *Balaenoptera borealis* sei whale. Canberra: Department of the Environment. Available

from:[http://www.environment.gov.au/biodiversity/threatened/species/pubs/34-conservation-advice-01102015.pdf]. In effect under the EPBC Act from 01-Oct-2015.

Threatened Species Scientific Committee (2015e). Conservation Advice *Pterodroma Mollis* soft-plumaged petrel. Canberra: Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/1036-conservation-advice-01102015.pdf. In effect under the EPBC Act from 01-Oct-2015.

Threatened Species Scientific Committee (2016a). Conservation Advice *Calidris canutus* Red knot. Canberra: Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/855-conservation-advice-05052016.pdf]. In effect under the EPBC Act from 05-May-2016.

Threatened Species Scientific Committee (2016b). Conservation Advice *Limosa lapponica menzbieri* Bar-tailed godwit (northern Siberian). Canberra: Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/86432-conservation-advice-05052016.pdf. In effect under the EPBC Act from 05-May-2016.

Thums, M., Whiting, S.D, Reisser, J.W., Pendoley, K.L., Pattiaratchi C.B., Harcourt, R.G., Mcmahon, C.R. & Meekan, M.G. (2013) Tracking sea turtle hatchlings—A pilot study using acoustic telemetry. Journal of Experimental Marine Biology and Ecology, 440: 156-163.

Thums, M., Whiting, S.D., Reisser, J., Pendoley, K.L., Pattiaratchi, C.B., Proietti, M., Meekan, M.G. (2016) Artificial light on water attracts turtle hatchlings during their near shore transit. Royal Society Open Science, 3(5), 160142.

Urick, R.J. (1983). *Principles of Underwater Sound*. 3rd edition. McGraw-Hill, New York, London. 423 p.

Walker, D.I and McComb, A.J. (1990). Salinity response of the seagrass Amphibolus antarctica: an experimental validation of field results. Aquatic Botany 36: 359-366.

Warner, G.A. and A. McCrodan (2011). Underwater Sound Measurements. (Chapter 3) *In* Hartin, K.G., L.N. Bisson, S.A. Case, D.S. Ireland, and D.E. Hannay (eds.). *Marine mammal monitoring and mitigation during site clearance and geotechnical surveys by Statoil USA E&P Inc. in the Chukchi Sea, August-October 2011: 90-day report. LGL Rep. P1193*. Report by LGL Alaska Research Associates, Inc. and JASCO Research Ltd. for Statoil USA E&P Inc., NMFS, and USFWS. p. 202 + appendices. ftp://wkst189.oar.noaa.gov/noaa_documents.lib/NMFS/Auke%20Bay/AukeBayScans/Removable%20Disk/p1192.pdf.

WDCS (2004). Oceans of Noise. Whale and Dolphin Conservation Society (Online). Available from: http:www.wdcs.org/stop/pollution/index.php.

Wells, F.E., McDonald, J.I. and Huisman, J.M. (2009). Introduced marine species in Western Australia. Published by the Department of Fisheries, Perth, WA.

Wiese, F.K., Montevecchi, W.A., Davoren G.K., Huettmann F., Diamond A.W. and Linke, J. (2001). Seabirds at Risk around Offshore Oil Platforms in the North-west Atlantic. Marine Pollution Bulletin Vol. 42, No. 12, pp. 1285-1290.

Wilson, P., Thums, M., Pattiaratchi, C., Meekan, M., Pendoley, K., Fisher, R. & Whiting, S. (2018) Artificial light disrupts the nearshore dispersal of neonate flatback turtles Natator depressus. Marine Ecology Progress Series, 600, 179-192. doi:https://doi.org/10.3354/meps12649

Wilson, P., Thums, M., Pattiaratchia, C., Whiting, S., Meekan, M., Pendoley, K. (submitted) Nearshore wave characteristics as cues for swimming orientation in flatback turtle hatchlings.

Wilson, P., Thums, M., Pattiaratchi, C., Whiting, S., Pendoley, K., Ferreira, L. C. & Meekan, M. (2019) High predation of marine turtle hatchlings near a coastal jetty. Biological Conservation, 236: 571-579.

Witherington, B.E. (1992). Behavioral responses of nesting sea turtles to artificial lighting. Herpetologica, 48: 31–39.

Witherington, B.E. & K.A. Bjorndal (1991) Influences of artificial lighting on the seaward orientation of hatchling loggerhead turtles *Caretta caretta*. Biological Conservation 55(2): 139-149.

Witherington, B.E. and Martin, R.E. (2003). Understanding, assessing and resolving light-pollution problems on sea turtle nesting beaches. Florida Marine Research Institute Technical Report TR-2 3rd Edition Revised, Florida Department of Environmental Protection, Tequesta, Florida, United States of America.

Wood, M. A. and C. R. McPherson (2019). Supplemental modelling results for Otway Basin Geophysical Operations Acoustic Modelling: Acoustic Modelling for Assessing Marine Fauna Sound Exposures, Technical note by JASCO Applied Sciences for Lattice Energy. Appendix D of Beach Energy Environment Plan, Otway Geophysical and Geotechnical Seabed Assessment.

Woodside (2008). Torosa South-1 Pilot Appraisal Well Environment Plan. Woodside Energy, Perth.

Yudhana, A., J.D. Sunardi, S. Abdullah, and R.B.R. Hassan (2010). Turtle hearing capability based on ABR signal assessment. *Telkomnika* 8: 187-194.

Zykov, M.M. (2013). *Underwater Sound Modeling of Low Energy Geophysical Equipment Operations*. Document Number 00600, Version 2.0. Technical report by JASCO Applied Sciences for CSA Ocean Sciences. https://www.slc.ca.gov/wp-content/uploads/2018/09/AppG.pdf.

APPENDIX A
Santos Environment, Health and Safety Policy

Santos

Environment, Health & Safety

SMS Santos

Policy

Our Commitment

Santos is committed to being the safest gas company wherever we have a presence and preventing harm to people and the environment

Our Actions

We will:

1. Integrate environment, health and safety management requirements into the way we work
2. Comply with all relevant environmental, health and safety laws and continuously improve our management systems
3. Include environmental, health and safety considerations in business planning, decision making and asset management processes
4. Identify, control and monitor risks that have the potential for harm to people and the environment, so far as is reasonably practicable
5. Report, investigate and learn from our incidents
6. Consult and communicate with, and promote the participation of all workers to maintain a strong environment, health and safety culture
7. Empower our people, regardless of position, to "Stop the Job" when they feel it necessary to prevent harm to themselves, others or the environment
8. Work proactively and collaboratively with our stakeholders and the communities in which we operate
9. Set, measure, review and monitor objectives and targets to demonstrate proactive processes are in place to reduce the risk of harm to people and the environment
10. Report publicly on our environmental, health and safety performance

Governance

The Environment Health Safety and Sustainability Committee is responsible for reviewing the effectiveness of this policy.

This policy will be reviewed at appropriate intervals and revised when necessary to keep it current.

Kevin Gallagher

Managing Director & CEO

Status: APPROVED

Document Owner:	Jodie Hatherly, General Counsel and VP Legal, Risk and Governance		
Approved by:	The Board	Version:	3

20 August 2019

APPENDIX B
Regulatory Framework of Relevant Legislation

Commonwealth Legislation	Summary	Relevant to activity?	Administering Authority	Relevant aspects of the activity	EP Section
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 the discovery of Aboriginal remains to be reported to the Minister.	No	Commonwealth – DAWE	There are no known sites of Aboriginal Heritage Significance within the operational area or EMBA.	N/A
Australian Ballast Water Requirements, Version 7	Australian Ballast Water Management Requirements outline the mandatory ballast water management requirements to reduce the risk of introducing harmful aquatic organisms into Australia's marine environment through ballast water from international vessels. These requirements are enforceable under the *Biosecurity Act 2015*.	Yes	Commonwealth – DAWE	Potential internationally sourced vessel operating in Australian Waters which could have the potential for introduction of Invasive Marine Species and potential ballast water exchange.	**Section 7.1** – Introduction of IMS
Australian Heritage Council Act 2003	This Act identifies areas of heritage value listed on the Register of the National Estate and sets up the Australian Heritage Council and its functions.	Yes	Australian Heritage Council	There is one national heritage places found on the National Heritage List, within the EMBA, as identified by the Act.	**Section 7.6** – Release of hydrocarbons
Australian Maritime Safety Authority Act 1990 (AMSA Act)	This Act specifies that the AMSA's 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. AMSA is the spill control agency for shipping sourced spill in Commonwealth waters. Facilitates international cooperation and mutual assistance in preparing and responding to a major oil spill incident and encourages countries to develop and maintain an adequate capability to deal with oil	Yes	AMSA	This Act applies to the use of any vessel associated with operations and is relevant to the activity in regards to the unplanned pollution from vessels.	**Section 7.6** – Release of hydrocarbons

Commonwealth Legislation	Summary	Relevant to activity?	Administering Authority	Relevant aspects of the activity	EP Section
	pollution emergencies. Requirements are given effect through AMSA. AMSA is the lead agency for responding to oil spills in the marine environment and is responsible for the Australian National Plan for Maritime Environmental Emergencies.				
Marine Orders	Marine Orders (MO) are subordinate rules made pursuant to the *Navigation Act 2012* and *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* affecting the maritime industry. They are a means of implementing Australia's international maritime obligations by giving effect to international conventions in Australian law.	Yes	AMSA	Vessel movements, safety, discharges and emissions	**Section 6** – Planned activities **Section 7** – Unplanned activities
Aquatic Resources Management Act 2016	This Act will be the primary legislation used to manage fishing, aquaculture, pearling and aquatic resources in Western Australia. The Act was scheduled for commencement on 1 January 2019, however, this has been deferred while an amendment to the Act is progressed.	Yes	Department of Primary Industries and Regional Development	Vessel movements have the potential to introduce IMS.	**Section 7.1** – Introduction of IMS
Maritime Powers Act 2013	Protects the heritage values of shipwrecks and relics for shipwrecks over 75 years. It is an offence to interfere with a shipwreck covered by this Act. Available historic shipwreck locations covered by international conventions enacted by this legislation have been identified and assessed (as applicable) within this EP.	No	The Department of Immigration and Border Protection	This Act applies to the shipwrecks (over 75 years old) within the EMBA. There is no planned interaction or interference with shipwrecks, and any unplanned impacts is only expected to affect the surface waters.	N/A

Commonwealth Legislation	Summary	Relevant to activity?	Administering Authority	Relevant aspects of the activity	EP Section
Biosecurity Act 2015 *Biosecurity Regulations 2016*	This Act provides the Commonwealth with powers to take measures of quarantine, and implement related programs as are necessary, to prevent the introduction of any plant, animal, organism or matter that could contain anything that could threaten Australia's native flora and fauna or natural environment. The Commonwealth's powers include powers of entry, seizure, detention and disposal. This Act includes mandatory controls on the use of seawater as ballast in ships and the declaration of sea vessels voyaging out of and into Commonwealth waters. The Regulations stipulate that all information regarding the voyage of the vessel and the ballast water is declared correctly to the quarantine officers.	Yes	Commonwealth – DAWE	Potential internationally-sourced vessel operating in Australian Waters which could have the potential for introduction of Invasive Marine Species and potential ballast water exchange.	**Section 7.1** – Introduction of IMS
Environment Protection and Biodiversity Conservation Act 1999 *Environment Protection and Biodiversity Conservation Amendment Regulations 2006*	The Act aims to: + protect MNES + provide for Commonwealth environmental assessment and approval processes + provide an integrated system for biodiversity conservation and management of protected areas.	Yes	Commonwealth – Department of Agriculture, Water and the Environment	The activity involves potential impacts to MNES which are threatened and migratory species;	**Section 6.2** – Light emissions **Section 6.1** – Acoustic disturbance to marine fauna **Section 6.6** – operational discharges **Section 7.6 -** Release of hydrocarbons
Environment Protection and Biodiversity Conservation Act	The Declaration of Ningaloo Marine Park in Commonwealth Waters.	Yes	Commonwealth – Department of Agriculture, Water and the Environment	Unplanned hydrocarbon/chemical release	**Section 7.6** – Release of hydrocarbons

Commonwealth Legislation	Summary	Relevant to activity?	Administering Authority	Relevant aspects of the activity	EP Section
1999 - Proclamation – Ningaloo Marine Park (Commonwealth Waters)					
Historic Shipwrecks Act 1976 *Historic Shipwrecks Regulations 2018*	This Act protects shipwrecks that have lain in territorial waters for 75 years or more. It is an offence to interfere with any shipwreck covered by the Act. Note: Act and Regulations planned to be repealed on commencement of *Underwater Cultural Heritage Act 2018*.	No	Commonwealth – Department of Agriculture, Water and the Environment	This Act applies to the shipwrecks (over 75 years old) within the EMBA. There is no planned interaction or interference with shipwrecks, and any unplanned impacts is only expected to affect the surface waters.	N/A
Underwater Cultural Heritage Act 2018	This Act extends protection provided under the *Historic Shipwrecks Act 1976* to other wrecks such as submerged aircraft and human remains. It also increases penalties applicable to damaged sites. Commencement date of Act to be proclaimed, but will commence at latest on 24 August 2019.	No	Commonwealth – Department of Agriculture, Water and the Environment	This Act applies to the shipwrecks (more than 75 years old) within the EMBA. There is no planned interaction or interference with shipwrecks, and any unplanned impacts is only expected to affect the surface waters.	N/A
National Greenhouse and Energy Reporting Act 2007	Introduces a single national reporting framework for the reporting and dissemination of information about greenhouse gas emissions, greenhouse gas projects and energy use and production of corporations.	Yes	Commonwealth – Department of Agriculture, Water and the Environment; and Climate Change Authority	This Act applies to the atmospheric emissions through combustion engine use to operate the vessels associated with the activity. Implementation of the Act will reduce the impact of GHG	**Section 6.3** – Atmospheric emissions

Commonwealth Legislation	Summary	Relevant to activity?	Administering Authority	Relevant aspects of the activity	EP Section
				emissions associated with vessel use for the installation and commissioning activity, through compliance with MARPOL Annex VI (Marine Order Part 97: Marine Pollution Prevention – Air Pollution), and require the use of low sulphur fuel.	
Maritime Legislation Amendment (Prevention of Air Pollution from Ships) Act 2007	This Act implements the requirements of MARPOL 73/78 Annex VI for shipping in Commonwealth waters.	Yes	Commonwealth, Department of Infrastructure, Regional Development and Cities	Implementation of this Act reduces the impact of GHG emissions associated with vessel use for the installation and commissioning activity, through compliance with MARPOL Annex VI (Marine Order Part 97: Marine Pollution Prevention – Air Pollution), and require the use of low sulphur fuel.	**Section 6.3** – Atmospheric emissions
Navigation Act 2012	An act regulating navigation and shipping including Safety of Life at Sea (SOLAS). A number of Marine Orders enacted under this Act apply directly to offshore petroleum exploration and production activities: + Marine Orders - Part 17: Liquefied gas carriers and chemical tankers + Marine Orders - Part 21: Safety of navigation and emergency procedures	Yes	Commonwealth, Department of Infrastructure, Regional Development and Cities	All vessel movements associated with the activity will be governed by marine safety regulations and marine orders under the Act.	**Section 7.6** – Release of hydrocarbons

Commonwealth Legislation	Summary	Relevant to activity?	Administering Authority	Relevant aspects of the activity	EP Section
	+ Marine Orders - Part 30: Prevention of collisions + Marine Orders - Part 47: Mobile Offshore Drilling Units + Marine Orders - Part 50: Special purpose ships + Marine Orders - Part 57: Helicopter Operations + Marine Orders - Part 59: Off-shore industry vessel operations + Marine Orders - Part 60: Floating Offshore facilities.				
Offshore Petroleum and Greenhouse Gas Storage Act 2006 *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009*	Petroleum exploration and development activities in Australia's offshore areas are subject to the environmental requirements specified in the OPGGS Act and associated Regulations. The OPGGS Act contains a broad requirement for titleholders to operate in accordance with "good oil-field practice". The OPGGS Environment Regulations provide an objective based regime for the management of environmental performance for Australian offshore petroleum exploration and production activities in areas of Commonwealth jurisdiction.	Yes	NOPSEMA	Environmental impacts and environmental risks of the activity due to: + noise emissions + artificial light + atmospheric emissions + seabed and benthic habitat disturbance + interaction with other marine users + vessel discharges + spill response operations + dropped objects + introduction of invasive marine species	N/A

Commonwealth Legislation	Summary	Relevant to activity?	Administering Authority	Relevant aspects of the activity	EP Section
				+ marine fauna interaction + release of hydrocarbons.	
Ozone Protection and Synthetic Greenhouse Gas Management Act 1989	Regulates the manufacture, importation and use of ozone depleting substances (typically used in fire-fighting equipment and refrigerants). Applicable to the handling of any ODS.	Yes	Commonwealth - Department of Agriculture, Water and the Environment	The activity does not include import, export or manufacture activities of ODS. This Act applies where ODS is found on vessel refrigeration systems; however, this is a rare occurrence.	**Section 6.3** – Atmospheric emissions
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 and provides legal immunity for persons acting under an AMSA direction.	Yes	Commonwealth, Department of Infrastructure, Regional Development and Cities	Potential impacts to commonwealth waters in the event of an unplanned hydrocarbon spill.	**Section 7.6** – Release of hydrocarbons
Protection of the Sea (Prevention of Pollution from Ships) Act 1983 *Protection of the Sea (Prevention of Pollution from Ships)*	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. The following Marine Orders relating to marine pollution prevention have been put in place to give effect to relevant	Yes	Commonwealth, Department of Infrastructure, Regional Development and Cities	The Act is relevant to the extent that Santos will comply with MARPOL through the following relevant Marine Orders relating to marine pollution prevention have been put in place to give effect to relevant regulations of	**Section 6.6** – Operational discharges **Section 7** – Unplanned activities risk assessment

Commonwealth Legislation	Summary	Relevant to activity?	Administering Authority	Relevant aspects of the activity	EP Section
(Orders) Regulations 1994 *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*	regulations of Annexes I, II, III, IV, V and VI of MARPOL 73/78: + Marine Orders - Part 91: Marine Pollution Prevention - Oil + Marine Orders - Part 93: Marine Pollution Prevention - Noxious Liquid Substances + Marine Orders - Part 94: Marine Pollution Prevention - Harmful Substances in Packaged Forms + Marine Orders - Part 95: Marine Pollution Prevention – Garbage + Marine Orders - Part 96: Marine Pollution Prevention – Sewage + Marine Orders - Part 97: Marine Pollution Prevention – Air Pollution + Marine Orders - Part 98: Marine Pollution – Anti-fouling Systems.			Annexes I, II, III, IV, V and VI of MARPOL 73/78:	
Protection of the Sea (Civil Liability of Bunker Oil Pollution Damage) Act 2008	This Act implements the requirements for the International Convention on Civil Liability for Bunker Oil Pollution Damage.	Yes	Commonwealth, Department of Infrastructure, Regional Development and Cities	This Act applies to diesel refuelling which will be undertaken at sea as part of the activity. Compliance with the Act reduces the risk of bunker oil pollution.	**Section 7.6** – Release of hydrocarbons
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 ant-fouling paints used on ships.	Yes	Commonwealth, Department of Infrastructure, Regional Development and Cities	This Act applies to vessel movements in Australian Waters associated with the activity. Vessels are required to have biofouling systems in place to prevent introduction	**Section 7.1** – Introduction of IMS

Commonwealth Legislation	Summary	Relevant to activity?	Administering Authority	Relevant aspects of the activity	EP Section
				of IMS/harmful impact on Australian biodiversity.	

International agreements and conventions

International agreements and conventions	Summary	Relevant to activity?	Relevant aspects	EP section
1996 Protocol To The Convention On The Prevention Of Marine Pollution By Dumping Of Wastes And Other Matter, 1972	Implemented in WA *Marine (Sea Dumping) Act and Environmental Protection (Sea Dumping) Act 1981*.	No	Planned operational discharges occur as parted of operations.	**Section 6.6** – Operational discharges
Agreement Between the Government of Australia and the Government of Japan for the Protection of Migratory Birds in Danger of Extinction and Their Environment 1974 (commonly referred to as the Japan Australia Migratory Bird Agreement or JAMBA)	This agreement recognises the special international concern for the protection of migratory birds and birds in danger of extinction that migrate between Australia and Japan. Implemented in EPBC Act 1999.	Yes	Only relevant in so far as the credible spill scenario may result in impact to migratory seabirds foraging or nesting in area.	**Section 7.6** – Release of hydrocarbons
Agreement Between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and Their Environment 1986 (commonly referred to as the China Australia Migratory Bird Agreement or CAMBA)	This agreement recognises the special international concern for the protection of migratory birds and birds in danger of extinction that migrate between Australia and China. Implemented in EPBC Act 1999.	Yes	Only relevant in so far as the credible spill scenario may result in impact to migratory seabirds foraging or nesting in area.	**Section 7.6** – Release of hydrocarbons
Convention for the Control of Transboundary Movements of	This convention deals with the transboundary movement of hazardous wastes, particularly by sea. Implemented	No	Activity does not involve transboundary movement of hazardous wastes.	N/A

International agreements and conventions	Summary	Relevant to activity?	Relevant aspects	EP section
Hazardous Wastes and Their Disposal 1989 (Basel Convention)	in *Hazardous Waste (Regulation of Exports and Imports) Act 1989*.			
United Nations Convention on Biological Diversity -1992	An international treaty to sustain life on earth.	Yes	Relevant only insofar as the activity may interact with MNES (threatened and migratory species) protected under the EPBC Act.	**Section 6.1** – **A**coustic disturbance to marine fauna **Section 7.1** – Introduction of IMS **Section 7.6** – Release of hydrocarbons
Convention on Oil Pollution Preparedness, Response and Co-operation 1990 (OPRC 90)	This convention comprises national arrangements for responding to oil pollution incidents from ships, offshore oil facilities, sea ports and oil handling. The convention recognises that in the event of pollution incident, prompt and effective action is essential.	Yes	In the event that worse-case credible spill scenarios may enact a national arrangement for response.	**Section 7.6** – Release of hydrocarbons
Convention on the Conservation of Migratory Species of Wild Animals 1979 (Bonn Convention)	The Bonn Convention aims to improve the status of all threatened migratory species through national action and international agreements between range states of particular groups of species.	Yes	Only relevant in so far as the credible spill scenario may result in impact to MNES protected migratory species.	**Section 7.6** – Release of hydrocarbons
International Convention for the Establishment of an International Fund for Compensation for Oil Pollution Damage (Fund 92)	This convention ensures compensation is provided for damage caused by oil pollution.	No	Relevant to oil tankers, not supply or support vessels.	N/A
International Convention for the Prevention of Pollution from Ships 1973/1978 (MARPOL 73/78)	This Convention and Protocol (together known as MARPOL 73/78) build on earlier conventions in the same area. MARPOL is concerned with operational discharges of pollutants from ships. It contains five	Yes	Already dealt with through the P*rotection of the Sea (Prevention of Pollution from Ships) Act 1983* – refer to legislation table above.	N/A

International agreements and conventions	Summary	Relevant to activity?	Relevant aspects	EP section
	Annexes, dealing respectively with oil, noxious liquid substances, harmful packaged substances, sewage and garbage. Detailed rules are laid out as to the extent to which (if at all) such substances can be released in different sea areas. The legislation giving effect to MARPOL in Australia is the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*, the *Navigation Act 1912* and several Parts of Marine Orders made under this legislation.			
International Convention for the Safety of Life at Sea 1974	This convention is generally regarded as the most important of all international treaties concerning the safety of merchant ships Implemented in the *Air Navigation Act 1920.*	Yes	Only relevant in so far as SOLAS relates to safety aspects of the activity, such as navigation aids which reduce potential for vessel collision and hydrocarbon release to the environment.	**Section 7.6** – Release of hydrocarbons
International Convention on Civil Liability for Oil Pollution Damage (1969)	This convention provides a mechanism for ensuring the payment of compensation for oil pollution damage.	No	Relevant to oil tankers.	N/A
International Convention for the Control and Management of Ships' Ballast Water and Sediments (Ballast Water Convention) 2004	The IMO has been addressing the problem of IMS in ships' ballast water since the 1980s. Ballast water and sediments guidelines were adopted in 1991 and the ballast water convention was adopted in 2004. Recent accession by Finland has triggered the final entry into force of these international requirements. As a result, the International Convention for the Control	Yes	Potential internationally sourced vessel operating in Australian Waters which could have the potential for introduction of Invasive Marine Species and potential ballast water exchange.	**Section 7.1** – Introduction of IMS

International agreements and conventions	Summary	Relevant to activity?	Relevant aspects	EP section
	and Management of Ships' Ballast Water and Sediment will enter into force on 8th September 2017 (IMO Briefing 22 2016). It aims to prevent the spread of harmful aquatic organisms from one region to another, by establishing standards and procedures for the management and control of ships' ballast water and sediments. Ballast Water Management systems must be approved by the Administration in accordance with this IMO Guidelines.			
United Nations Convention on the Law of the Sea (UNCLOS) (1982)	Part XII of the convention sets up a general legal framework for marine environment protection. The convention imposes obligations on State Parties to prevent, reduce and control marine pollution from the various major pollution sources, including pollution from land, from the atmosphere, from vessels and from dumping (Articles 207 to 212). Subsequent articles provide a regime for the enforcement of national marine pollution laws in the many different situations that can arise. Australia signed the agreement relating to the implementation of Part XI of the Convention in 1982, and UNCLOS in 1994.	Yes	Only relevant to the extent that Santos will comply with MARPOL through the following relevant 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 Orders - Part 91: Marine Pollution Prevention - Oil + Marine Orders - Part 93: Marine Pollution Prevention - Noxious Liquid Substances + Marine Orders - Part 95: Marine Pollution Prevention – Garbage + Marine Orders - Part 96: Marine Pollution Prevention – Sewage + Marine Orders - Part 97: Marine Pollution Prevention - Air Pollution	**Section 6.6** – Operational discharges **Section 7.1** – Introduction of IMS **Section 7.6** – Release of hydrocarbons

International agreements and conventions	Summary	Relevant to activity?	Relevant aspects	EP section
			+ Marine Orders - Part 98: Marine Pollution - Anti-fouling Systems	
United Nations Framework Convention on Climate Change (1992)	The objective of the convention is to stabilise greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous interference with the climate system. Australia ratified the convention in December 1992 and it came into force on 21 December 1993.	Yes	Only relevant in to the extent that to reduce impact of GHG emissions associated with vessel use, Santos will comply with MARPOL Annex VI (Marine Orders Part 97: Marine Pollution Prevention – Air Pollution) And require the use of low sulphur fuel.	**Section 6.3** – Atmospheric emissions

APPENDIX C
Description of the Existing Environment

Appendix C1 Description of the Existing Environment

Appendix C2 PMST Searches (operational area, release of hydrocarbons EMBA and 20km buffer)

The searches are completed using the exact coordinates that are utilised to produce the figures throughout **Section 3** of the EP, ensuring that the EMBA encompasses the full range of environmental receptors that might be contacted by surface and subsurface hydrocarbons at the low exposure level in the highly unlikely event of a worst case oil spill.

On the first page of each PMST report, is a coarse graphic showing the area over which the search has been conducted. However, the granularity of this can make the output look different to the spatial area represented on figures within the EP.

The co-ordinates are also provided within the PMST report to allow for duplication of the search and verification if required.

Santos do not have control over the PMST search tool output, but instead have provided the reports and coordinates to ensure transparency.

Appendix C3 Values and Sensitivities of the Marine and Coastal Environment (EA-00-RI-10062)

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.

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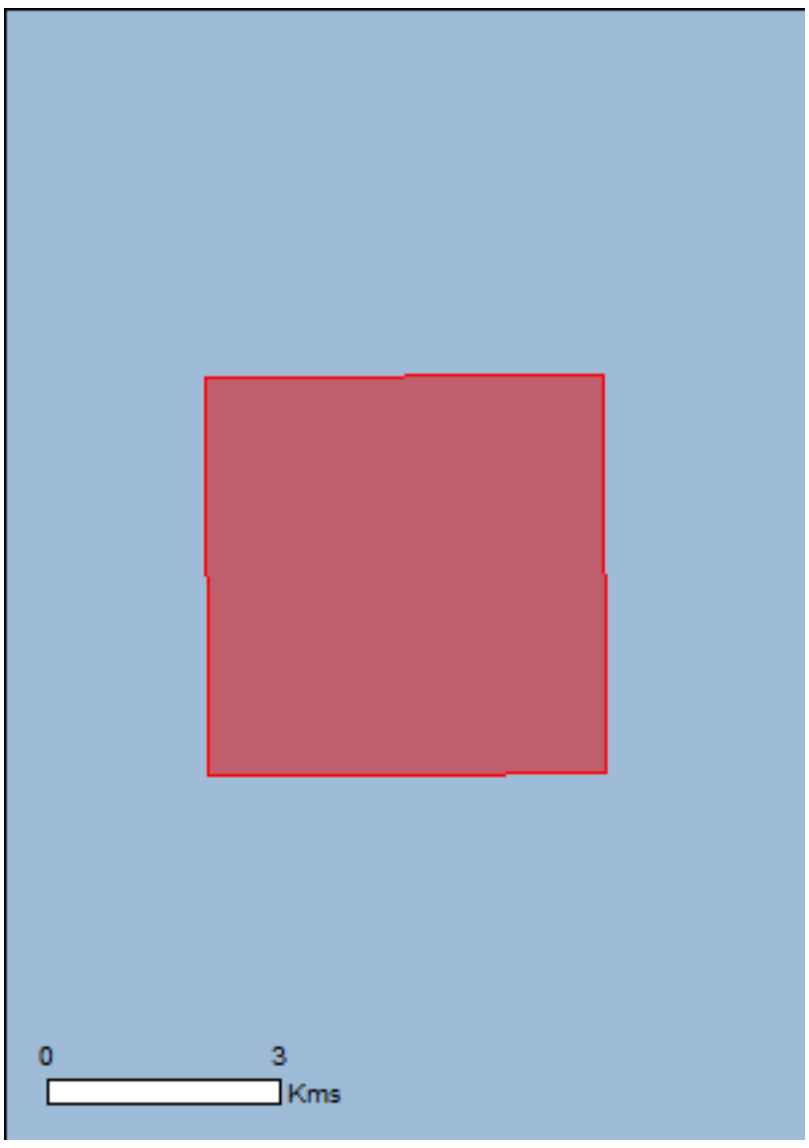

Coordinates

Buffer: 0.0Km

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:	19
Listed Migratory Species:	33

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:	58
Whales and Other Cetaceans:	13
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

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)	None

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	Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	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
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		

Name	Status	Type of Presence
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 likely 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
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	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
Glyphis garricki Northern River Shark, New Guinea River Shark [82454]	Endangered	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 may 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
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat may 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 likely 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
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 Ray [84994]		Species or species habitat likely 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 likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	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
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
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
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 ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		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

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
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	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

Name	Threatened	Type of Presence
Calidris ferruginea Curlew Sandpiper [856]	Critically 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 may 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
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 habitat may occur within area

Name	Threatened	Type of Presence
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 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 area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Reptiles		

Name	Threatened	Type of Presence
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 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 likely 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
Enhydrina schistosa Beaked Seasnake [1126]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Hydrophis coggeri Slender-necked Seasnake [25925]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		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	Species or species habitat likely 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		

Name	Status	Type of Presence
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat may occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		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
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

Extra Information

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

-12.507938 124.867605,-12.507614 124.913599,-12.552804 124.913932,-12.553129 124.867931,-12.507938 124.867605

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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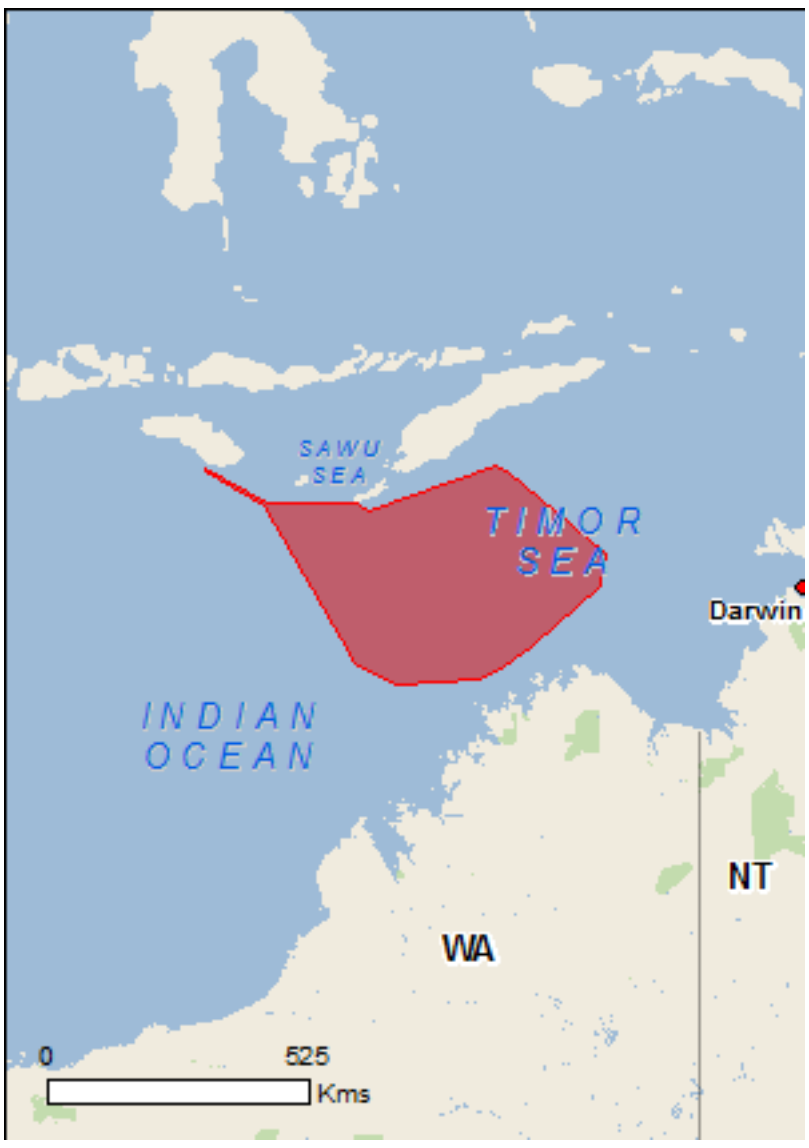
EPBC Act Protected Matters Report

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.

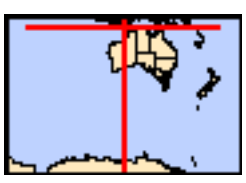
Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 24/05/21 11:06:07



Coordinates

Buffer: 0.0Km



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:	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	25
Listed Migratory Species:	57

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:	1
Commonwealth Heritage Places:	1
Listed Marine Species:	92
Whales and Other Cetaceans:	26
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:	1
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	5

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Ashmore reef national nature reserve	Within Ramsar site

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
Extended Continental Shelf

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	Breeding 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
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Russkoye Bar-tailed Godwit [86432]	Critically Endangered	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
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	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

Name	Status	Type of Presence
[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		
[Aipysurus apraefrontalis](#) Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known 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	Foraging, feeding or related behaviour known to occur within area
[Dermochelys coriacea](#) Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour likely to occur within area
[Eretmochelys imbricata](#) Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
[Lepidochelys olivacea](#) Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour known to occur within area
[Natator depressus](#) Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sharks		
[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

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Breeding known to occur within area
Ardenna pacifica Wedge-tailed Shearwater [84292]		Breeding known 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]		Breeding known to occur within area
Hydroprogne caspia Caspian Tern [808]		Breeding known to occur within area
Onychoprion anaethetus Bridled Tern [82845]		Breeding known to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding known 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
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 may occur within area
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
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

Name	Threatened	Type of Presence
		area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour 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	Foraging, feeding or related behaviour likely to occur within area
Dugong dugon Dugong [28]		Breeding known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour 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	Foraging, feeding or related behaviour known 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 likely 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 likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Orcaella heinsohni Australian Snubfin Dolphin [81322]		Species or species habitat may 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

Name	Threatened	Type of Presence
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
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Migratory Terrestrial Species		
Cecropis daurica Red-rumped Swallow [80610]		Species or species habitat may occur within area
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat known to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat known to occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Acrocephalus orientalis Oriental Reed-Warbler [59570]		Species or species habitat known to occur within area
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat 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
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may 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

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Natural		
Ashmore Reef National Nature Reserve	EXT	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		
Acrocephalus orientalis Oriental Reed-Warbler [59570]		Species or species habitat known to occur within area
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous minutus Black Noddy [824]		Breeding known to occur within area
Anous stolidus Common Noddy [825]		Breeding known to occur within area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Breeding known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat 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
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may 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]		Breeding known to occur within area
Hirundo daurica Red-rumped Swallow [59480]		Species or species habitat may occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		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
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding known to occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area
Puffinus pacificus Wedge-tailed Shearwater [1027]		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 anaethetus Bridled Tern [814]		Breeding 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 caspia Caspian Tern [59467]		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
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

Name	Threatened	Type of Presence
		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 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

Name	Threatened	Type of Presence
		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 area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Mammals		
Dugong dugon Dugong [28]		Breeding 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 known 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 fuscus Dusky Seasnake [1119]		Species or species habitat known to occur

Name	Threatened	Type of Presence 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	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour 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	Foraging, feeding or related behaviour 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
Enhydrina schistosa Beaked Seasnake [1126]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Hydrelaps darwiniensis Black-ringed Seasnake [1100]		Species or species habitat may occur within area
Hydrophis atriceps Black-headed Seasnake [1101]		Species or species habitat may occur within area
Hydrophis coggeri Slender-necked Seasnake [25925]		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

Name	Threatened	Type of Presence
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour 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 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
Orcaella brevirostris Irrawaddy Dolphin [45]		Species or species habitat may occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species

Name	Status	Type of Presence
		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
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 likely 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
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
Ashmore Reef	Recreational Use Zone (IUCN IV)
Ashmore Reef	Sanctuary Zone (IUCN Ia)
Cartier Island	Sanctuary Zone (IUCN Ia)
Kimberley	Multiple Use Zone (IUCN VI)
Oceanic Shoals	Multiple Use Zone (IUCN VI)

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Browse Island	WA
Unnamed WA41775	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
Mammals		
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area

Nationally Important Wetlands [Resource Information]

Name	State
Ashmore 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
Ashmore Reef and Cartier Island and surrounding	North-west
Carbonate bank and terrace system of the Sahul	North-west
Continental Slope Demersal Fish Communities	North-west
Pinnacles of the Bonaparte Basin	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

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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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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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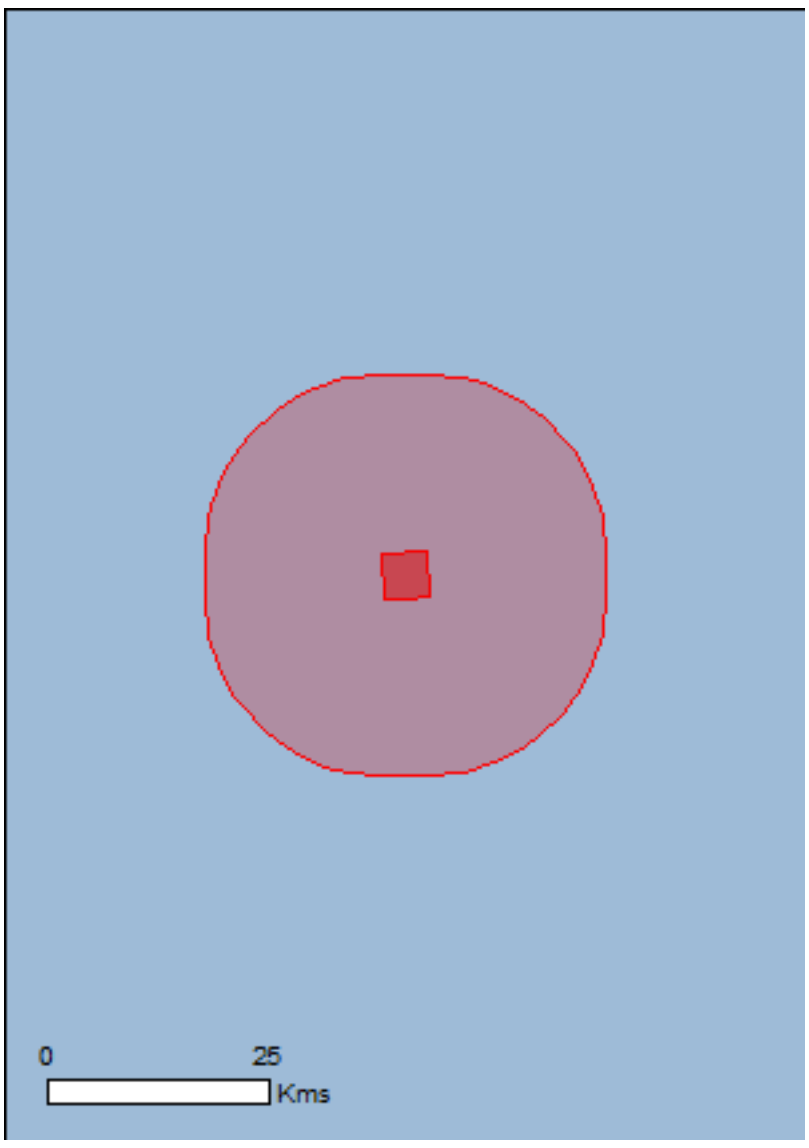

Coordinates

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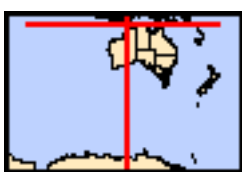

Summary

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:	19
Listed Migratory Species:	33

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:	59
Whales and Other Cetaceans:	13
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

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)	1

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	Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	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
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		

Name	Status	Type of Presence
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
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	Species or species habitat known to occur within area
Sharks		
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 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 may 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
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat may 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
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 Ray [84994]		Species or species habitat likely 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 likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
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
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 ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		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

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
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	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

Name	Threatened	Type of Presence
Calidris ferruginea Curlew Sandpiper [856]	Critically 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 may 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
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 habitat may occur within area

Name	Threatened	Type of Presence
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 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 area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Reptiles		

Name	Threatened	Type of Presence
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 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
Enhydrina schistosa Beaked Seasnake [1126]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Hydrophis coggeri Slender-necked Seasnake [25925]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		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	Species or species habitat 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 borealis Sei Whale [34]	Vulnerable	Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat may occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		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
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

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
Carbonate bank and terrace system of the Sahul	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

-12.507938 124.867605,-12.507614 124.913599,-12.552804 124.913932,-12.553129 124.867931,-12.507938 124.867605

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.

Department of Agriculture Water and the Environment
GPO Box 858
Canberra City ACT 2601 Australia
+61 2 6274 1111

APPENDIX D
Stakeholder Consultation

Santos

STAKEHOLDER CONSULTATION

Stairway Vessel Based Activity

Environment Plan

Santos

STAKEHOLDER CONSULTATION

Consultation Correspondence

Consultation, Santos

From: Consultation, Santos
Sent: Wednesday, 2 June 2021 2:46 PM
Subject: Santos Consultation - Stairway-1 Exploration Drilling and Site Survey Program
Attachments: Santos Consultation - Stairway-1 Exploration Drilling and Site Survey Program.pdf

Good afternoon

Santos is preparing two Environment Plans (EPs) in accordance with the Commonwealth Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 for site surveys (geophysical, hydrographic and geotechnical), and an exploration well (Stairway-1) located in petroleum exploration permit AC/P50, in Commonwealth waters approximately 650 km from Darwin.

The information attached provides more detail on the proposed activities, including a location map and a summary of potential risks, impacts and management measures.

Activity Summary

Activity Name	Stairway-1 Exploration Drilling and Site Survey Program	
Activity Summary	Santos proposes to undertake site surveys and drill one exploration well (Stairway-1) in petroleum exploration permit AC/P50, located in Commonwealth waters approximately 650 km from Darwin and 200 km from the nearest shoreline. Before Santos can undertake the site survey and drill the exploration well, the company must have an accepted Environment Plan (EP) in place for each activity. Two EPs will be developed to allow for the activities due to a difference in schedule.	
Estimated Start Date	Site survey targeting a window between Q4 2021 and Q3 2022. Drilling targeting between Q2 2022 and Q4 2023 depending on MODU selection.	
Total Duration	Allowing for potential down time, for example due to weather, the site survey may extend to up to 10 days. the one well drilling activity is planned to take 40 days, however the MODU may be on location for up to 80 days, allowing for operational delays and any weather delays.	
Permit Number	AC/P50	
	Latitude	**Longitude**

Operational Coordinates	12° 30′ 28.575″ S	124° 52′ 03.378″ E
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	12° 33′ 10.095″ S	124° 54′ 50.155″ E
	12° 33′ 11.262″ S	124° 52′ 04.550″ E
Location Map	Please see attached	
Approximate Water Depth	80 m - 100 m	
Exclusion Zone	A 500 m PSZ (exclusion zone) around the MODU at all times. No PSZ is established around vessels during the site survey.	

If you wish to comment on Santos' proposed Stairway-1 Exploration Drilling and Site Survey Program, or if you require additional information, please contact Santos on the contact details below. Santos will endeavour to address all feedback prior to the EPs being submitted for assessment. Your feedback **by 9 July 2021** would be welcomed.

The Environment Regulations require NOPSEMA to publish the environment plan submitted by the titleholder for assessment, and to publish the final accepted version of an environment plan. Environment plans are published in full, with the exception of sensitive information from the consultation process and transcripts of correspondence between stakeholders and the titleholder. This information is used by NOPSEMA during the assessment, but is not published for wider review.

If you do not wish for your comments to be published in this environment plan, or wish to provide your comments anonymously, please make this known to Santos as soon as possible.

We look forward to hearing from you.

Kind regards

Santos

[redacted]
Santos Limited, Level 7 100 St Georges Tce, Perth WA 6000
t: +61 8 6218 [redacted]
https://www.santos.com/

From: [redacted]
Subject: ![EXT]: Stairway-1 Exploration Drilling and Site Survey - Consultation
Date: Thursday, 3 June 2021 3:49:38 PM
Attachments: Santos Consultation - Stairway-1 Exploration Drilling and Site Survey Program (Commercial Fishers).pdf
Stairway_001_FigA_210525_WAState_MMF_RevA.pdf
Stairway_001_FigA_210525_WAState_NDSF_RevA.pdf
Stairway_001_FigA_210525_WAState_SharkFisheries_RevA.pdf

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We look forward to hearing from you.

[redacted]

Santos

PO Box 5624, Perth, 6831

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L1, 56 Marine Tce. Fremantle WA 6160
PO Box 1605. Fremantle WA 6959

[redacted]

wafic.org.au
wamsc.com.au

WESTERN AUSTRALIAN
FISHING INDUSTRY
COUNCIL INC

Consultation, Santos

From: Consultation, Santos
Sent: Monday, 21 June 2021 8:06 AM
Subject: FW: Santos Consultation - Stairway-1 Exploration Drilling and Site Survey Program
Attachments: Santos Consultation - Stairway-1 Exploration Drilling and Site Survey Program.pdf

Good morning,

I am following up on an email sent to you on 2 June 2021 (copy below) containing consultation material on Santos' proposed Stairway-1 Exploration Drilling and Site Survey Program.

Santos is preparing two Environment Plans (EPs) in accordance with the Commonwealth Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 for site surveys (geophysical, hydrographic and geotechnical), and an exploration well (Stairway-1) located in petroleum exploration permit AC/P50, in Commonwealth waters approximately 650 km from Darwin.

Should you require additional information or have a comment to make about the proposed activities, please be in touch via the contact details below.

Kind regards

Santos

[redacted]
Santos Limited, Level 7 100 St Georges Tce, Perth WA 6000
t: +61 8 6218 [redacted]

https://www.santos.com/

From: Consultation, Santos
Sent: Wednesday, 2 June 2021 2:46 PM
Subject: Santos Consultation - Stairway-1 Exploration Drilling and Site Survey Program

Good afternoon

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Location Map	Please see attached	
Approximate Water Depth	80 m - 100 m	
Exclusion Zone	A 500 m PSZ (exclusion zone) around the MODU at all times.	

	No PSZ is established around vessels during the site survey.

If you wish to comment on Santos' proposed Stairway-1 Exploration Drilling and Site Survey Program, or if you require additional information, please contact Santos on the contact details below. Santos will endeavour to address all feedback prior to the EPs being submitted for assessment. Your feedback **by 9 July 2021** would be welcomed.

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We look forward to hearing from you.

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Santos Limited, Level 7 100 St Georges Tce, Perth WA 6000
t: +61 8 6218[redacted]

https://www.santos.com/

Consultation, Santos

From: Consultation, Santos
Sent: Thursday, 5 August 2021 3:33 PM
Cc: Consultation, Santos
Subject: UPDATE: Santos Consultation - Stairway-1 Exploration Drilling and Site Survey Program
Attachments: Santos Consultation - Stairway-1 Exploration Drilling and Site Survey Program - AUGUST 2021 UPDATE.pdf

Good afternoon,

I refer to previous correspondence from Santos (below) in relation to Santos' proposed Stairway-1 Exploration Drilling and Site Survey Program.

To recap, Santos is preparing two Environment Plans (EPs) in accordance with the Commonwealth Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 for site surveys (geophysical, hydrographic and geotechnical), and an exploration well (Stairway-1) located in petroleum exploration permit AC/P50, in Commonwealth waters approximately 650 km from Darwin.

Santos previously advised the drilling activity was anticipated to occur between Q2 2022 and Q4 2023 depending on MODU selection. Santos has now revised this window to **Q2 2022 and Q4 2024**, depending on MODU selection.

Updated consultation material is attached and provides more detail on the proposed activities, including a location map and a summary of potential risks, impacts and management measures. **Please note the only change is to the anticipated time period in which the activity may take place.**

Should you require additional information or have a comment to make about the proposed activities, please be in touch via the contact details below.

Kind regards

Santos

[redacted]
Santos Limited, Level 7 100 St Georges Tce, Perth WA 6000
[redacted]

https://www.santos.com/

From: Consultation, Santos
Sent: Monday, 21 June 2021 8:06 AM
Subject: FW: Santos Consultation - Stairway-1 Exploration Drilling and Site Survey Program

Good morning,

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Santos is preparing two Environment Plans (EPs) in accordance with the Commonwealth Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 for site surveys (geophysical, hydrographic and geotechnical), and an exploration well (Stairway-1) located in petroleum exploration permit AC/P50, in Commonwealth waters approximately 650 km from Darwin.

Should you require additional information or have a comment to make about the proposed activities, please be in touch via the contact details below.

Kind regards

Santos

[redacted]
Santos Limited, Level 7 100 St Georges Tce, Perth WA 6000
t: [redacted]

https://www.santos.com/

From: Consultation, Santos
Sent: Wednesday, 2 June 2021 2:46 PM
Subject: Santos Consultation - Stairway-1 Exploration Drilling and Site Survey Program

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Location Map	Please see attached	
Approximate Water Depth	80 m - 100 m	
Exclusion Zone	A 500 m PSZ (exclusion zone) around the MODU at all times. No PSZ is established around vessels during the site survey.	

If you wish to comment on Santos' proposed Stairway-1 Exploration Drilling and Site Survey Program, or if you require additional information, please contact Santos on the contact details below. Santos will endeavour to address all feedback prior to the EPs being submitted for assessment. Your feedback **by 9 July 2021** would be welcomed.

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We look forward to hearing from you.

Kind regards

Santos

[redacted]

Santos Limited, Level 7 100 St Georges Tce, Perth WA 6000

[redacted]

https://www.santos.com/

Santos

STAKEHOLDER CONSULTATION

Consultation Material

AUGUST 2021 UPDATE

STAKEHOLDER CONSULTATION

Santos

Stairway-1 Exploration Drilling and Site Survey Program

Overview

Santos proposes to undertake site surveys and drill one exploration well (Stairway-1) in petroleum exploration permit AC/P50, located in Commonwealth waters approximately 650 km from Darwin and 200 km from the nearest shoreline (see **Figure 1**).

Before Santos can undertake the site survey and drill the exploration well, the company must have an accepted Environment Plan (EP) in place for each activity. Two EPs will be developed to allow for the activities due to a difference in schedule. The EPs will be developed and implemented in accordance with the Commonwealth Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS(E)R) for acceptance by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA).

Effective 25 April 2019, exploration drilling environment plans submitted to NOPSEMA must be published on their website for a 30-day public comment period. Santos anticipates that its exploration well EP will be available for public comment in Q3 2021. Additional information on the public comment period can be found at https://info.nopsema.gov.au/home/open_for_comment.

The site survey EP is not required to be published for public comment.

EP consultation prior to submission to NOPSEMA provides for increased transparency and an opportunity for stakeholders to provide input to the environmental management of the proposed exploration drilling and site survey activity. All stakeholders are encouraged to review the consultation material contained in this document and to respond to Santos prior to the end of the public comment period.

Please advise if you have any objections, claims or information requests about the proposed activity. Santos will endeavour to address all feedback prior to the Stairway-1 exploration drilling and site survey EPs being submitted for assessment.

Site Survey Activity Description

As part of the preparatory work required to safely undertake the drilling, a site survey is required to assess the shallow seabed soils suitability to provide a safe foundation for a Mobile Offshore Drilling Unit (MODU). Santos plans to commence the site survey as early as Q4 2021 in AC/P50 with a single survey vessel.

The survey will occur within a 5km x 5km operational area in water depths of approximately 100 m and defined by coordinates listed in **Table 1**.

The surveys that may be required include geophysical and hydrographic surveys to define the seafloor and identify any debris or hazards that may impact the location of the well or MODU. Geotechnical surveys, remote operated vehicles or autonomous underwater vehicles may also be required for seabed and water sampling. Data acquired from the site survey will subsequently be processed to generate site survey reports for use in drilling the well. This data is required up to six months prior to drilling to inform planning for drilling the well.

The activity ends once the objectives of the survey have been met and the vessel has departed the operational area. No equipment will be left within the operational area after this activity.

Drilling Activity Description

Santos plans to commence drilling one well (Stairway-1) in AC/P50 with a semi-submersible or jack-up Mobile Offshore Drilling Unit (MODU). This could occur between Q2 2022 and Q4 2024 depending on which MODU is contracted for the well.

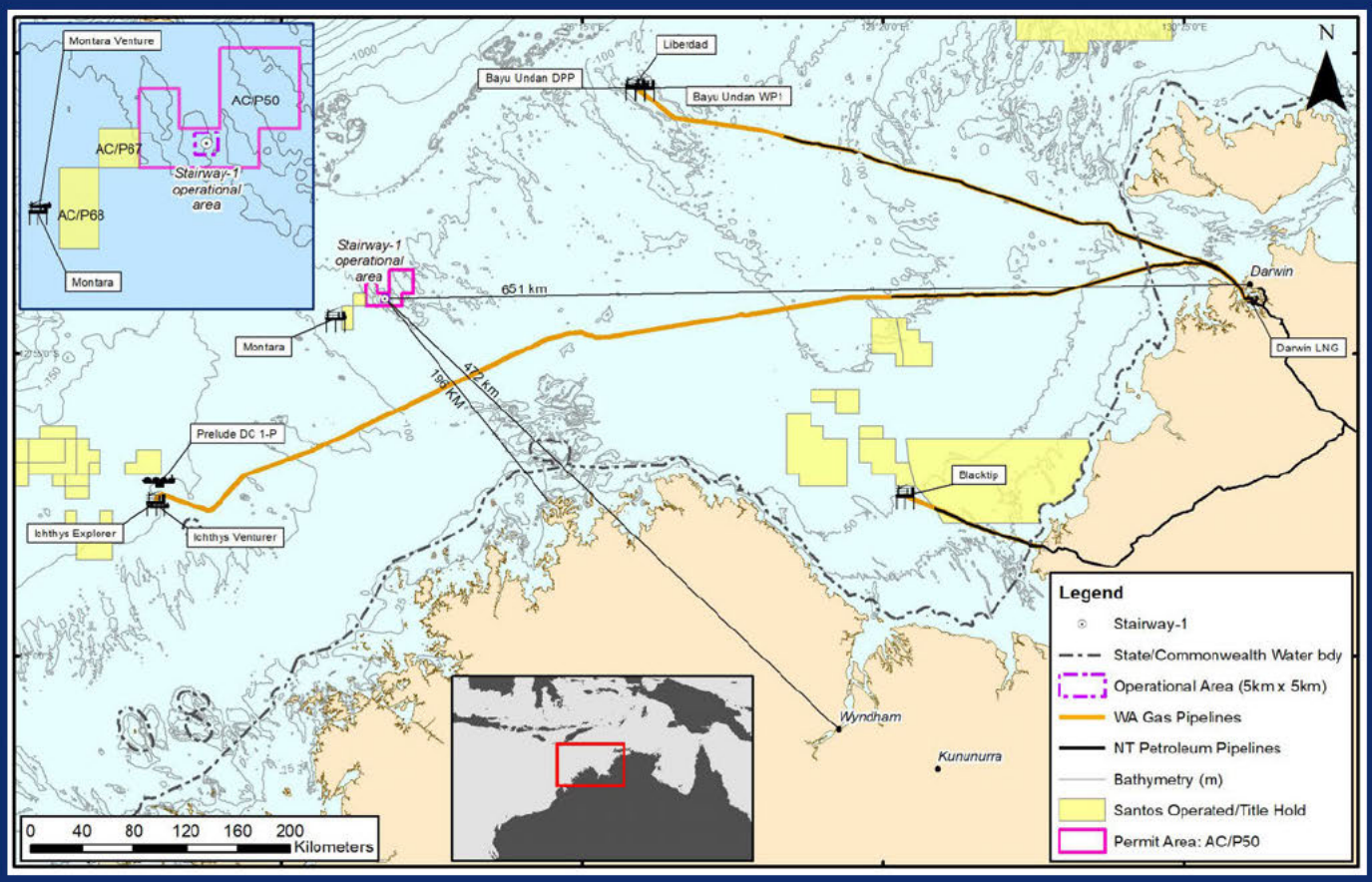
The well will be drilled within the 5km x 5km operational area in water depths of approximately 100 m and defined by coordinates listed in **Table 1**. Within the operational area, a 500m petroleum safety zone (PSZ, exclusion zone) will be established around the MODU to prevent other marine users entering this zone.

The Stairway-1 well is planned to be drilled, evaluated and permanently plugged and abandoned. Cement plugs are planned to be placed to safely plug and abandon the well. The abandonment program will ensure moveable hydrocarbons (identified while drilling) are isolated in accordance with the NOPSEMA-accepted Well Operations Management Plan (WOMP).

The activity ends once the well has been plugged and abandoned and the MODU and all support vessels have departed the operational area. No equipment will be left above the seabed.

Further activity details are summarised in **Table 1**, and potential environmental risks, impacts and management measures, including interaction with commercial fishers, are outlined in **Table 2**.

Figure 1: Stairway-1 Exploration Drilling and Site Survey Location Map



OPERATIONAL AREA	
Latitude	**Longitude**
12° 30' 28.575" S	124° 52' 03.378" E
12° 30' 27.412" S	124° 54' 48.955" E
12° 33' 10.095" S	124° 54' 50.155" E
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Table 1: Exploration drilling and site survey activity summary

ACTIVITY INFORMATION			
Operational Area (5km x 5km box)	Within Permit	Latitude	Longitude
	AC/P50	12° 30' 28.575" S	124° 52' 03.378" E
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Water Depth	Approximately 80 - 100 m		
Schedule	Site survey targeting a window between Q4 2021 and Q3 2022.	Drilling targeting between Q2 2022 and Q4 2024 depending on MODU selection	
Duration	• Allowing for potential down time, for example due to weather, the site survey may extend to up to 10 days. • The one well drilling activity is planned to take 40 days, however the MODU may be on location for up to 80 days, allowing for operational delays and any weather delays. • Activities will be 24 hours per day, seven days per week.		
Site survey Equipment/Vessels	• Typically, a single vessel will be used to undertake the activity but a second vessel may be required for support. • Various types of equipment may be required depending on the MODU requirements and survey objectives. • Vessels will not anchor in the operational area. • It is planned that vessels will transit to and from Darwin or Broome Port.		
Drilling Equipment/Vessels	• Jack-up or semi-submersible Mobile Offshore Drilling Unit (MODU). • MODU supported by up to four support vessels (typically only 2 required) and helicopters. • An observation class remotely operated vehicle (ROV) will be available on location. • At least one support vessel will remain on standby to the MODU within the distance defined in the Safety Case (nominally 3 nautical miles). • Support vessels will not anchor in the operational area during the activity. • If a semi-submersible MODU is used, up to 12 anchors will be deployed to maintain its position with each anchor a maximum distance of 2.5 km from the MODU and within the 5km x 5km operational area. • It is planned that support vessels will transit to and from Darwin or Broome Port.		
Petroleum Safety Zone (PSZ) zone	A 500 m PSZ (exclusion zone) around the MODU at all times. No PSZ is established around vessels during the site survey.		
Operational Area (5km x 5km)	Santos will not restrict commercial fishing access to the operational area, and is committed to concurrent operations where safety of either vessel is not compromised, noting maritime laws of the sea apply within this area.		
Description of natural environment	NWS Transition Province in the North-West Marine Bioregion (DEWHA, 2008a) and the Timor Province.		
Proximity to key regional features	Regional Feature	Stairway-1 Operational Area	
	Cartier Island (Australian Marine Park)	145 km	
	Mainland Australia	196 km	
	Ashmore Reef (Australian Marine Park)	199 km	
	Indonesia	261 km	
	Timor	267 km	
	Tiwi Islands	564 km	
	Darwin	651 km	
Hydrocarbon type	Marine diesel during the site survey. Crude oil during drilling.		
Worst case hydrocarbon spill scenario	329m^3 of diesel during site survey. 11.88 MMSTB crude oil to the sea surface over 11 weeks. Surface release of hydrocarbons from an exploration well.		
Oil spill response level required	In the event of a hydrocarbon spill, a Level 1, 2 or 3 response would be implemented as defined in the activity-specific Oil Pollution Emergency Plan (OPEP).		

Table 2: Potential environmental risks and impacts

POTENTIAL RISKS AND IMPACTS	
Commercial Fishing Specific Potential Risks and/or Impacts	**Management Measures**
	• Relevant commercial fishing stakeholders will be notified prior to commencement and on cessation of the drilling activity. • Relevant maritime notices issued. • A 500 m radius exclusion zone will be in place around the MODU for the duration of the activity. The temporary exclusion zone will cease on MODU departure. • Santos will not restrict commercial fishing access to the operational area, and is committed to concurrent operations where safety of either vessel is not compromised. • A visual and radar watch will be maintained on the support vessel bridge at all times. • Vessel personnel will be prohibited from any recreational fishing activities in the operational area. • Santos commits to reduce impacts on other marine users through the provision of information to relevant stakeholders such that they are able to plan for their activities and avoid unexpected interference. • Santos inductions for vessels will include a topic to reinforce the importance of marine communications regarding any potential interactions with active commercial fishing.
Other Potential Risks and Impacts	**Management Measures**
Hydrocarbon release	• NOPSEMA-accepted MODU Safety Case and Santos Well Operations Management Plan (WOMP) in place. • Prior to drilling there will be a relief well plan in place. • Appropriate refuelling procedures and equipment will be used to prevent spills to the marine environment. • Appropriate spill response plans (OPEP), equipment and materials will be in place and maintained.
Drilling discharge	• Chemicals potentially discharged to sea are Gold/Silver/D or E rated through the offshore chemical notification scheme (OCNS), or pose little or no risk to the environment (PLONOR) or have a completed Santos risk assessment so that only environmentally acceptable products are used. • Only water-based drilling fluid systems will be used.
Marine fauna interactions	• Implementation of Environment Protection and Biodiversity Conservation (EPBC) Regulations (Part 8) for interacting with cetaceans to minimise the disturbance to fauna caused by marine vessels and helicopters.
Light emissions	• MODU/vessels navigation lighting and equipment are compliant with SOLAS/AMSA Marine Orders.
Atmospheric emissions	• MODU/vessels marine diesel (fuel oil) sulphur content is compliant with MARPOL/AMSA Marine Order.
Seabed disturbance	• No vessel anchoring, unless in an emergency. • Objects dropped overboard are recovered (where possible) to mitigate the environmental consequences from objects remaining in the marine environment.
Operational MODU and vessel discharges	• Routine MODU and vessel discharge (sewage, bilge water, food waste) will meet legal requirements. • Deck cleaning products will not be harmful to the marine environment.
Biosecurity risk management	• MODU and vessels are managed to low risk in accordance with the Santos Invasive Marine Species Management Plan prior to movement/transit into or within the invasive marine species management zone.
Spill response operations	• In the event of a hydrocarbon spill, the Santos OPEP requirements are implemented to mitigate environmental impacts.

Consultation

If you wish to comment on Santos' Stairway-1 exploration drilling and site survey program, or if you require additional information, please contact Santos on the contact details below. Santos would appreciate your feedback by **9 July 2021**.

Consultation Adviser

Santos
PO Box 5624, Perth, 6831
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Email: [redacted]

STAKEHOLDER CONSULTATION

Santos

Stairway-1 Exploration Drilling and Site Survey Program

Overview

Santos proposes to undertake site surveys and drill one exploration well (Stairway-1) in petroleum exploration permit AC/P50, located in Commonwealth waters approximately 650 km from Darwin and 200 km from the nearest shoreline (see **Figure 1**).

Before Santos can undertake the site survey and drill the exploration well, the company must have an accepted Environment Plan (EP) in place for each activity. Two EPs will be developed to allow for the activities due to a difference in schedule. The EPs will be developed and implemented in accordance with the Commonwealth Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS(E)R) for acceptance by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA).

Effective 25 April 2019, exploration drilling environment plans submitted to NOPSEMA must be published on their website for a 30-day public comment period. Santos anticipates that its exploration well EP will be available for public comment in Q3 2021. Additional information on the public comment period can be found at https://info.nopsema.gov.au/home/open_for_comment.

The site survey EP is not required to be published for public comment.

EP consultation prior to submission to NOPSEMA provides for increased transparency and an opportunity for stakeholders to provide input to the environmental management of the proposed exploration drilling and site survey activity. All stakeholders are encouraged to review the consultation material contained in this document and to respond to Santos prior to the end of the public comment period.

Please advise if you have any objections, claims or information requests about the proposed activity. Santos will endeavour to address all feedback prior to the Stairway-1 exploration drilling and site survey EPs being submitted for assessment.

Site Survey Activity Description

As part of the preparatory work required to safely undertake the drilling, a site survey is required to assess the shallow seabed soils suitability to provide a safe foundation for a Mobile Offshore Drilling Unit (MODU). Santos plans to commence the site survey as early as Q4 2021 in AC/P50 with a single survey vessel.

The survey will occur within a 5km x 5km operational area in water depths of approximately 100 m and defined by coordinates listed in **Table 1**.

The surveys that may be required include geophysical and hydrographic surveys to define the seafloor and identify any debris or hazards that may impact the location of the well or MODU. Geotechnical surveys, remote operated vehicles or autonomous underwater vehicles may also be required for seabed and water sampling. Data acquired from the site survey will subsequently be processed to generate site survey reports for use in drilling the well. This data is required up to six months prior to drilling to inform planning for drilling the well.

The activity ends once the objectives of the survey have been met and the vessel has departed the operational area. No equipment will be left within the operational area after this activity.

Drilling Activity Description

Santos plans to commence drilling one well (Stairway-1) in AC/P50 with a semi-submersible or jack-up Mobile Offshore Drilling Unit (MODU). This could occur between Q2 2022 and Q4 2023 depending on which MODU is contracted for the well.

The well will be drilled within the 5km x 5km operational area in water depths of approximately 100 m and defined by coordinates listed in **Table 1**. Within the operational area, a 500m petroleum safety zone (PSZ, exclusion zone) will be established around the MODU to prevent other marine users entering this zone.

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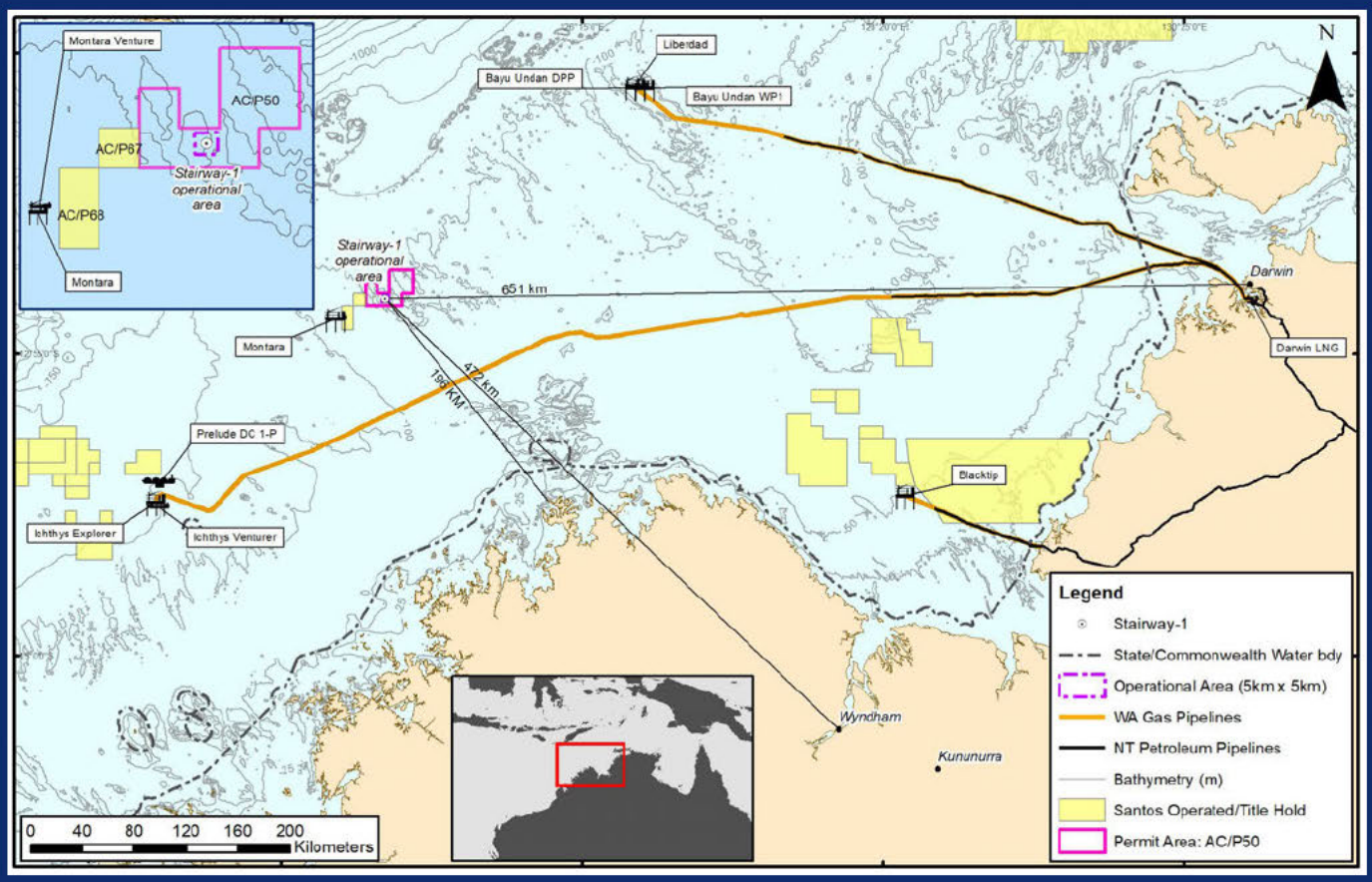

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Water Depth	Approximately 80 - 100 m		
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Hydrocarbon type	Marine diesel during the site survey. Crude oil during drilling.		
Worst case hydrocarbon spill scenario	329m^3 of diesel during site survey. 11.88 MMSTB crude oil to the sea surface over 11 weeks. Surface release of hydrocarbons from an exploration well.		
Oil spill response level required	In the event of a hydrocarbon spill, a Level 1, 2 or 3 response would be implemented as defined in the activity-specific Oil Pollution Emergency Plan (OPEP).		

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Hydrocarbon release	• NOPSEMA-accepted MODU Safety Case and Santos Well Operations Management Plan (WOMP) in place. • Prior to drilling there will be a relief well plan in place. • Appropriate refuelling procedures and equipment will be used to prevent spills to the marine environment. • Appropriate spill response plans (OPEP), equipment and materials will be in place and maintained.
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Spill response operations	• In the event of a hydrocarbon spill, the Santos OPEP requirements are implemented to mitigate environmental impacts.

Consultation

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COMMERCIAL FISHING INDUSTRY
STAKEHOLDER CONSULTATION

Santos

Stairway-1 Exploration Drilling and Site Survey Program

Overview

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Before Santos can undertake the site survey and drill the exploration well, the company must have an accepted Environment Plan (EP) in place for each activity. Two EPs will be developed to allow for the activities due to a difference in schedule. The EPs will be developed and implemented in accordance with the Commonwealth Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS(E)R) for acceptance by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA).

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Please advise if you have any objections, claims or information requests about the proposed activity. Santos will endeavour to address all commercial fishing industry feedback prior to the Stairway-1 exploration drilling and site survey EPs being submitted for assessment.

Site Survey Activity Description

As part of the preparatory work required to safely undertake the drilling, a site survey is required to assess the shallow seabed soils suitability to provide a safe foundation for a Mobile Offshore Drilling Unit (MODU). Santos plans to commence the site survey as early as Q4 2021 in AC/P50 with a single survey vessel.

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The activity ends once the objectives of the survey have been met and the vessel has departed the operational area. No equipment will be left within the operational area after this activity.

Drilling Activity Description

Santos plans to commence drilling one well (Stairway-1) in AC/P50 with a semi-submersible or jack-up Mobile Offshore Drilling Unit (MODU). This could occur between Q2 2022 and Q4 2023 depending on which MODU is contracted for the well.

The well will be drilled within the 5km x 5km operational area in water depths of approximately 100 m and defined by coordinates listed in Table 1. Within the operational area, a 500m petroleum safety zone (PSZ, exclusion zone) will be established around the MODU to prevent other marine users entering this zone.

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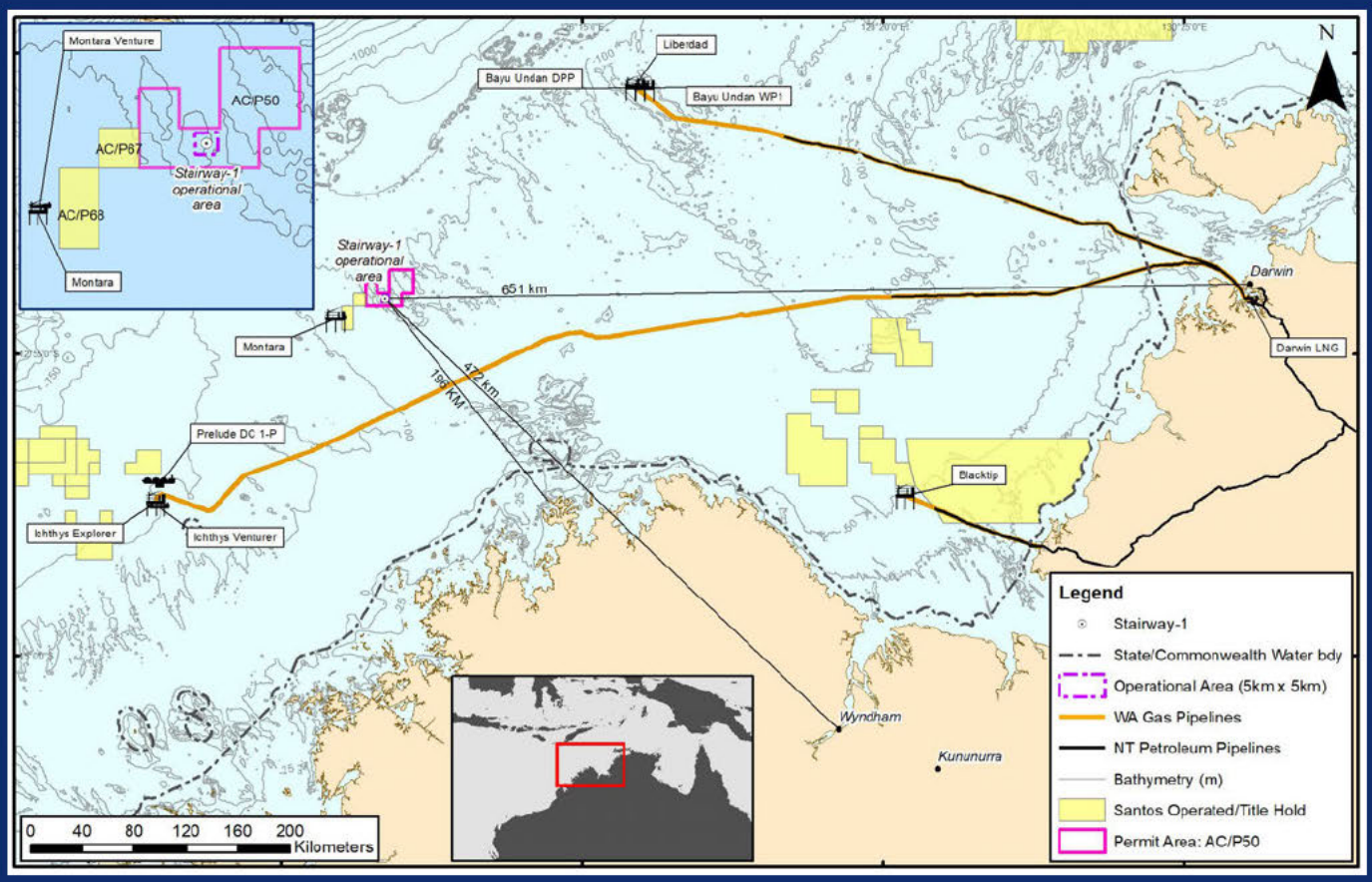

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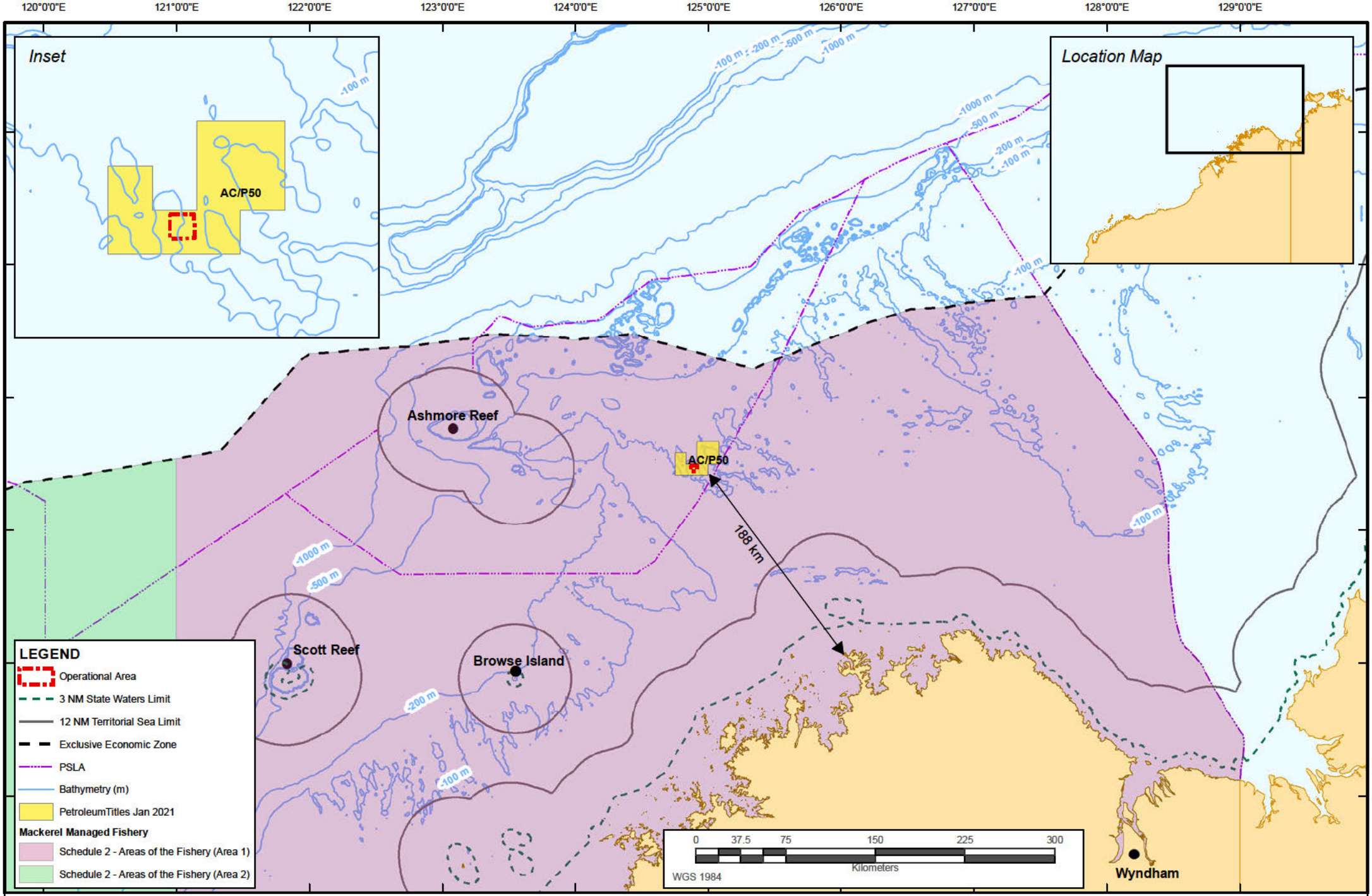
Santos

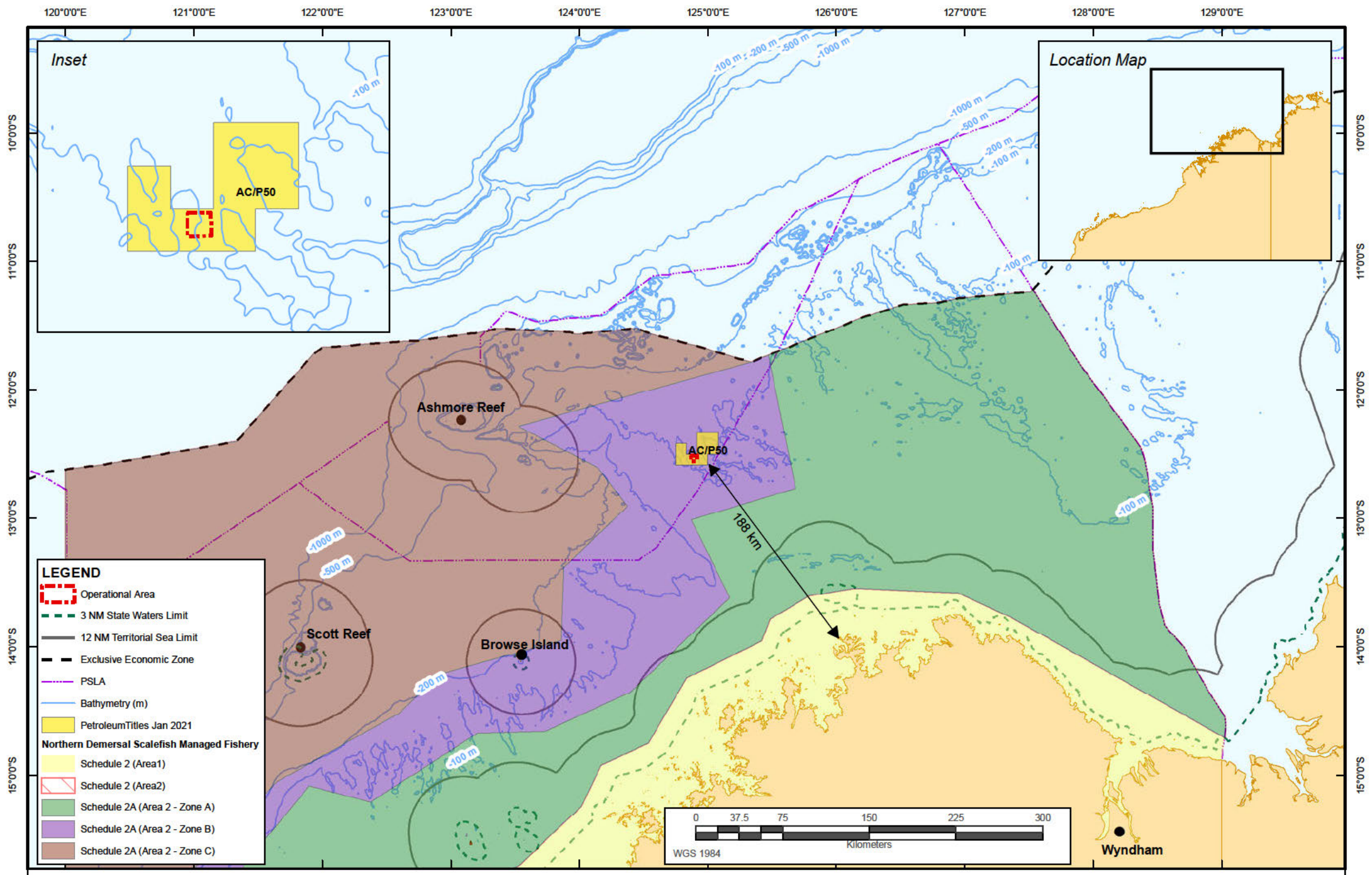
STAKEHOLDER CONSULTATION

Consultation Maps



Santos

STAIRWAY-1 EXPLORATION DRILLING
WA State Fisheries - Mackerel Managed Fishery



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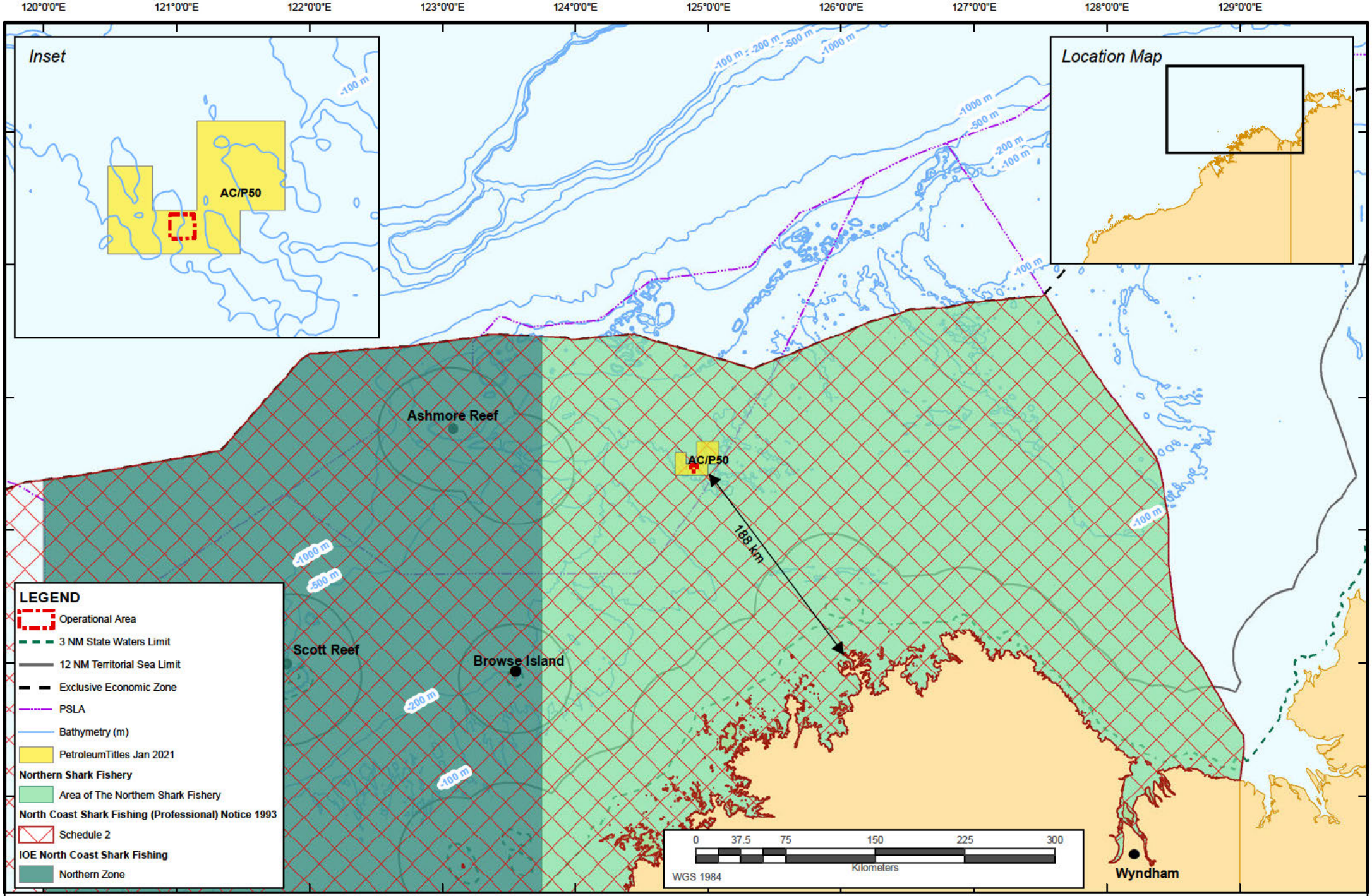
STAIRWAY-1 EXPLORATION DRILLING

WA State Fisheries - Northern Demersal Scalefish Managed Fishery



Santos

STAIRWAY-1 EXPLORATION DRILLING
WA State Fisheries - Shark Fisheries

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STAKEHOLDER CONSULTATION

Quarterly Consultation Update

Consultation, Santos

From: Consultation, Santos
Sent: Thursday, 8 July 2021 8:43 AM
Cc: Consultation, Santos
Subject: Santos | Quarterly Consultation Update July 2021
Attachments: Santos Offshore Quarterly Consultation Update July 2021.pdf

Good morning

Please find attached Santos' Offshore *Quarterly Consultation Update* for Q3 2021.

This document is intended to provide **advanced notification to allow stakeholders to identify activities that may impact them or for which more information is sought**. Information of interest to other marine users (such as commercial fishers), including water depth and exclusion zones, are provided within and a map is provided at the rear of the document.

If you have questions regarding any projects included in this document, please be in touch as soon as possible. If you would like to arrange to meet with Santos staff for a briefing session regarding the upcoming projects program, please do not hesitate to contact us and that meeting will be arranged.

I thank you for your time and continued support, your acknowledgment of receipt of this email is appreciated.

Kind regards

Santos

Aileen Stewart
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https://www.santos.com/

Quarterly Consultation Update

Santos

July 2021

This update outlines planned activities by Santos Limited (Santos) in Western Australia through Q3 2021 to Q4 2021. It is intended to provide advance notification to enable stakeholders to identify activities that may impact them, or for which more information is sought.

This document is provided in accordance with State and Commonwealth regulatory consultation guidelines, and can be supplemented with detailed project information packages or briefing sessions from Santos by request, using the contact details provided below.

Please note that the scheduling of activities can change for reasons including vessel and equipment availability and regulatory approvals. If there are any significant changes made to scheduling, stakeholders will be advised.

A summary of Santos' current operating facilities is also provided.

The spatial locations of activities described throughout this document can be found in the tables within, and in figures at the end of, this update.

Potential impact to stakeholder interests

When reviewing Santos' activities within this document, please consider how they may impact your area of interest as an individual stakeholder.

Impacts to stakeholders may include exclusion zones for short and long term projects. For example, the gazetted exclusion zone around a drilling rig is 500 metres (m), while the exclusion zone around a slow-moving vessel, towing seismic streamers, can be larger.

This may impact mariner access to an area during a proposed activity. Santos recommends stakeholders assess all information provided and seek additional information if required.

Operational activities relate to operations at Varanus Island, Burrup Pipeline, Devil Creek and the *Ningaloo Vision* Floating Production Storage and Offloading (FPSO) facilities. These facilities have an existing exclusion zone which has been in place for an extended period of time.

Thank you for taking the time to review this update. Stakeholder feedback is valuable before, during and after activities, so if you have any concerns or queries relating to the activities described in this document, please feel free to contact us at the email below.

Contact Us

Santos
Ph: (08) 6218 7095
Email: offshore.consultation@santos.com
Web: http://Santos.com/

Proposed Western Australia offshore activities

This table gives key information on upcoming activities that are proposed to occur from Q3 2021

Activity Name	Type of Activity	Permit Number	Latitude	Longitude	Water Depth (approx.)	Start date estimate	End date estimate	Exclusion zone details
Vessel Based Activity (Commonwealth Waters)	Geophysical & Geotechnical Multi-Site Surveys & Multi-year	WA-437-P WA-438-P WA-541-P WA-1-P WA-209-P WA-41-L WA-33-R WA-510-P	Coordinates available on request		40 m to 110 m	Q2 2021	Q2 2026	N/A
Varanus Island A Tank Demolition (Onshore)	Demolition	PL-29	Coordinates available on request		N/A	Q3 2021	Q3 2021	N/A
Pavo-1 (Bedout Basin) (Commonwealth Waters)	Exploration Drilling	WA-438-P	Coordinates available on request		40 m to 110 m	Q1 2022	Estimated completion up to 80 days after start date	500m around MODU
Dancer-1 (Commonwealth Waters)	Exploration Drilling	WA-1-P	19° 58’ 19.30” S	116° 20’ 56.51” E	Approx. 63 m	Q4 2021	Estimated completion up to 75 days after start date	500m around MODU
Stairway -1 (Commonwealth Waters)	Geophysical & Geotechnical Site Survey	AC/P50	12° 30’ 28.575” S / 124° 52’ 03.378” E 12° 30’ 27.412” S / 124° 54’ 48.955” E 12° 33’ 10.095” S / 124° 54’ 50.155” E 12° 33’ 11.262” S / 124° 52’ 04.550” E		80 – 100 m	Q4 2021 to Q3 2022	Estimated completion up to 10 days after start date	N/A
Yoorn-1 (Commonwealth and State waters)	Geophysical & Geotechnical Site Survey	WA-499-P TL-5 TP-27 TP-8	Coordinates available on request		40 – 50 m	Q1/Q2 2022	2-10 days after start date	N/A

Activity Name	Type of Activity	Permit Number	Latitude	Longitude	Water Depth (approx.)	Start date estimate	End date estimate	Exclusion zone details
Petrel (Commonwealth waters)	Seismic Survey	WA-454-P, WA-27-R, WA-40-R, NT/P84	Coordinates available on request		59 m to 103 m	Between 1 Dec 2021 and 31 March 2022 or 1 Dec 2022 and 31 March 2023		3 nm Area of Avoidance requested around vessel and streamers
Apus-1 (Bedout Basin) (Commonwealth Waters)	Exploration Drilling	WA-437-P	Coordinates available on request		40 m to 110 m	Q1 2022	Estimated completion up to 80 days after start date	500m around MODU
Stairway-1 (Commonwealth Waters)	Exploration Drilling	AC/P50	Coordinates available on request		80 – 100 m	Q2 2022 and Q4 2023	Estimated completion up to 80 days after start date	500m around MODU
Spartan-2 (Commonwealth Waters)	Production well and Tie In	WA-33-R	20° 32’ 4.4706” S / 115° 14’52.8985” E		60 m	Q3 2022	Q1 2023	500 m around MODU and John Brookes facility
Harriet Joint Venture (Harriet Alpha, Simpson Alpha, Simpson Bravo, Bambra Sea Pole) (State waters)	Plug & Abandonment	TL/1	Harriet Alpha: 20° 36’ 06.47" S, 115° 36’ 51.12" E Simpson Alpha: 20° 40' 20.00” S, 115° 35' 07.76” E Simpson Bravo: 20° 40' 24.27” S, 115° 35' 05.66” E Bambra Sea Pole: 20° 32' 50.45” S, 115° 36' 16.88” E		6 to 27 m	Q1 2022	Within 5 years of commencement of EP	500 m around each facility, well and MODU.
Yoorn, Parnassus and Jelen (Commonwealth Waters)	Exploration Drilling and Geotechnical Survey	WA-499-P WA-208-P WA-546-P	Coordinates available on request		40 – 60 m	Q2 2022 (Yoorn-1) Q3/4 Parnassus and Jelen	Estimated completion up to 80 days after start date of each well	500m around MODU. Survey areas are 500m around well centers

Current offshore activities

Santos provides an update on ongoing activities in Q3 2021.

Activity Name	Type of Activity	Permit Number	Latitude	Longitude	Water Depth (approx.)	Start date	End date estimate	Exclusion zone details
Varanus Island Compression Project (Onshore)	Compression Facility Installation	PL-29 PL-12	Coordinates available on request		N/A	Q4 2021 to Q1 2022	Estimated Completion Q1 2022	N/A
Keraudren Extension (Commonwealth Waters)	Seismic Survey	WA-435-P WA-436-P WA-437-P WA-438-P	Coordinates available on request		>50 to 200 m	Q2 2021	31 July 2021	3 nautical miles around vessel and streamers
Sinbad Campbell Asset Removal (State Waters)	Asset removal	TL/5	Sinbad 20° 28' 52.62" S, 115° 42' 44.36 E Campbell 20° 24' 46.67" S, 115° 43' 51.56" E		40 m	Q4 2020 – Q3 2021	Estimated completion up to 60 days after start of removal campaign for each asset	500m around vessel
Van Gogh (Phase 2) (Commonwealth Waters)	Infill Drilling	WA-35-L	21° 20' 57.29" S	114° 04' 23.613" E	380 m	Q2 2021	Q4 2021	500m around MODU
Van Gogh (Phase 2) (Commonwealth Waters)	Installation & Commissioning	WA-35-L	21° 20' 57.29" S	114° 04' 23.613" E	380 m	Q2 2021	Q4 2021	500m around installation vessel

Completed offshore activities

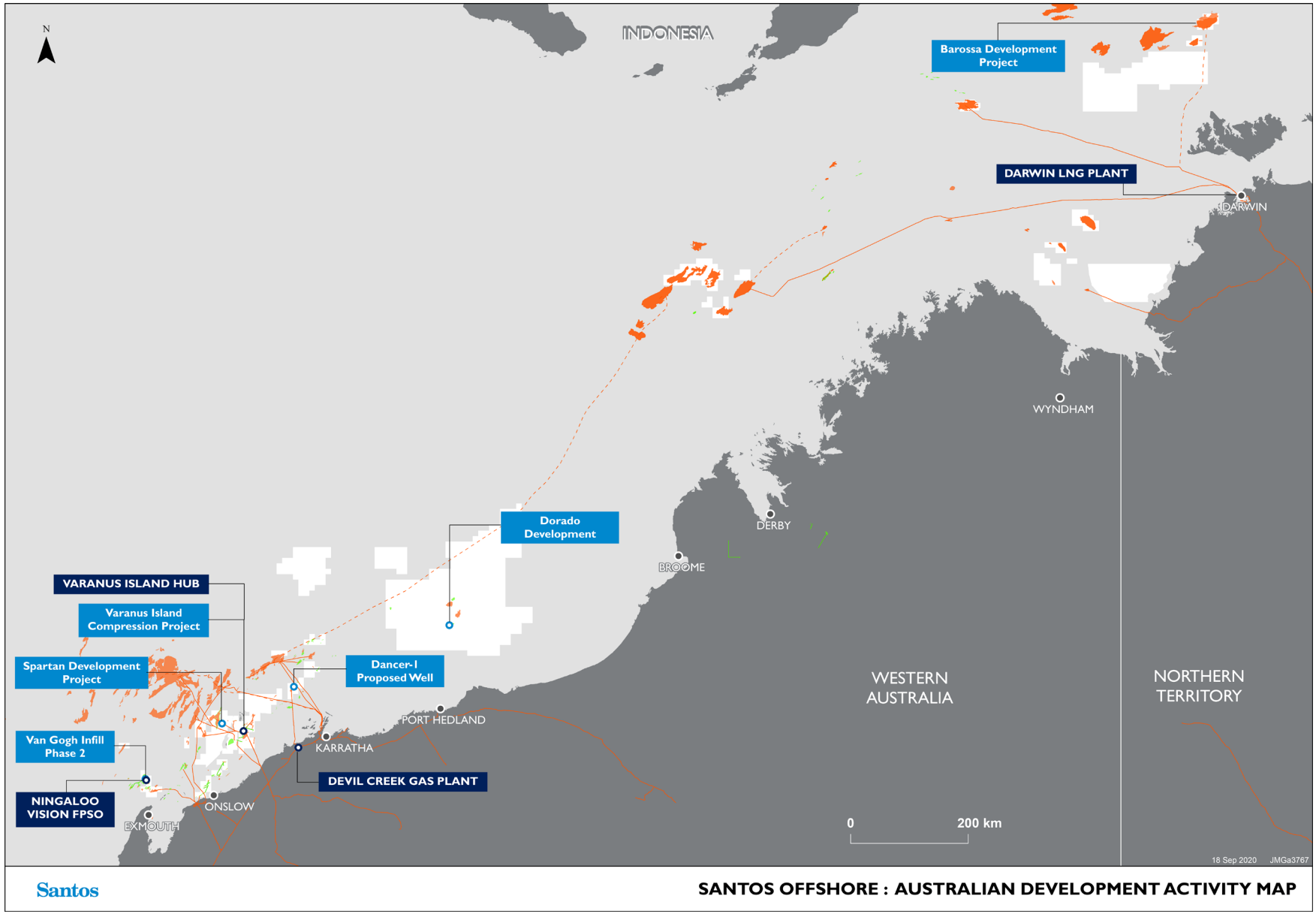
Santos provides an update on activities previously consulted and now completed.

Activity Name	Type of Activity	Permit Number	Water Depth	Latitude	Longitude
Archer (Commonwealth Waters)	Seismic Survey	WA-437-P WA-541-P	70 to 96 m	Coordinates available on request	
Legendre (Commonwealth Waters)	Site Survey	WA-20-L	Approx. 52m	Coordinates available on request	

Santos' West Australian operations

Santos provides an overview of existing operations on the North West Shelf.

Operational Activity Name	Type of Activity	Water depth	Exclusion zone	Update
Devil Creek Gas Plant (Reindeer facility, pipeline and gas plant)	Gas Production	Reindeer platform at 61 m	500 m around Reindeer Platform	Ongoing operations.
Varanus Island Hub (State and Commonwealth waters)	Oil & Gas Production	Various offshore platforms from	500 m around all offshore platforms (coordinates available on request)	Ongoing operations. Environmental monitoring program ongoing at Varanus Island.
Mutineer-Exeter Field	Ceased Production	130 – 160 m	None	Production from the field has ceased and subsea infrastructure is currently preserved.
Burrup Lateral Gas	Gas Supply	Onshore	Onshore	Ongoing operations.
***Ningaloo Vision* FPSO**	Oil Production	340 m	500 m around FPSO	Ongoing operations.


N
INDONESIA
Barossa Development Project
DARWIN LNG PLANT
DARWIN
WYNDHAM
DERBY
BROOME
Dorado Development
VARANUS ISLAND HUB
Varanus Island Compression Project
Spartan Development Project
Dancer-1 Proposed Well
PORT HEDLAND
KARRATHA
Van Gogh Infill Phase 2
DEVIL CREEK GAS PLANT
NINGALOO VISION FPSO
ONSLOW
EXMOUTH
WESTERN AUSTRALIA
NORTHERN TERRITORY
0
200 km
18 Sep 2020 JMGa3767
Santos
SANTOS OFFSHORE : AUSTRALIAN DEVELOPMENT ACTIVITY MAP

APPENDIX E
Environment Consequence Descriptors

Excerpt from *Offshore Division Environmental Hazard Identification and Assessment Guideline* (EA-91-IG-00004), Revision 5 (Issued October 2020).

	Consequence Level	I	II	III	IV	V	VI
	Acceptability	**Acceptable**	**Acceptable**	**Unacceptable**	**Unacceptable**	**Unacceptable**	**Unacceptable**
	Severity Description	**Negligible** ***No impact or negligible impact***	**Minor** ***Detectable but insignificant change to local population, industry or ecosystem factors. Localised effect***	**Moderate** ***Significant impact to local population, industry or ecosystem factors***	**Major** ***Major long-term effect on local population, industry or ecosystem factors***	**Severe** ***Complete loss of local population, industry or ecosystem factors AND/ OR extensive regional impacts with slow recovery***	**Critical** ***Irreversible impact to regional population, industry or ecosystem factors***
Environmental Receptors	Fauna In particular, EPBC Act listed threatened/migratory fauna or *WA Biodiversity Conservation Act 2016* specially protected fauna	Short term behavioural impacts only to small proportion of local population and not during critical lifecycle activity; No decrease in local population size; No reduction in area of occupancy of species; No loss/disruption of habitat critical to survival of a species; No disruption to the breeding cycle of any individual; No introduction of disease likely to cause a detectable population decline.	Detectable but insignificant decrease in local population size; Insignificant reduction in area of occupancy of species; Insignificant loss/disruption of habitat critical to survival of a species; Insignificant disruption to the breeding cycle of local population.	Significant decrease in local population size but no threat to overall population viability; Significant behavioural disruption to local population; Significant disruption to the breeding cycle of a local population; Significant reduction in area of occupancy of species; Significant loss of habitat critical to survival of a species; Modify, destroy, remove, isolate or decrease availability of quality of habitat to the extent that a significant decline in local population is likely; Introduce disease likely to cause a significant population decline.	Long term decrease in local population size and threat to local population viability; Major disruption to the breeding cycle of local population; Major reduction in area of occupancy of species; Fragmentation of existing population; Major loss of habitat critical to survival of a species; Modify, destroy, remove, isolate or decrease availability of quality of habitat to the extent that a long term decline in local population is likely; Introduce disease likely to cause a long term population decline.	Complete loss of local population; Complete loss of habitat critical to survival of local population; Wide spread (regional) decline in population size or habitat critical to regional population.	Complete loss of regional population; Complete loss of habitat critical to survival of regional population.
	Physical Environment/Habitat Includes: air quality; water quality; benthic habitat (biotic/abiotic), particularly habitats that are rare or unique; habitat that represents a Key Ecological Feature[4]; habitat within a protected area; habitats that include benthic primary producers[5] and/or epi-fauna[6]	No or negligible reduction in physical environment/habitat area/function.	Detectable but localised and insignificant loss of area/function of physical environment/habitat. Rapid recovery evident within approximately two years (two season recovery).	Significant loss of area and/or function of local physical environment/habitat. Recovery over medium term (2–10 years)	Major, large-scale loss of area and/or function of physical environment/local habitat. Slow recovery over decades.	Extensive destruction of local physical environment/habitat with no recovery; Long term (decades) and wide spread loss of area or function of primary producers on a regional scale.	Complete destruction of regional physical environment/habitat with no recovery. Complete loss of area or function of primary producers on a regional scale.
	Threatened ecological communities (EPBC Act listed ecological communities)	No decline in threatened ecological community population size, diversity or function; No reduction in area of threatened ecological community; No introduction of disease likely to cause decline in threatened ecological community population size, diversity or function.	Detectable but insignificant decline in threatened ecological community population size, diversity or function; Insignificant reduction in area of threatened ecological community.	Significant decline in threatened ecological community population size, diversity or function; Significant reduction in area of threatened ecological community; Introduction of disease likely to cause significant decline in threatened ecological community population size, diversity or function.	Major, long term decline in threatened ecological community population size, diversity or function; Major reduction in area of threatened ecological community; Fragmentation of threatened ecological community; Introduce disease likely to cause long term decline in threatened ecological community population size, diversity or function.	Extensive, long term decline in threatened ecological community population size, diversity or function; Complete loss of threatened ecological community.	Complete loss of threatened ecological community with no recovery.

[4] As defined by the Department of Agriculture, Water and Environment (DaWE)
[5] Benthic photosynthetic organisms such as seagrass, algae, hard corals and mangroves
[6] Fauna attached to the substrate including sponges, soft corals and crinoids.

Consequence Level		I	II	III	IV	V	VI
Acceptability		Acceptable	Acceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable
Severity Description		Negligible *No impact or negligible impact*	Minor *Detectable but insignificant change to local population, industry or ecosystem factors. Localised effect*	Moderate *Significant impact to local population, industry or ecosystem factors*	Major *Major long-term effect on local population, industry or ecosystem factors*	Severe *Complete loss of local population, industry or ecosystem factors AND/ OR extensive regional impacts with slow recovery*	Critical *Irreversible impact to regional population, industry or ecosystem factors*
	Protected Areas Includes: World Heritage Properties; Ramsar wetlands; Commonwealth/ National Heritage Areas; Land/ Marine Conservation Reserves.	No or negligible impact on protected area values; No decline in species population within protected area; No or negligible alteration, modification, obscuring or diminishing of protected area values.*	Detectable but insignificant impact on one of more of protected area's values. Detectable but insignificant decline in species population within protected area. Detectable but insignificant alteration, modification, obscuring or diminishing of protected area values.*	Significant impact on one of more of protected area's values; Significant decrease in population within protected area; Significant alteration, modification, obscuring or diminishing of protected area values.	Major long_term effect on one of more of protected area's values; Long-term decrease in species population contained within protected area and threat to that population's viability; Major alteration, modification, obscuring or diminishing of protected area values.	Extensive loss of one or more of protected area's values; Extensive loss of species population contained within protected area.	Complete loss of one or more of protected area's values with no recovery; Complete loss of species population contained within protected area with no recovery.
	Socio-economic receptors Includes: fisheries (commercial and recreational); tourism; oil and gas; defence; commercial shipping.	No or negligible loss of value of the local industry; No or negligible reduction in key natural features or populations supporting the activity.	Detectable but insignificant short-term loss of value of the local industry. Detectable but insignificant reduction in key natural features or population supporting the local activity.	Significant loss of value of the local industry; Significant medium term reduction of key natural features or populations supporting the local activity.	Major long-term loss of value of the local industry and threat to viability; Major reduction of key natural features or populations supporting the local activity.	Shutdown of local industry or widespread major damage to regional industry; Extensive loss of key natural features or populations supporting the local industry.	Permanent shutdown of local or regional industry; Permanent loss of key natural features or populations supporting the local or regional industry.