Santos

BAROSSA SUBSEA INFRASTRUCTURE INSTALLATION ENVIRONMENT PLAN

Rev	Rev Date	Author / Editor	Amendment
0	17/10/2023	Santos	Issued to NOPSEMA

Abbreviations and definitions

Abbreviation	Description
″	inch
°C	Degrees Celsius
µm	Micrometre; 1 µm = 10^{-6} metre = 0.000001 metre or one millionth of a metre
µPA	micropascal
3D	3-dimensional
ABF	Australian Border Force
ACMA	Australian Communications and Media Authority
ADBAC	alkyl dimethyl benzyl ammonium chloride
AFANT	Amateur Fishermen's Association of the Northern Territory
AFANT	Amateur Fishers Association Northern Territory
AFMA	Australian Fisheries Management Authority (Cth)
AHO	Australian Hydrographic Office
AHT	anchor handling tug
ALAN	artificial light at night
ALARP	as low as reasonably practicable
ALR Act	*Aboriginal Land Rights (Northern Territory) Act 1976* (Cth)
AMCS-NT	Australian Marine Conservation Society – NT
AMOSC	Australian Marine Oil Spill Centre
AMP	Australian Marine Park
AMSA	Australian Maritime Safety Authority
AMSA-NT	Australian Marine Sciences Association - NT
AMT-TL	Association of Marine Tourism Timor-Leste
ANZECC	Australian and New Zealand Environment and Conservation Council
Appeal Judgment	*Santos NA Barossa Pty Ltd v Tipakalippa* [2022] FCAFC 193
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ASBTIA	Australian Southern Bluefin Tuna Industry Association
ATSEA	Arafura and Timor Seas Ecosystem Action
ATSIHP Act	*Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (Cth)
BIA	biologically important area
BODIS	biodegradability of insoluble substances
CCWA	Conservation Council of WA
CEFAS	Centre for Environment, Fisheries and Aquaculture Science (UK)
CFA	Commonwealth Fisheries Association

Abbreviation	Description
CH_4	methane
CHARM	chemical hazard and risk management
CM	control measure
cm	centimetre
CMID	Common Marine Inspection Document
CMT	crisis management team
CO_2	carbon dioxide
CO_2-e	carbon dioxide equivalent
CoA	Commonwealth of Australia
COLREGs	International Regulations for Preventing Collisions at Sea
cP	centipoise
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAFF	Department of Agriculture, Fisheries and Forestry (Cth)
DAWE	Department of Agriculture, Water and the Environment (Cth) (now DCCEEW and DAFF)
dB	decibel
dB peak	The peak; maximum value reached by the sound pressure; C-weighted scale
dB re 1 µPa	decibels relative to one micropascal; the unit used to measure the intensity of an underwater sound
dB(A)	decibel; A-weighted scale
DBCA-WA	Department of Biodiversity, Conservation and Attractions (WA)
DCCEEW	Department of Climate Change, Energy, the Environment and Water (Cth)
DEPWS	Department of Environment, Parks and Water Security (NT)
DEWHA	Department of the Environment, Water, Heritage and the Arts (Cth) (now DCCEEW)
DFAT	Department of Foreign Affairs and Trade (Cth)
DIPL-NT	Department of Infrastructure, Planning and Logistics (NT)
DISER	Department of Industry, Science, Energy and Resources (Cth) (now DISR)
DISR	Department of Industry, Science and Resources (Cth)
DITRDCA	Department of Infrastructure, Transport, Regional Development, Communications and the Arts (Cth)
DITT-NT	Department of Industry (NT)
DNP	Director of National Parks
DoD	Department of Defence
DoE	Department of Environment (Commonwealth) (now DCCEEW)
DoEE	Department of the Environment and Energy (Cth) (now DCCEEW)
DoEH	Department of the Environment and Heritage (Cth)
DP	dynamic positioning

Abbreviation	Description
DPIRD	Department of Primary Industries and Regional Development (WA)
Drilling EP	Barossa Development Drilling and Completions EP (BAD-200 0003)
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities (Cth) (now DCCEEW)
e.g.	for example
EC_{10}	a concentration or dose that yields biological effects in 10% of test animals/species
EC_{50}	median effective concentration, concentration at which 50% of the test organisms are immobilised
ECNT	Environment Centre Northern Territory
EEZ	exclusive economic zone
ELC_{50}	median effective concentration, concentration at which death results for 50% of the test organisms
EMBA	environment that may be affected
EDO	Environmental Defenders Office
ENVID	environmental hazard identification workshop
EP	environment plan
EP Consultation Guidance	NOPSEMA guidance GL2086 – Consultation in the course of preparing an environment plan – May 2023
EPA	Environment Protection Authority (NT)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
EPBC Regulations	Environment Protection and Biodiversity Regulations 2000 (Cth)
EPO	environmental performance outcome
EPS	environmental performance standard
ErC_{50}	median effective concentration, concentration which results in a 50% reduction in algal growth
ESD	ecologically sustainable development
FCGT	flood, clean, gauge and pressure testing
FLET	flowline end termination
FPSO	floating production, storage and offloading
g/m^2	gram per square metre
GDA94	Geocentric Datum of Australia 1994
GEP	gas export pipeline
GHG	greenhouse gas
h	hour
ha	hectare
HFO	heavy fuel oil
HOCNF	harmonised offshore chemical notification format

Abbreviation	Description
hp	horsepower
HQ	hazard quotient
HSE	health, safety and environment
Hz	hertz
i.e.	that is
IBC	intermediate bulk container
IFO	intermediate fuel oil
IMCA	International Maritime Contractors Association
IMCRA	Integrated Marine and Coastal Regionalisation of Australia
IMO	International Maritime Organization
IMP	introduced marine pest
IMR	inspection, maintenance and repair activities
IMS	invasive marine species
IMT	incident management team
INMARSAT-C	International Maritime Satellite C
ISO	International Organization for Standardization
IUCN	International Union for Conservation of Nature
JRCC	Joint Rescue Coordination Centre
Judgment	*Tipakalippa v National Offshore Petroleum Safety and Environmental Management Authority (No 2)* [2022] FCA 1121
KEF	key ecological feature
kg	kilogram
kHz	kilohertz
KLC	Kimberley Land Council
km	kilometre
km^2	square kilometre
kW	kilowatt
L	litre
L/kg	litres per kilogram
LBL	long baseline acoustic underwater positioning array
LC_{50}	concentration at which there is mortality of 50% of a group of specific test species
LED	light-emitting diode
LEVA	low exposure value area
LNG	liquefied natural gas
LOEC	lowest observed effect concentration
LWIV	light well intervention vessel

Abbreviation	Description
m	metre
m^2	square metre
m^3	cubic metre
MARPOL	International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978; also known as MARPOL 73/78
MARS	Maritime Arrivals Reporting System
MBES	multibeam echo sounder
MC	measurement criteria
MDO	marine diesel oil
MEG	monoethylene glycol
MEVA	moderate exposure value area
mg/L	milligrams per litre
MGO	marine gas oil
MLBE	mooring line buoyancy element
mm	millimetre
MMO	marine mammal observer
MNES	matters of national environmental significance
MoC	management of change
MODU	mobile offshore drilling unit
MoU	memorandum of understanding
MPA	Marine Protected Areas
MPNMP	Marine Park Network Management Plan
Mt	million tonnes
N/A	not applicable
N_2O	nitrous oxide
NEBA	net environmental benefit analysis
NGER	National Greenhouse and Energy Reporting
NGER Act	*National Greenhouse and Energy Reporting Act 2007* (Cth)
NH_4HSO_3	ammonium bisulfite
NIAA	National Indigenous Australians Agency
NLC	Northern Land Council
Nm	nautical mile
NMFS	National Marine Fisheries Service (US)
NMR	North Marine Region
NOAA	National Oceanic and Atmospheric Administration (US)
NOEC	no observed effect concentration

Abbreviation	Description
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NOPTA	National Offshore Petroleum Titles Administrator
NO_x	oxides of nitrogen
NPFI	Northern Prawn Fishery Industry
NSF	National Science Foundation (US)
NT	Northern Territory
NT Act	*Native Title Act 1993* (Cth)
NTASS Act	*Northern Territory Aboriginal Sacred Sites Act 1989* (NT)
NTGFIA	Northern Territory Guided Fishing Industry Association
NTSC	Northern Territory Seafood Council
NWMR	North-West Marine Region
OA	Operational Area as defined in Section 2.3
OCIMF	Oil Companies International Marine Forum
OCNS	Offshore Chemical Notification Scheme
ODS	ozone-depleting substance
OECD	Organisation for Economic Co-operation and Development
OPEP	oil pollution emergency plan
OPGGS Act	*Offshore Petroleum and Greenhouse Gas Storage Act 2006* (Cth)
OPGGS(E)R	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth)
OPP	Barossa Area Development Offshore Project Proposal accepted by NOPSEMA in March 2018
OSPAR	Oslo–Paris Convention for the Protection of the Marine Environment of the North East Atlantic
OVID	Offshore Vessel Inspection Database
PC	protection concentration; e.g. PC99 is 99% protection concentration, PC95 is 95% protection concentration etc.
pig	pipeline inspection gauge
PLET	pipeline end termination
PLONOR	pose little or no risk
PMST	Protected Matters Search Tool
POB	persons on board
PPA	Pearl Producers Association
ppb	parts per billion
ppm	parts per million
PSZ	petroleum safety zone
PTS	permanent threshold shift

Abbreviation	Description
PTW	permit to work
Q1, Q2, etc.	3-monthly quarter of a calendar year; e.g. Q1 = January to March
Ramsar	Convention on Wetlands of International Importance
Relevant Person	As set out in Regulation 11A(1)(a)-(e) of the OPGGS(E)R
Rmax	maximum range
ROV	remotely operated vehicle
RPS APASA	RPS Asia-Pacific Applied Science Associates (company)
SDS	safety data sheet
SEL	sound exposure level
SEL_{cum}	cumulative sound exposure level
SITREP	situation report
SMPEP	shipboard marine pollution emergency plan
SO_2	sulfur dioxide
SOLAS	(International Convention for the) Safety of Life at Sea
SOPEP	shipboard oil pollution and emergency plan
SPL	sound pressure level
SSS	side-scan sonar
STCW	International Convention on Standards of Training, Certification and Watchkeeping
STP	submerged turret production
SURF	subsea umbilicals, risers and flowlines
t	tonne
T&I	transport and installation
THS	tubing head spool
TLC	Tiwi Land Council
TTS	temporary threshold shift
UCH Act	*Underwater Cultural Heritage Act 2018* (Cth)
UK	United Kingdom
US	United States
USBL	ultra short baseline
UTA	umbilical termination assembly
UV	ultraviolet
WA	Western Australia
WA DoT	Department of Transport (WA)
WAFIC	Western Australian Fishing Industry Council
WHO	World Health Organization
WWF	World Wildlife Fund

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1 Introduction

1.1 Environment plan summary

Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS(E)R 2009) requirements
Regulation 11(3)
Within 10 days after receiving notice that the Regulator has accepted an Environment Plan (EP) (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 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; ix. details of the titleholder's nominated liaison person for the activity; and b. must be to the satisfaction of the Regulator.

A summary will be prepared as required by Regulation 11(4) drawing on the following sections of this EP.

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 Appendix C
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
The arrangements for ongoing monitoring of the titleholder's environmental performance	Section 8
Response arrangements in the Oil Pollution Emergency Plan	Section 8.5 and Barossa Subsea Infrastructure Installation Oil Pollution Emergency Plan (BAS-210 0109)
Consultation already undertaken and plans for ongoing consultation	Sections 3.2.5.10, 4 and 8
Details of the titleholders nominated liaison person for the activity	Section 1.5.1

1.2 Activity overview

Santos NA Barossa Pty Ltd (Santos) proposes to install a part of the Barossa Gas Project relating to the Barossa subsea umbilicals, risers and flowlines (SURF), manifolds and floating production, storage and offloading (FPSO) moorings installation (collectively referred to as subsea infrastructure) and pre-commissioning activity. This is more simply referred to as the 'Activity'.

The Activity is proposed within Commonwealth waters, approximately 300 km north-north-west of Darwin, Northern Territory (NT), within the boundaries of the Commonwealth Petroleum Production Licence NT/L1 (Figure 1-1).

The petroleum activity covered in this EP is part of the Barossa Development. The Barossa Development is described in the Barossa Development Offshore Project Proposal (OPP) (ConocoPhillips, 2018), which was accepted by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) in March 2018.

This EP identifies and evaluates environmental impacts and risks associated with the Activity.

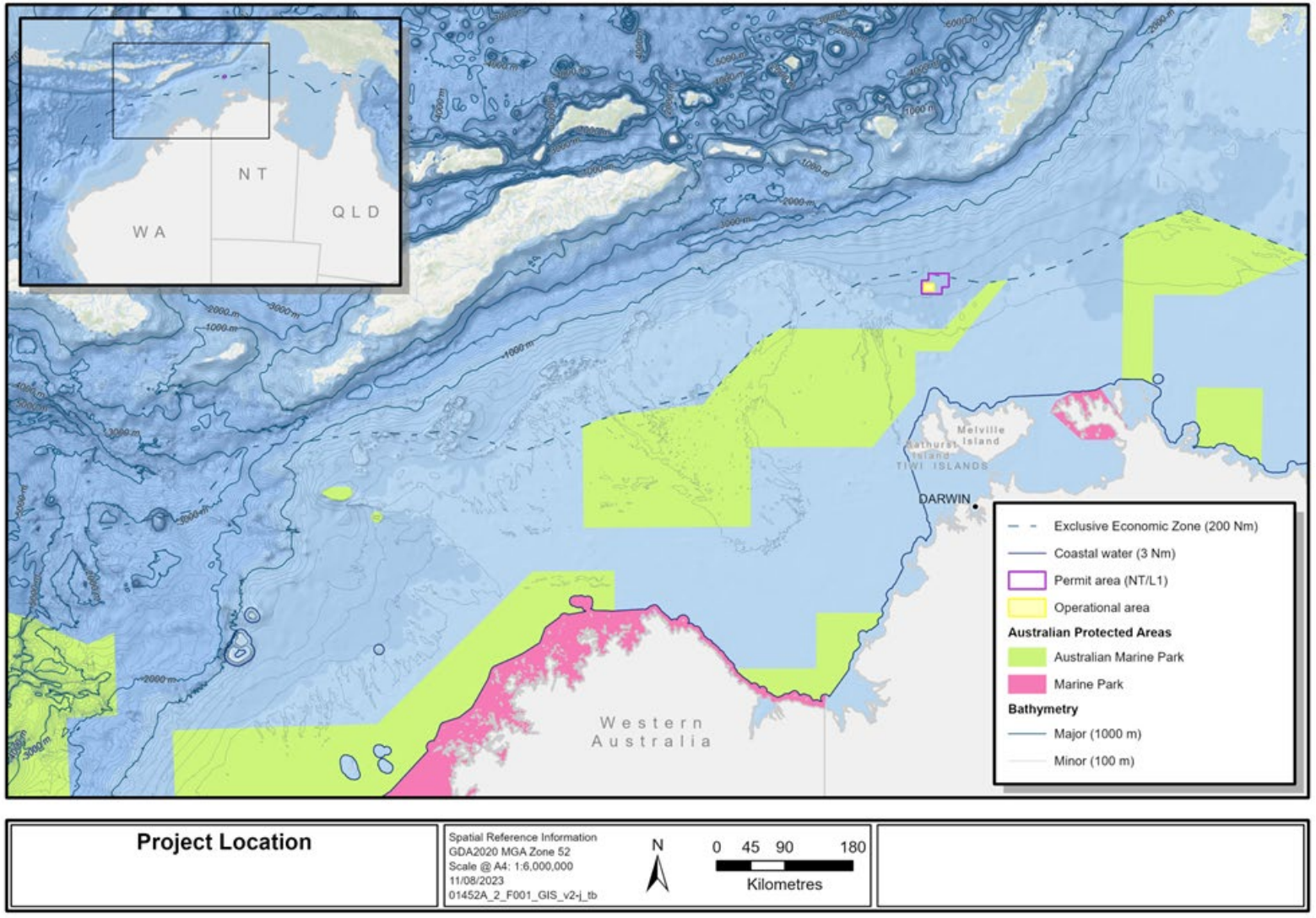


Figure 1-1: Location of the proposed Activity

1.3 Purpose of this Environment Plan

OPGGS(E)R 2009 Requirements
Regulation 10A
For Regulation 10, the criteria for acceptance of an environment plan are that the plan: a. is appropriate for the nature and scale of the activity; and b. demonstrates that the environmental impacts and risks of the activity will be reduced to as low as reasonably practicable; and c. demonstrates that the environmental impacts and risks of the activity will be of an acceptable level; and d. provides for appropriate environmental performance outcomes, environmental performance standards and measurement criteria; and e. includes an appropriate implementation strategy and monitoring, recording and reporting arrangements; and f. does not involve the activity or part of the activity, other than arrangements for environmental monitoring or for responding to an emergency, being undertaken in any part of a declared World Heritage property within the meaning of the *Environment Protection and Biodiversity Conservation Act* (EPBC Act); and g. demonstrates that: i. the titleholder has carried out the consultations required by Division 2.2A; and ii. the measures (if any) that the titleholder has adopted, or proposes to adopt, because of the consultations are appropriate; and h. complies with the Act and the regulations.

This EP has been prepared in accordance with the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth) (OPGGS(E)R) for acceptance by 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 will be of an acceptable level. The EP's implementation strategy will be used to measure and report on environmental performance to demonstrate that impacts and risks are being continuously reduced to ALARP and are at an acceptable level. The environmental management of the activity described in the EP complies with Santos' Environment, Health and Safety Policy (Appendix A) and with all relevant legislation (Appendix B). This EP documents and considers all Relevant Persons consultation undertaken in the course of preparing the EP (Section 3.2.5.10).

1.4 Environment plan validity

This EP is valid for 5 years from the date that it is accepted by NOPSEMA, or until submission and acceptance of a Regulation 25A end-of-operation of EP notification, whichever comes first.

There will be an interim preservation period from the end of pre-commissioning activities to the commencement of the activities covered under the Barossa Production Operations EP (BAA-200 0637). The end-of-operation of EP notification will occur at the completion of the interim preservation period. Activities undertaken during the preservation period are within the scope of this EP.

Santos may revise this EP, using the Management of Change (MoC) process described in Section 8.9.2.

1.5 Operator and titleholder details

OPGGS(E)R 2009 Requirements
Regulation 15. Details of titleholder and liaison person
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 Australian Company Number (ACN) (within the meaning of the *Corporations Act 2001*) - ACN. 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). 15(3) The environment plan must include arrangements for notifying the Regulator of a change in the titleholder, a change in the titleholder's nominated liaison person or a change in the contact details for either the titleholder or the liaison person.

The titleholder details are provided in Table 1-1, with the nominated operator shown in bold.

Table 1-1: Titleholder details for the Activity

Title	Titleholder (nominated operator in bold)	ACN	Interest (%)	Contact details
NT/L1	**Santos NA Barossa Pty Ltd**	**109 974 932**	**25.0**	Business address: Level 7, 100 St Georges Terrace, Perth WA 6000 Phone: (08) 6218 7100 Fax: (08) 6218 7200 Email: **barossa.regulatory@santos.com**
	Santos Offshore Pty Ltd	005 475 589	25.0	
	SK E&S Australia Pty Ltd	158 702 071	37.5	Business address: Level 6, 60 Martin Place, Sydney NSW 2000 Phone: (02) 2121 3304 Fax: None Email: **upstream@sk.com**
	JERA Barossa Pty Ltd	654 004 387	12.5	Business address: Level 9, Brookfield Place, 125 St Georges Terrace, Perth WA 6000 Phone: (08) 6311 7610 Fax: (08) 6311 7613 Email: **barossa@jeraaustralia.com.au**

1.5.1 Details for nominated liaison person

Details for Santos' nominated liaison person for the activity are:

Name:	Michael Marren
Business address:	Level 7, 100 St Georges Terrace, Perth WA 6000
Phone:	(08) 6218 7100
Email:	offshore.consultation@santos.com

1.5.2 Notification procedure in the event of changed details

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

1.6 Environmental management framework

OPGGS(E)R 2009 Requirements
Regulation 13(4). Environmental assessment
Requirements 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 Santos' Environment, Health and Safety Policy presented in Appendix A.

Sections 3, 3.2.5.10, 6, 7 and 8 reflect this policy, detailing and evaluating environmental impacts and risks and providing control measures with set environmental performance outcomes (EPOs) and standards (EPSs).

1.6.2 Relevant environmental legislation

Relevant legislative and other requirements are presented in Appendix B, inclusive of the relevant EP sections where the requirement may prescribe or control how an activity is undertaken. Australia is a signatory to numerous international conventions and agreements relevant to the Activity. Relevant government departments have been consulted during the development of this EP so as to promote compliance with relevant legislation, conventions and agreements, as detailed in Section 4.

2 Activity description

OPGGS(E)R 2009 Requirements
Regulation 13. Environmental assessment
Description of the activity 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 (e.g. 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 summary

SURF is a term used to describe the subsea infrastructure required to gather gas and condensate from the production wells and deliver these products to the FPSO for processing. This EP provides for the Activity, which comprises the key subsea infrastructure shown in Figure 2-1. The subsea infrastructure has been designed to support the connection of subsea production wells described in the Barossa Development Drilling and Completions EP (BAD-200 0003) to the FPSO, and moorings infrastructure required to securely anchor the FPSO in position. Pre-commissioning activities will include testing the pipes to make sure that they do not leak, and testing the controls to make sure that safety systems function correctly. Table 2-1 summarises the activities for this EP.

The following infrastructure and associated activities are excluded from the scope of this EP:

- drilling, completion and well management activities (includes the construction of subsea production wells and installation of subsea Christmas trees and tubing head spool [THS]), which will be covered under the Barossa Development Drilling and Completions EP (BAD-200 0003)
- installation and preconditioning activities of the gas export pipeline (GEP) (includes installation of FPSO pipeline end termination [FPSO PLET]), which are covered under the NOPSEMA-accepted Barossa Gas Export Pipeline Installation EP (BAA-210 0010) (Available from: **https://info.nopsema.gov.au/activities/353/show_public**)
- installation and preconditioning activities of the Darwin Pipeline Duplication (DPD) (includes installation of DPD PLET and the DPD) in Commonwealth waters, which will be covered under the Barossa Darwin Pipeline Duplication EP (BAA-210 0074)
- commissioning, start-up and operation activities (includes FPSO and the submerged turret production [STP] buoy to FPSO hook-up), which will be covered under the Barossa Production Operations EP (BAA-200 0637).

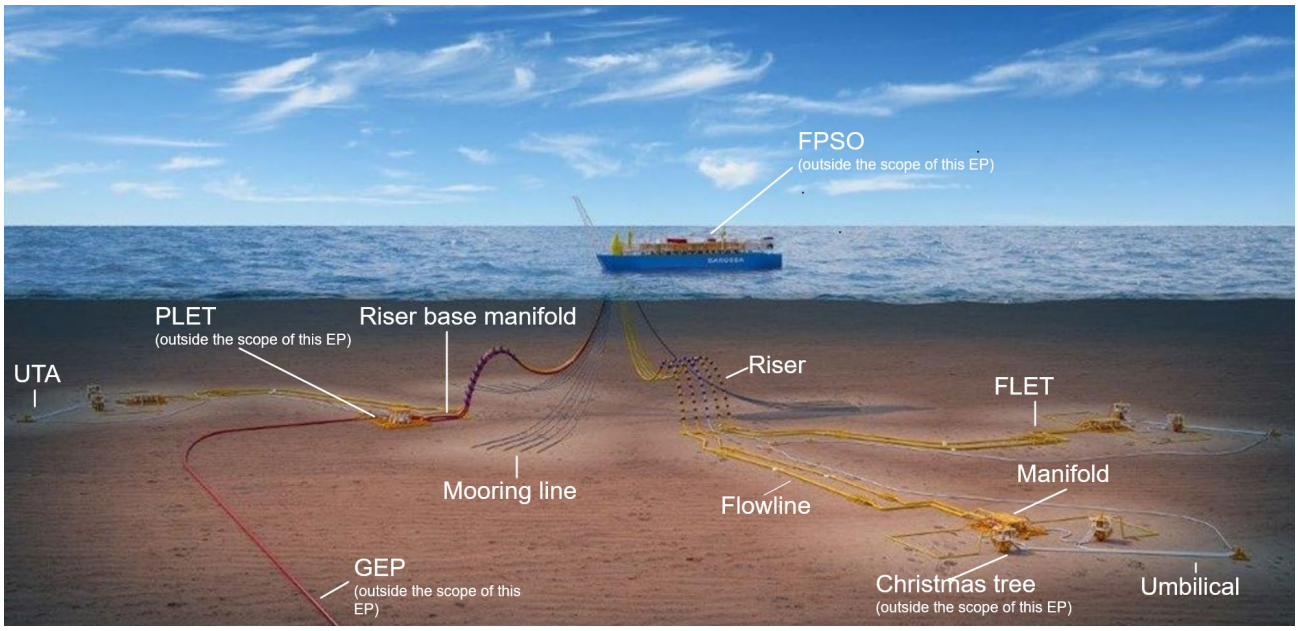


Figure 2-1: Indicative Barossa field layout

Table 2-1: Summary of key subsea infrastructure and activities

Description
Subsea infrastructure/hardware
• FPSO mooring system (including 15 FPSO mooring line suction anchors with mooring chains, sheathed wires and mooring line buoyancy elements [MLBEs]), including installation aids • STP buoy for securing the FPSO mooring lines and temporary hang-off for the risers, STP pull-in rope and marker buoy • three 14″ and three 6″ corrosion-resistant alloy rigid flowlines with 3 layer and topcoat polypropylene [PP] corrosion coating; nominal length of 19 km • temporary initiation anchors, installation aids and ancillary equipment • flowline end terminations (FLETs) at the end of each flowline (including FLET foundations with scour protection) • displacement initiator structures and mattresses along the flowline routes to control lateral bucking in operation (including scour protection) • 4 manifolds (3 production and one riser base) and foundations (including scour protection) • 10 riser tether base structures (including scour protection) • three 12″ production, two 12″ export and three 6″ service risers ranging in length from approximately 878 m to 933 m, including installation aids • 3 static umbilicals ranging from approximately 5,900–6,700 m long with umbilical termination assembly (UTAs), including installation aids • 2 dynamic umbilicals ranging from approximately 920–984 m long, including installation aids • 6 UTA foundations (including scour protection) • spools, and production well and annulus jumpers, including installation aids • span rectification (if required) • steel tube, optical and electrical flying leads (including stabilisation such as mattresses) • subsea support structures (flowline walking mitigation, spool, and production well and annulus jumper support mattresses)

Description
Key activities

Vessel activities within the Operational Area (OA) include:
• surveys
• installation of temporary subsea positioning systems
• installation of FPSO mooring system
• installation of structures, supporting structures and equipment:
  ○ temporary initiation anchors, installation aids and ancillary equipment
  ○ lateral buckling initiation site(s) construction
  ○ FLET foundations, manifold foundations and UTA foundations, including wet parking (if required)
  ○ riser and riser tether base, including wet parking (if required)
  ○ umbilical and UTA
  ○ spool and jumpers (includes the connection to the FPSO PLET and Christmas tree [note: FPSO PLET and Christmas tree are outside the scope of this EP]) and support mattresses
  ○ flowline walking mitigation mattresses
  ○ STP buoy positioning and hook-up to mooring lines
  ○ scour protection of structure foundations
• flowline installation, including FLETs
• potential span rectification:
  ○ pre-lay and post-lay flowline span rectification
• deballasting of STP buoy during mooring line hook-up and riser installation
• bunkering
• pre-commissioning:
  ○ flood, clean, gauge and pressure testing (FCGT)
  ○ dewatering
  ○ preconditioning
  ○ nitrogen packing
  ○ flushing and hydrostatic leak testing
• unplanned and non-routine inspection, maintenance and repair activities (IMR) (includes during the preservation period)

Activity vessels
• reel-lay vessel • construction vessels • support and supply vessels (such as IMR vessels, survey vessels, anchor-handling tug [AHT], dynamic positioning (DP) transportation) These are collectively referred to as ‘activity vessels’ throughout this EP.
Other support
• helicopters • remotely operated vehicles (ROVs)

2.2 Location and tenure

The Activity will be undertaken in Commonwealth waters within the area of Commonwealth Petroleum Production Licence NT/L1, which is approximately 300 km north-north-west of Darwin, NT. The Operational Area (OA) is approximately 143 km north of the Tiwi Islands, NT and approximately 44 km north-east of the Oceanic Shoals Marine Park (Figure 1-1).

2.3 OA and timing

The OA covered under this EP is the area within which all planned activities will occur. The OA is defined as approximately 10 km by 13.5 km; Table 2-2 lists the coordinates. Figure 2-2 shows the location and OA of the subsea infrastructure.

Table 2-2: OA coordinates

Point	Easting	Northing	Latitude	Longitude	Water depth (m)
1	631312.0	8917778.5	9° 47′ 17.291″ S	130° 11′ 50.284″ E	269
2	644689.0	8917778.5	9° 47′ 15.665″ S	130° 19′ 9.304″ E	269
3	644689.0	8907768.8	9° 52′ 41.501″ S	130° 19′ 10.596″ E	227
4	631312.0	8907768.8	9° 52′ 43.142″ S	130° 11′ 51.457″ E	234

Source: Datum GDA94

The total duration of the Activity is estimated to be 9 months, subject to vessel availability, supply chain issues, operational efficiencies and weather conditions. The EP has assessed the impact of activities throughout the calendar year, across all seasons, to provide operational flexibility. The Activity is estimated to commence between Q4 2023 and Q4 2025, subject to obtaining regulatory and business approvals. The preservation phase commences on completion of the nitrogen packing until commissioning. This ensures the integrity of the subsea infrastructure is maintained. The preservation phase for the subsea infrastructure will last up until the commencement of activities under the Barossa Production Operations EP (BAA-200 0637).

Activity vessels and other support within the OA are considered part of the petroleum activity. Activities outside the OA are not part of the petroleum activity and will be managed in accordance with applicable legislation.

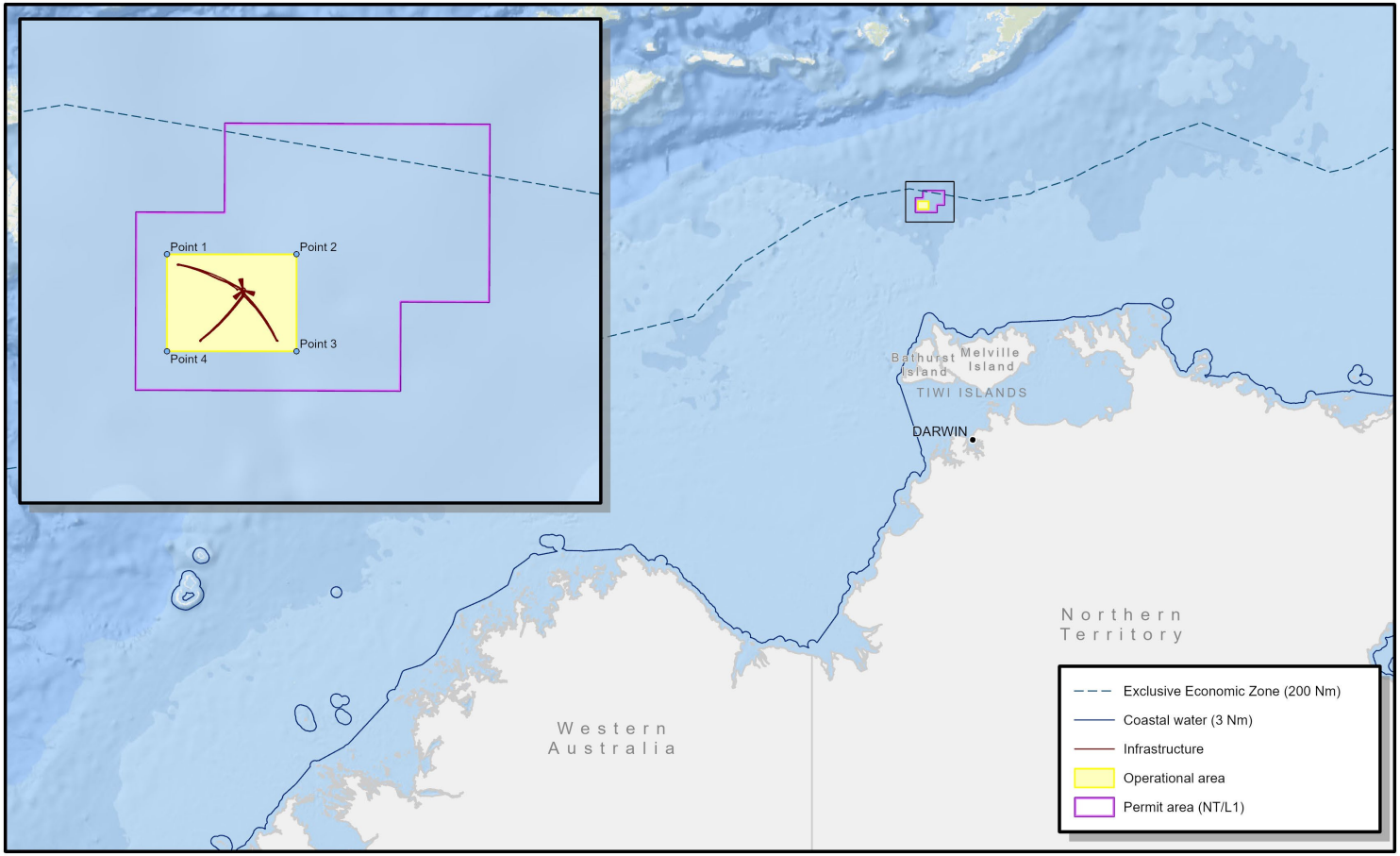


Figure 2-2: Proposed subsea infrastructure and OA

2.4 Vessels and support activities

Multiple vessel types will be required to complete the activities within the OA to support the Activity and interim preservation period. Table 2-3 summarises the indicative activities for each vessel type that may be required. The indicative activities listed for each vessel type may change or be undertaken by another activity vessel type due to project schedule requirements, vessel availability or unforeseen circumstances.

For the purposes of assessing the cumulative environmental impacts of multiple vessels working within the OA at any given time, it is assumed that a conservative case would be 2 largest vessels (i.e. the reel-lay and construction vessels working alongside each other). Each vessel will undertake separate installation or supply tasks and, therefore, only be co-located for small timeframes. This is important when assessing factors such as cumulative lighting or noise impacts. Noting that support or supply vessels may also be in the vicinity of the reel-lay and construction vessels temporarily.

Table 2-3: Vessel types that may be used for the Activity

Vessel type	Indicative activities
Reel-lay	• install temporary initiation anchors • install the Barossa flowlines and FLETs • undertake bunkering Optional scope: • undertake surveys • install riser and riser tether bases • install displacement initiators • install suction anchors • install scour protection
Construction	• undertake surveys • undertake flowline span rectification work • install subsea support structures (flowline walking mitigation, foundations, manifolds, suction anchors, buckle initiation site construction) • support flowline, riser and umbilical activities (touchdown / ROV monitoring, subsea positioning) • install FPSO mooring system • position STP buoy, marker buoy and hook-up to mooring lines • undertake STP buoy deballasting • install risers, riser tether bases, umbilicals, UTA and flying leads, displacement initiators • install local stabilisation of flying leads (such as mattresses) • install and leak test spool and production well and annulus jumpers • install scour protection • undertake pre-commissioning activities • undertake bunkering • undertake MEG transfers

Vessel type	Indicative activities
Support and supply	• undertake surveys • install and tension of FPSO mooring chains • transport food, supplies, equipment materials, fuel (bunkering) and MEG to the reel-lay and construction vessels • provide support and supplies • undertake unplanned and non-routine IMR activities • transfer solid waste and debris (if required) from vessels back to the mainland for disposal • undertake tow, trail and assist activities Optional scope: • position STP buoy and marker buoy
Other support	Helicopters: • undertake crew transfers • undertake refuelling • provide miscellaneous supplies • undertake medivac, if required ROVs: • support and monitor installation, pre-commissioning and unplanned and non-routine IMR activities • undertake surveys • undertake localised stabilisation, span rectification and unplanned local seabed rectification

Activity vessels will be selected and onboarded in accordance with Santos' Offshore Marine Assurance Procedure (SO-91-ZH-10001) to ensure contracted vessels are operated, maintained and crewed in accordance with industry standards, regulatory requirements (e.g. this EP and Marine Orders) and the relevant Santos procedures mentioned in this EP. The marine assurance process includes close inspection of vessel suitability, equipment and design, and personnel training, including officer experience.

SBES equipment may be fitted and used on activity vessels to provide seabed depth measurements. This equipment is required to be fitted to all vessels over 300 gross tonnage under SOLAS – Part 1 - Chapter V – Safety of Navigation – Regulation 19 – Carriage Requirement for Shipborne Navigational Systems and Equipment.

Vessels will generate and manage solid wastes. Vessels will also undertake routine discharges and emissions, as listed in Table 2-10. Activity vessels may be bunkered (refuelled) within the OA (Section 2.5.11).

2.4.1 Reel-lay vessel

The Barossa flowlines and FLETs will be installed using a specialised reel-lay vessel, which may vary depending on vessel availability and specific project requirements. An example of a reel-lay vessel is the *Seven Oceans* (Figure 2-3). See Table 2-4 for a typical reel-lay vessel specification.

The reel-lay vessel will be equipped with:

- a lay system
- cranes
- DP systems
- ROVs
- helideck and helicopter refuelling system.

Figure 2-3: Indicative reel-lay vessel (Seven Oceans)

Table 2-4: Typical specification for a reel-lay vessel (based on *Seven Oceans*)

Item	Description
Length	157.35 m
Net tonnage	5,640 t
Gross tonnage	18,201 t
Total persons on board (POB)	Up to 120
Lighting	Navigational, deck, task-specific and emergency lighting
Ballast system	Total volume 6,932 m³
Freshwater system	2 reverse osmosis units
Cooling system	Sea water used to cool main engines, refrigerators and service cooling; sea water is circulated by pumps
Sewage system	International Maritime Organization/International Convention for the Prevention of Pollution from Ships (IMO/MARPOL) compliant sewage treatment plants
Putrescible waste system	MARPOL-compliant comminuting (grinding) system
Incinerators	MARPOL-compliant incinerators

Item	Description
Fuel tanks	Multiple isolatable fuel tanks with total capacity 4,372 m³ Maximum single fuel tank is 504 m³
Power generation	6 main diesel generators, 3,360 kW each

2.4.2 Construction vessels

The subsea infrastructure will be installed using specialised construction vessels, which may vary depending on vessel availability and specific project requirements. An example of a typical construction vessel is the *Seven Oceanic* (Figure 2-4). See Table 2-5 for typical construction vessel specifications.

Construction vessels will be equipped with:

- cranes
- DP system
- ROVs
- helideck and helicopter refuelling system.

Figure 2-4: Indicative construction vessel (*Seven Oceanic*)

Table 2-5: Typical specification for a construction vessel (based on *Seven Oceanic*)

Vessel Systems	Typical Characteristics
Length	156.9 m
Net tonnage	4,954 t
Gross tonnage	16,511 t
Total POB	Up to 140
Lighting	Navigational, deck, task-specific and emergency lighting
Ballast system	Total volume 8,864 m³
Freshwater system	One reverse osmosis and 2 distiller units

Vessel Systems	Typical Characteristics
Cooling system	Freshwater tanks vary in size up to 364 m³ (total combined 1,642 m³) Sea water used to cool main engines, refrigerators and service cooling; sea water is circulated by pumps
Sewage system	IMO/MARPOL-compliant sewage treatment plants
Putrescible waste system	MARPOL-compliant comminuting (grinding) system
Incinerators	MARPOL-compliant incinerators
Fuel tanks	Multiple isolatable fuel tanks with total capacity 2,199 m³ Maximum single fuel tank is 603 m³
Power generation	2 main diesel generators, 3,360 kW each 2 main diesel generators, 5,760 kW each

2.4.3 Support and supply vessels

Table 2-1 lists the typical support and supply vessel types. Table 2-3 lists the indicative activities carried out by support and supply vessels. Support and supply vessels may transit between the OA to port (e.g. Darwin and international ports) and mooring locations.

2.4.4 Other support

Other support activities associated with the Activity may be conducted by helicopters and ROVs.

2.4.4.1 Helicopters

Table 2-3 lists the indicative activities for helicopter operations. Helicopter operations may include offshore helicopter refuelling on vessel helidecks within the OA, subject to flight distances and the weight of the loads the helicopter will carry. Helicopter flights will occur approximately 3 times a week at the peak utilisation, with approximately 78 helicopter movements throughout the Activity.

2.4.4.2 ROVs

Table 2-3 lists the indicative activities and Table 2-6 lists the typical specifications for ROV operations. ROVs are operated using hydraulic control fluids (synthetic blend base oil), with the largest hydraulic control fluid tank being 5 L and equipped with work-baskets and camera systems.

ROV's may be deployed and recovered from the reel-lay (typically via internal moonpools) or construction vessels (typically via side launching ROV system). Each ROV requires an umbilical to provide electrical power and data and operational transmissions.

Table 2-6: Typical ROV specification

Specification	Typical Characteristics
Work class	150–200 hp
Weight	2,450–4,400 kg
Footprint	up to 1.8 m by 3.5 m
Hydraulic control fluid tank	Up to 5 L

2.5 Installation activities

2.5.1 Underwater acoustic positioning

Installation of the subsea infrastructure requires accurate positioning on the seabed and therefore long baseline (LBL) and/or ultra short baseline (USBL) acoustic positioning may be required. These systems provide accuracy up to one metre. Typically, for USBL positioning, transponders are attached to subsea equipment and ROVs and will be recovered once the equipment is correctly positioned on the seabed. For LBL, transponders are typically fixed to seabed frames, which are deployed and then fully recovered once the subsea equipment is correctly positioned.

LBL arrays are required at the drill centres, flowline cut-to-length locations and FPSO locations for spool and well jumper metrology. After flowline cut-to-length and metrology, the units will be retrieved. Transponders will be active during calibration or positioning only. The operation duration is approximately 3 days for each array (approximately 7 locations); however the array may be put into sleep mode during its deployment and left in place for approximately two weeks while the vessel undertakes other activities.

LBL and USBL systems work by emitting short pulses of medium- to high-frequency sound by a transceiver and detected by a subsea transponder, which returns its own acoustic signal. Transmissions are not continuous but comprise short ‘chirps’ with a duration that ranges from 3 to 40 milliseconds, typically at 19–33 kHz.

Additional equipment associated with both systems that may be used include surface and subsea deployed beacons, transponders and receivers. Table 2-8 details the total temporary footprint for the transponder frames.

2.5.2 Surveys

Surveys will be undertaken at various stages throughout the Activity with a duration of ~0.5 days per survey dependent on the area to be surveyed. Initial pre-lay surveys will be undertaken before flowline and umbilical installation activities commence. Pre-lay surveys identify debris, seabed features (including cultural heritage) or obstructions along the flowline and umbilical routes. It is not a full geophysical survey. An allowance of 50 m on either side of the flowline and umbilical routes allows for localised rerouting if any significant obstructions and areas of spanning are identified during the pre-lay survey. Surveys have already been undertaken for the flowline routes. No seabed features (including maritime heritage) were identified. However, if an unexpected find is identified during the pre-lay survey, the unexpected find will be assessed using the Barossa Unexpected Finds Protocol (BAS-210 0051) to minimise potential impacts to heritage objects and values. If the unexpected find is determined to be debris (i.e. not a maritime object), it may be recovered using an ROV, subsea work-basket and/or vessel crane. Once recovered, the debris will be stored safely onboard an activity vessel until it can be appropriately documented for ultimate storage or disposal onshore in accordance with project guidelines.

The survey methods for identifying debris, seabed features, buried assets and obstructions are non-intrusive and the equipment does not disturb the seabed. Survey methods may primarily include multibeam echo sounder (MBES), side-scan sonar (SSS), ROV video and magnetometer. MBES uses sound pulses to establish the seabed profile. Most modern MBES systems work by transmitting a broad acoustic pulse from a hull-, pole- or ROV-mounted transducer. Other ROV-mounted equipment (such as an altimeter and obstacle avoidance sonar) will also be used.

As-laid, as-built and as-constructed surveys will also be progressively undertaken throughout the Activity. The data from these surveys will be used to determine the final subsea infrastructure position.

2.5.3 Mooring installation

2.5.3.1 FPSO mooring line suction anchor installation

FPSO mooring line suction anchors are steel structures that anchor FPSO mooring line and are designed to suit the local seabed's geotechnical properties (see Figure 2-5). Fifteen FPSO mooring line suction anchors will be installed, one for each mooring line. The expected total footprint is less than 2 ha (see Table 2-8).

FPSO mooring line suction anchors, with short anchor chain segments pre-attached to each anchor's padeye, will be installed using the construction vessel. The vessel crane will lift the FPSO mooring line suction anchor from a barge deck to the seabed, then an ROV will position and orientate the anchors. The FPSO mooring line suction anchor will penetrate the seabed under its own weight up to a self-penetration depth; further penetration to full depth will be achieved when the ROV docks onto the anchor top and pumps out the sea water within the suction anchor.

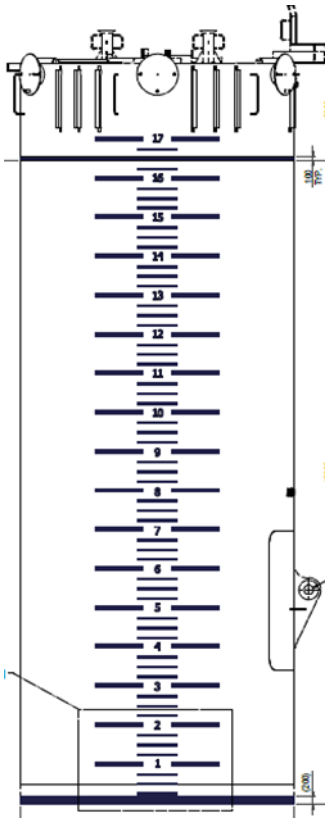


Figure 2-5: Example of suction anchor

2.5.3.2 Mooring chain, wire and MLBE installation

Each of the 15 mooring lower chain segments (diameter of nominally 157 mm studless chain) is approximately 734 m long and likely be installed using a support vessel. The support vessel will deploy each lower chain segment. An ROV will then connect the lower chain segment to the suction anchor (H-link connector). The lower chain segment will be progressively lowered to the seabed as the support vessel moves along the predefined lay route towards the mooring centre location. Once the lower chain segment installation is complete, the support vessel will apply tension to the chain to embed the chain catenary close to the suction anchor. The lower chain segment will be temporarily abandoned on the seabed for later connection to the lower wire segment.

Each of the 15 mooring lower wire and upper wire segments (diameter of nominally 123 mm sheathed spiral strand wire rope) is approximately 501 m long with intermediate MLBE and will be

installed by a construction vessel (see Figure 2-6). The construction vessel will recover each lower chain segment end to the deck and connect it to the lower wire segment, with the assistance of an ROV. The lower wire segment, MLBE and upper wire segment will be progressively installed and lowered to the seabed as the construction vessel moves along the predefined route towards the mooring centre location.

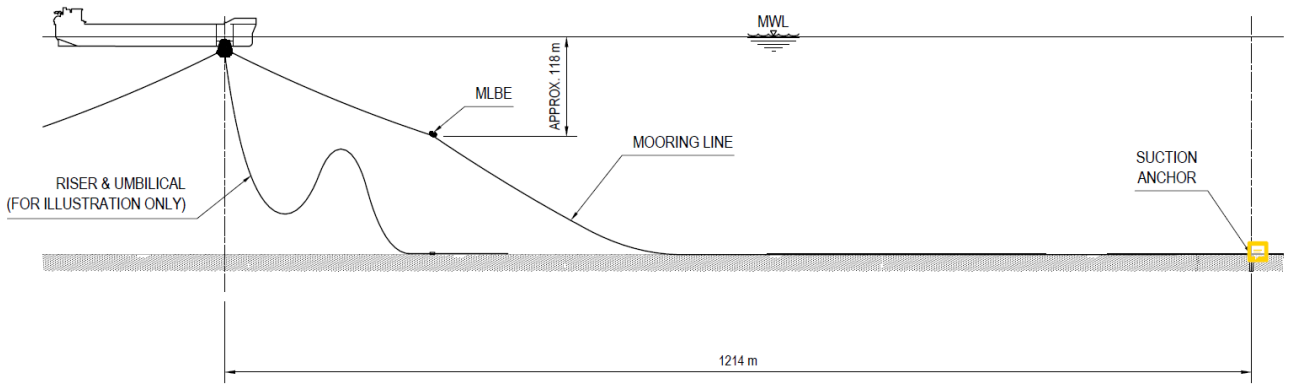


Figure 2-6: Indicative mooring and riser profile [1]

2.5.3.3 STP buoy installation and mooring line hook-up

The STP buoy secures the FPSO to the mooring system and provides buoyancy for the mooring lines and risers before pull-in to the FPSO (out of scope for this EP) (see Figure 2-6). Comprising of a buoyancy cone, an integrated turret with a ballasting system, mooring connections and riser connections (see Figure 2-7), the STP buoy is approximately 16 m in diameter and 19 m high.

The STP buoy will arrive near the Barossa field via dry transport on a heavy lift vessel or barge. It will be wet towed to the OA using support vessels and pulled down to its idle depth in preparation for connecting the mooring lines (see Figure 2-8). The pull down will be done using a clump weight to overcome the net buoyancy of the STP buoy. The expected total footprint for the installation aids used during STP buoy installation and mooring line hook-up is detailed in Table 2-8.

Each of the 15 upper wire segments will be connected to the STP buoy using a mooring connector attached to the socket on the upper wire segment. The support vessels will be used to position the STP buoy during the first few mooring line connections and then released. The construction vessel will use a winch to pull each mooring connector into the STP buoy under the guidance of an ROV.

[1] For illustrative purposes only: FPSO and FPSO/STP buoy hook-up out of scope for this EP.

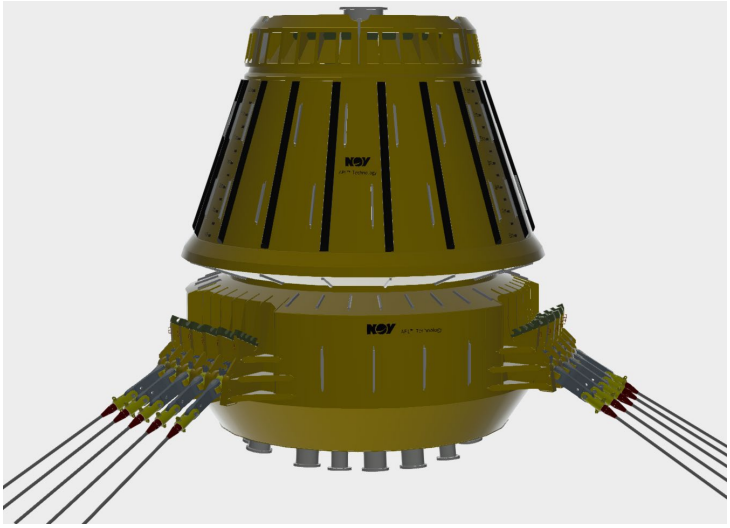


Figure 2-7: Example of STP buoy

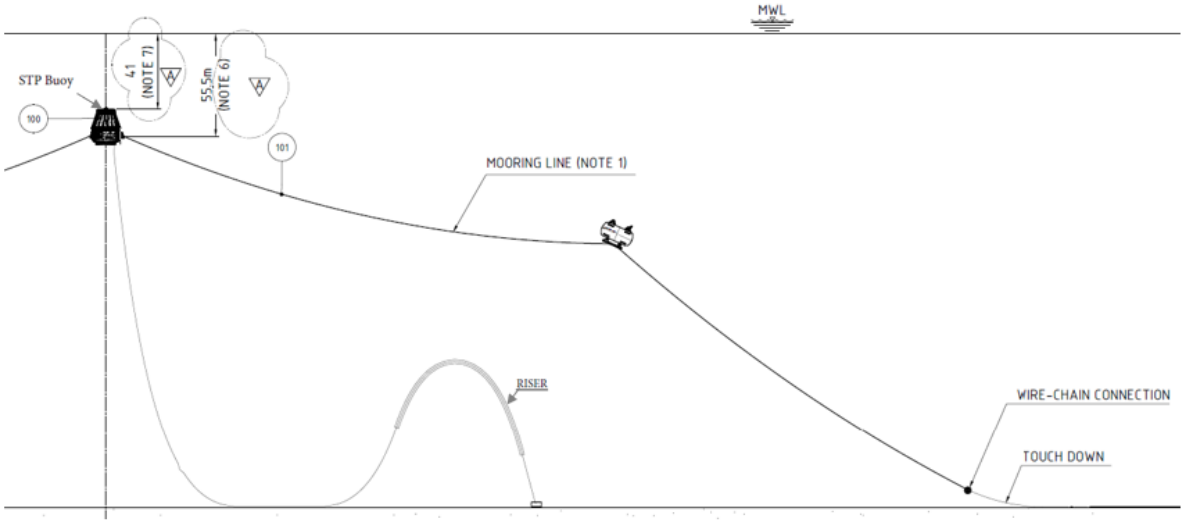


Figure 2-8: Indicative idle condition mooring and riser profile

2.5.3.4 STP buoy deballasting

The internal tanks of the STP buoy will be pre-ballasted with treated sea water. The treated sea water is a mixture of sea water sourced within Australian waters conditioned with a hydrotest mixture comprising of biocides (to prevent biofouling on the internal surfaces), an oxygen scavenger and corrosion inhibitor (to control corrosion of the tanks) and a dye (allows for leaks to be detected through visual inspections). The typical dosage rate is 440–550 mg/L using products similar to Hydrosure or Roemex Hydro 4. All chemicals used in deballasting activities will be subject to a chemical selection assessment process (see Section 2.12).

During the mooring line hook-up and riser installation activities, the STP buoy's tanks will be gradually deballasted to maintain a depth of approximately 55 m. During deballasting, air will be pumped into the tanks and treated sea water discharged to sea (at a depth of approximately 40 m). Deballasted treated sea water will be discharged in several stages for up to 9 weeks (nominally). The volume of treated sea water expected to be discharged during deballasting is listed in Table 2-9.

An ROV will connect a line from the top of the STP buoy to a marker buoy using an ROV. The marker buoy will then be abandoned over the side of the reel-lay vessel with the flashing light activated until

the STP buoy to FPSO hook-up activities occur—covered under the Barossa Production Operations EP (BAA-200 0637).

2.5.4 Flowline installation

2.5.4.1 Flowline support structure installation

FLET foundations are steel structures that provide long-term support for FLETs and are designed to suit the local seabed's geotechnical properties (Figure 2-9). Twelve FLET foundations will be installed (one for each FLET). The expected footprints for production and service FLET foundations are approximately 19 m by 11 m and approximately 17 m by 10 m, respectively. Scour protection could extend up to nominally 1.5 m around the foundations (Section 2.5.10). The expected total footprint for the FLET foundations and scour protection is listed in Table 2-8.

Displacement initiators are steel structures that provide a location for controlled lateral buckling of the flowline during operation and are designed to suit the local seabed's geotechnical properties (Figure 2-10). Nominally 23 displacement initiators will be installed along the 6 flowline routes. Each displacement initiator will have a touchdown mattress that the flowline will be laid on plus additional scour protection. The expected footprints for production and service displacement initiators are approximately 15 m by 5 m and approximately 13 m by 3 m, respectively—scour protection could extend out up to nominally 1 m around the structures. The expected total footprint for the displacement initiator structures and scour protection is listed in Table 2-8.

FLET foundations and displacement initiators will be installed using the construction vessel. The reel-lay or construction vessel crane would lift the FLET foundations and displacement initiators from the barge's deck to the seabed, and an ROV will position and orientate the structures. FLET foundations may be wet parked (if required), and a footprint allowance is provided in Table 2-8.

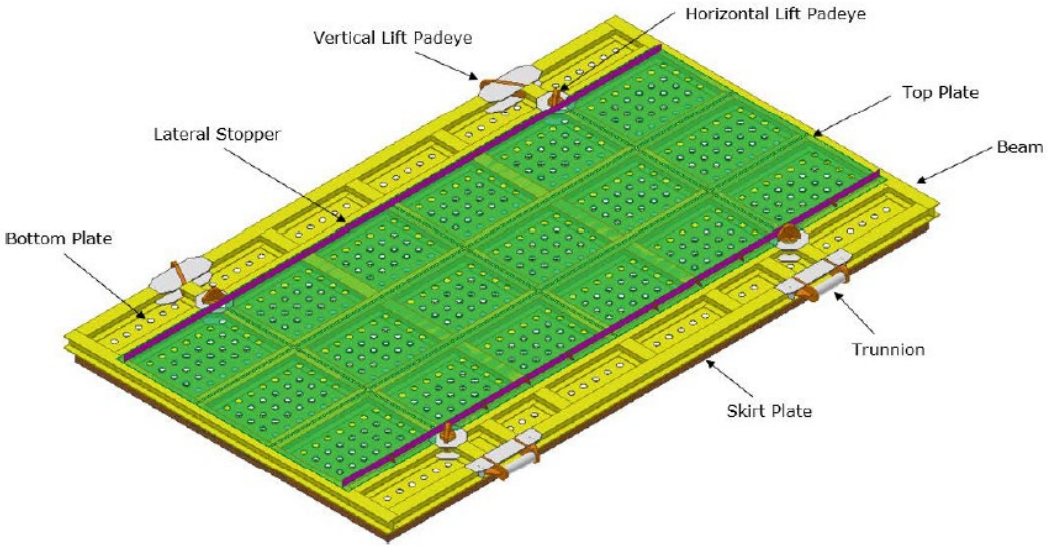


Figure 2-9: Example of FLET foundation

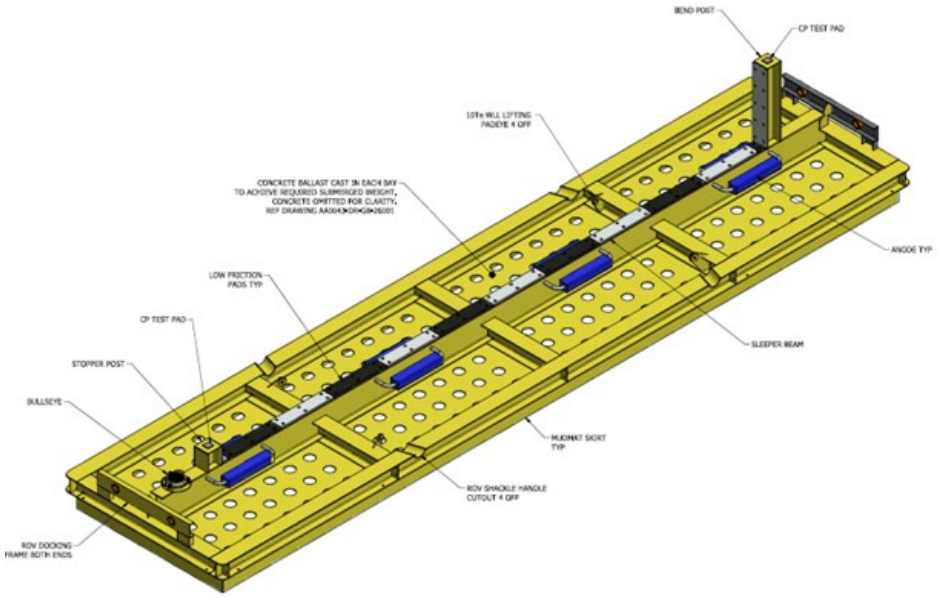


Figure 2-10: Example of displacement initiator

2.5.4.2 Span rectification

Analysis of the flowline routes (Intecsea, 2022) identified no span locations—a further span analysis will be conducted from pre-lay and post-lay survey data. In the unlikely event a span requires rectification, some localised seabed rectification (e.g. jetting of span shoulders or removal of soil for grout bag installation) may be required prior to positioning either pre-lay mattresses or grout bags. The seabed footprint associated with span rectification contingency is listed in Table 2-8.

Pre-lay and post-lay span rectification techniques are outlined in Sections 2.5.4.2.1 and 2.5.10.

2.5.4.2.1 Grout bags

Grout bags are commonly used to correct post-lay spans. Grout bags are made of flexible material (e.g. woven polypropylene), which are filled with granular material such as sand (Figure 2-11). A binder (typically cement) is included to stabilise the granular material within the bag. Grout bags can also come filled with rock without any binding material (depending on the size of the rock particles). Depending on the height of the span, small, pre-filled grout bags may be installed individually by ROV or may be lowered slowly to the seabed by crane in bulker bags for individual placement.

Higher spans are rectified using post-filled grout bags. The empty grout bags are positioned under the pipe by ROV and are filled from the surface using a liquid slurry of grout via a downline. The downlines are flushed to subsea after each operation to ensure the grout does not set in the downline between filling operations. Table 2-9 lists the nominal amounts of grout that may be released during the grouting operation. Typically, post-filled grout bags are pyramidal in shape and the footprint of each grout bag is up to approximately 5 m by 5 m, depending on span height. Depending on seabed conditions, scour protection may also be required to ensure the grout bags are not undermined; scour protection could extend nominally 3 m around the circumference of the grout bag.

Figure 2-11: Example of grout bags

2.5.4.3 Temporary initiation anchors

Initiation of the 6 Barossa flowlines will require temporary initiation anchors to be installed at each first-end FLET location to allow the flowlines to be tensioned for initial lay-away. The initiation anchor will be connected to either a suction, drag or deadman anchor, or a clump weight which has been pre-installed prior to the flowline installation. After the flowline is installed, the temporary initiation anchors are disconnected and removed from the seabed. The temporary seabed footprint associated with installing the temporary initiation anchors is listed in Table 2-8.

2.5.4.4 Flowline lay

There will be three 14″ production and three 6″ service flowlines ranging from 5,640–6,630 m long (nominally) (see Figure 2-12). Each flowline will have a 3-layer and topcoat polypropylene (PP) corrosion coating. The topcoat provides additional friction to aid installation and mitigate lateral buckling events. The reel-lay vessel will install the flowlines using a reel-lay installation method. These flowlines will be prefabricated and stored on a large-diameter reel on the vessel's deck. Tie-in welds for FLET connections will be done on the vessel.

The reel-lay vessel may require flowlines to be reloaded during the Activity and this will likely take place outside the OA. Lay direction may be from the FPSO location towards the drill centre or vice versa, depending on operational requirements. The production flowlines will be installed empty (air-filled), while the service flowlines will be installed pre-flooded.

The flowline goes through a straightening process and passes through the vessel's tensioners in a lay tower at the vessel's stern—the tower angle is adjusted for water depth and bottom pipe tension. Tension is applied to the flowline by the reel-lay vessel's tensioners and forward DP thrust to maintain the catenary and prevent the flowline from buckling as it is lowered to the seabed. The reel-lay vessel will proceed forwards at a speed of approximately less than one knot. Each flowline will be laid over the displacement initiators and touchdown mattresses, and then scour protection will be installed.

The seabed footprint associated with installing the flowlines is listed in Table 2-8.

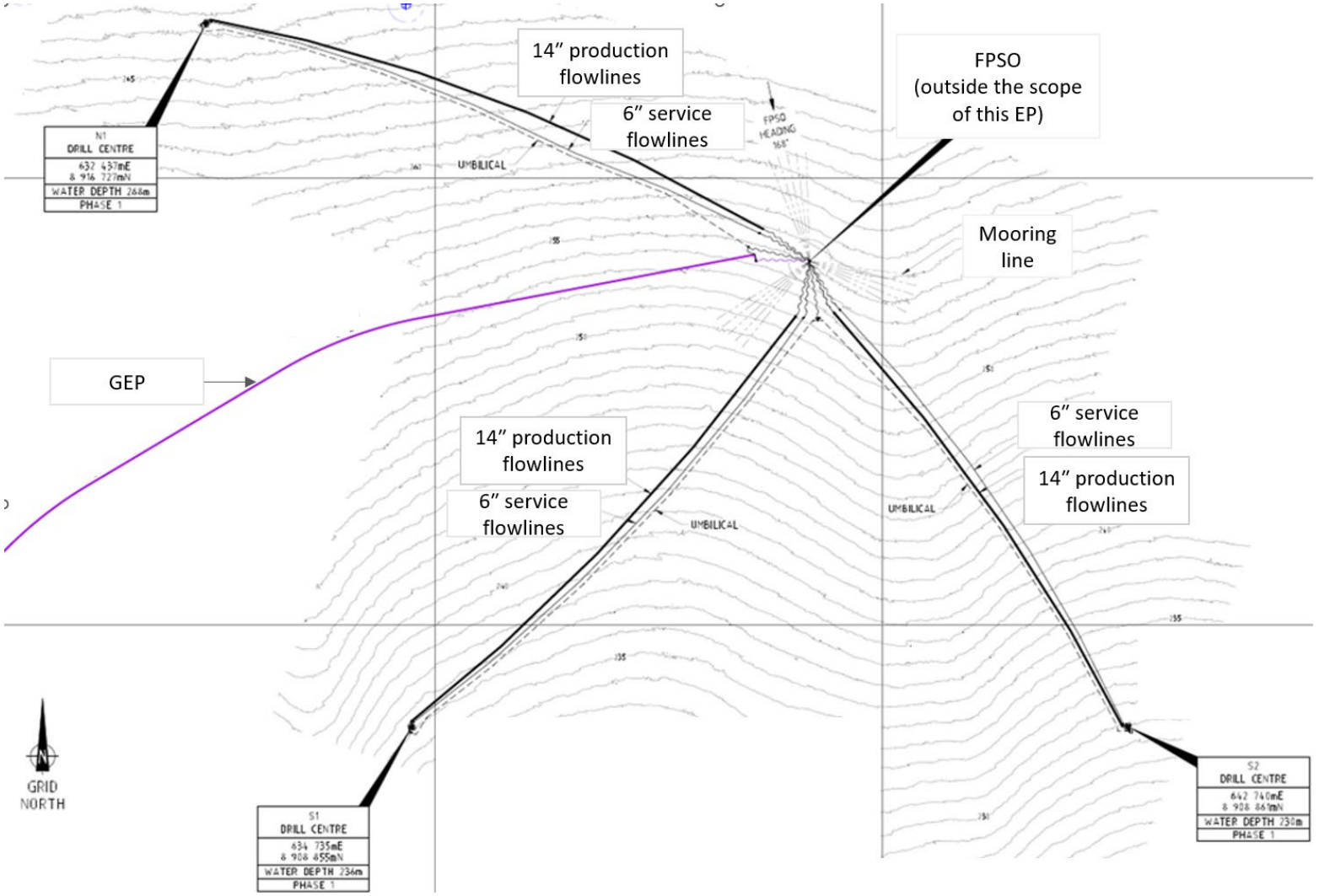


Figure 2-12: Indicative flowline and static umbilical schematic (excludes flexible risers and dynamic umbilicals)

2.5.5 Flowline end termination structure installation

An example of a FLET is shown in Figure 2-13. The FLET cavity will be pre-flooded with MEG or treated freshwater (see Section 2.6 for chemical composition), then installed by the reel-lay vessel. FLETs will be installed using an inline method where each FLET is lowered from the vessel ramp onto the horizontal working plane (firing line) where it is then welded to the pipe catenary held by the reel-lay vessel's friction clamp. The FLET and flowline are progressively lowered to the seabed as the vessel moves forwards, until FLET/flowline assembly lands onto the pre-installed FLET foundation. Once in place, FLET structures sit on the FLET foundations and do not add to the seabed disturbance footprint.

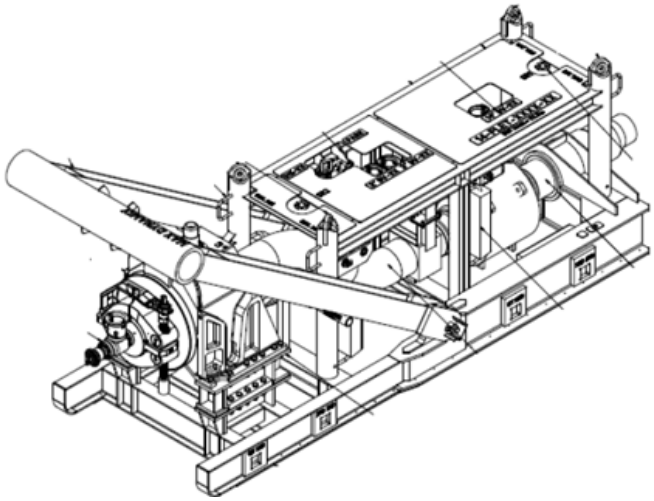


Figure 2-13: Example of FLET

2.5.6 Manifold installation

Production and riser base manifold foundations are steel structures that provide long-term support for manifolds and are designed to suit the local seabed's geotechnical properties (Figure 2-14). Four manifold foundations will be installed (one for each manifold) (Figure 2-15). Production manifold foundations are expected to have a footprint ranging from approximately 18–21 m by 16 m and riser base manifold foundation footprints are expected to be approximately 25 m by 16 m—scour protection could extend up to nominally 3 m around the foundations. The expected total footprint for the manifold foundations and scour protection is listed in Table 2-8.

The manifold foundations and manifolds will be installed by the construction vessel. The manifolds will arrive pre-flooded with MEG (see Section 2.6 for chemical composition). The construction vessel crane will lift the manifold foundations and manifolds from the support vessel deck to the seabed where an ROV may be used to position and orientate the structures. Once in place, the manifolds sit on the foundations and do not add to the seabed disturbance footprint.

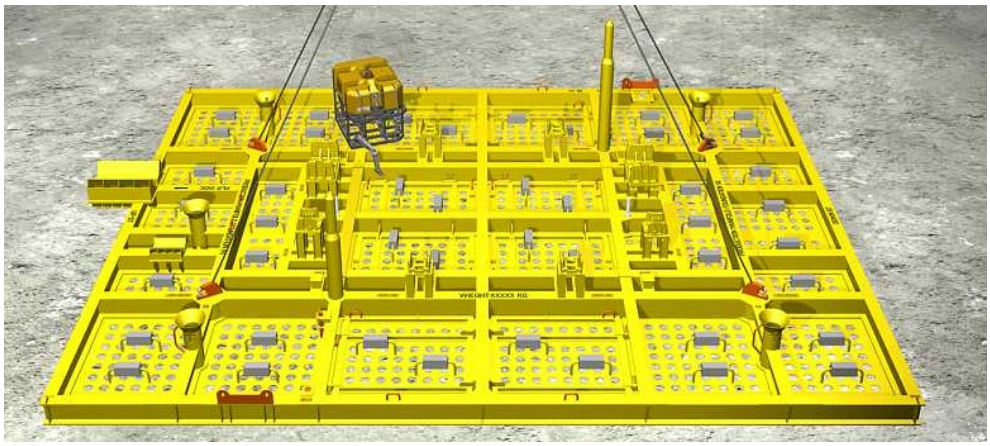


Figure 2-14: Example of manifold foundation

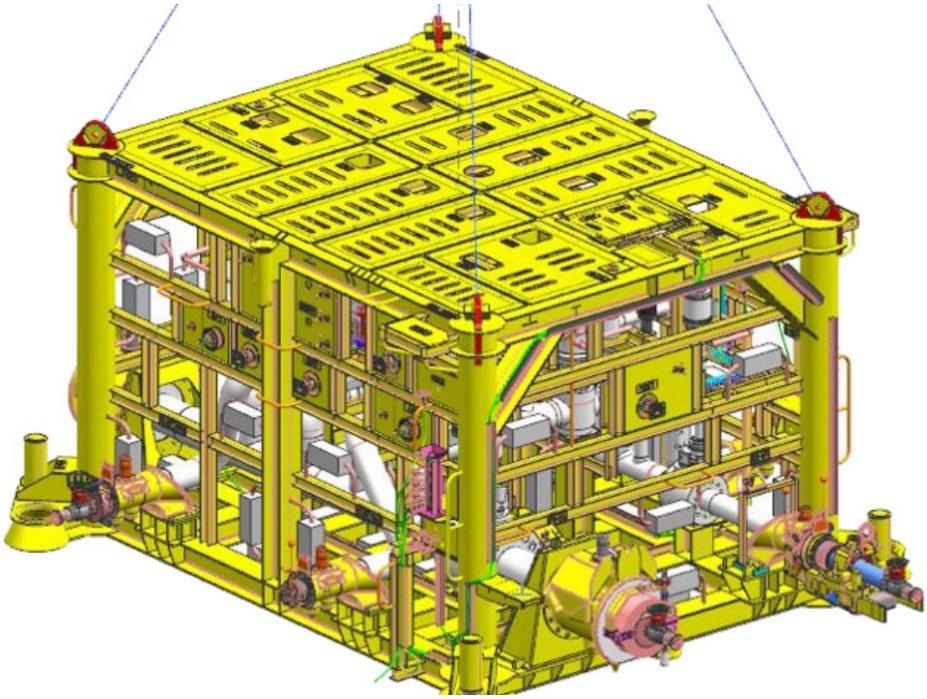


Figure 2-15: Example of manifold

2.5.7 Riser installation

2.5.7.1 Riser tether base installation

Riser tether bases are steel anchoring structures that secure risers and dynamic umbilicals to the seabed at specific points; they will be designed to suit the local seabed's geotechnical properties (Figure 2-16). Ten riser tether base structures will be installed (one for each riser and dynamic umbilical). The footprints for riser tether bases are expected to range up to approximately 12 m by 9 m—scour protection could extend up to nominally 1.0 m around the foundations. The expected total footprint for the riser installation is listed in Table 2-8.

Riser tether bases will be installed using either the reel-lay or construction vessel. The vessel crane would lift the riser tether bases from an activity vessel deck to the seabed where an ROV may be used to position and orientate the structures.

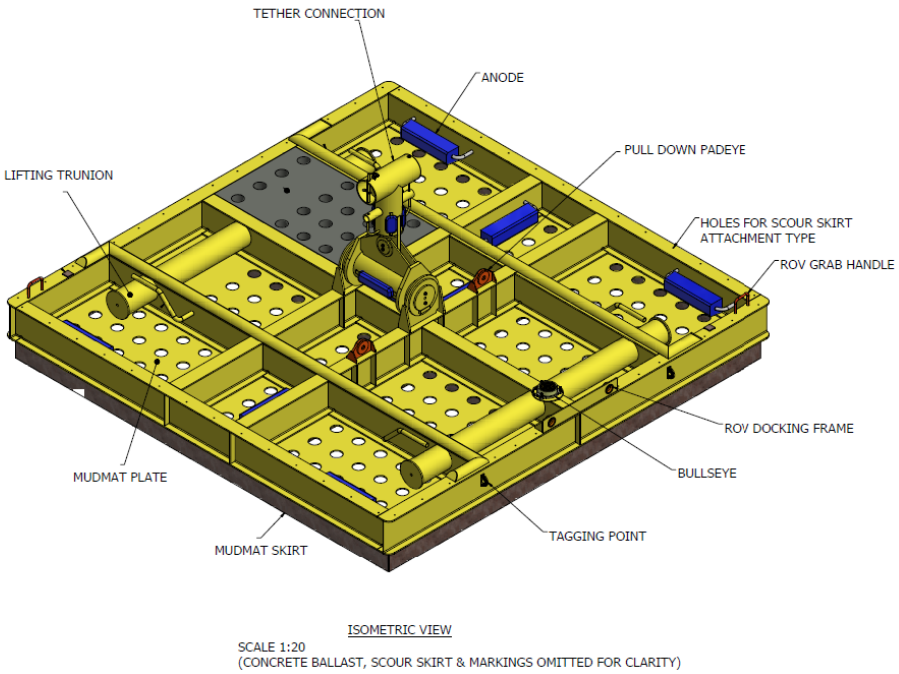


Figure 2-16: Example of riser and umbilical tether base

2.5.7.2 Riser installation

Three 12″ production, two 12″ export and three 6″ service risers ranging in length from approximately 878 m to 933 m and will be installed between the STP buoy and subsea infrastructure. The risers will arrive pre-flooded with MEG (see Section 2.6 for chemical composition). The risers will be installed by deploying the first end topside termination and hanging it on the underside of the STP buoy. The riser is then progressively laid out as the construction vessel moves away from the buoy and towards the pre-installed FLET/riser base manifold. During installation, ancillary equipment, including buoyancy modules and a tether clamp are attached to the riser. A temporary clump weight is attached to the riser to offset the buoyancy and enable the riser to be lowered near to the seabed. The tether is then connected to the pre-installed riser tether base to allow the riser to be pulled into the riser base and connected.

From the tether base to the FLET or riser base manifold, the riser is laid on the seabed until the connector/riser assembly lands on the pre-installed FLET or riser base manifold. Once the connector/risers are positioned, the temporary caps will be removed (inconsequential discharges may occur), and the connector/riser connected to the FLET or riser base manifold using ROVs. The connector/risers may be wet parked prior to permanent connection to the associated FLET or riser base manifold (if required).

The seabed footprint associated with installing the risers is listed in Table 2-8.

2.5.8 Umbilical and flying lead installation

UTA foundations are steel structures that provide long-term support for UTAs (see Figure 2-17); they will be designed to suit the local seabed's geotechnical properties. Six UTA foundations will be installed. Based on preliminary engineering, UTA foundations are expected to have a footprint ranging from approximately 10–12 m by 4 m—scour protection could extend up to nominally 3 m around the foundations. The expected total footprint for the foundation and scour protection is listed in Table 2-8.

UTA foundations will be installed using either the reel-lay or the construction vessel. The vessel crane would lift the UTA foundation from the activity vessel deck to the seabed, where an ROV will position and orientate the structures.

Three static umbilicals ranging from approximately 5,900–6,700 m long with UTAs will be installed during the umbilical laydown operations. The umbilicals are progressively lowered from the moving construction vessel to the seabed, until the UTA/umbilical assembly lands on the pre-installed UTA foundation. Once in place, the UTA structures sit on the UTA foundations and do not add to the seabed disturbance footprint.

Two dynamic umbilicals (approximately 920–984 m long) will be pulled in and hung off from the STP buoy. Each umbilical will be progressively lowered to the seabed as the construction vessel moves towards the pre-installed UTA foundation. Ancillary equipment including buoyancy modules, tether clamp and tether are attached during the lowering operation. A temporary clump weight is attached to assist the lowering operation and enable the tether to be attached to the pre-installed tether base. From the tether base (see Figure 2-16) to the UTA foundation the umbilical is laid on the seabed until the UTA/umbilical assembly lands on the pre-installed UTA foundation.

Umbilicals and steel tube flying leads will be installed with the lines filled with either MEG (see Section 2.6 for chemical composition) or water-based hydraulic control fluid. The chemical selection assessment process is described in Section 2.12.

Steel tube, optical and electrical flying leads will be installed to interconnect the UTAs and other subsea infrastructure. Some of the flying leads will be stabilised using sand or grout bags (approximately 20 kg) at various points along their length. Temporary clump weights or turning bollards may be used to help install the steel tube flying leads. The seabed footprint associated with this activity is listed in Table 2-8.

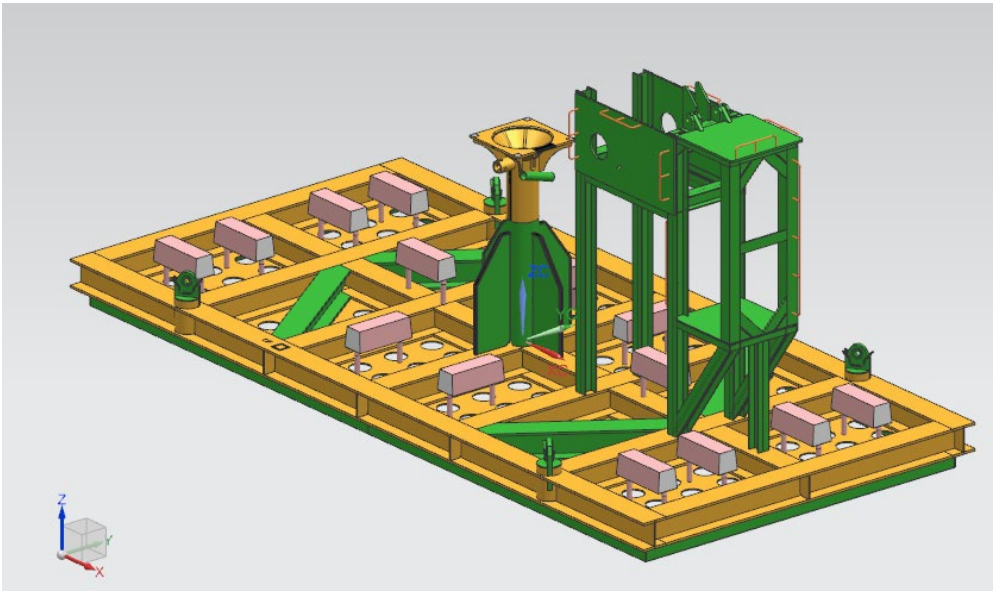


Figure 2-17: Example of UTA foundation

2.5.9 Spool and jumper installation

The 14″ and 6″ spools will be installed to connect FLETs to production manifolds and the 26″ spool will connect the riser base manifold to the FPSO PLET (Note: FPSO PLET installation is outside the scope of this EP). An example of a spool is shown in Figure 2-18. The 8″ production well and 2″ annulus jumpers will connect the Christmas trees to production manifolds (Note: Christmas tree installation is outside the scope of this EP). Spools and well jumpers will be installed pre-flooded with treated freshwater. Once the spools and well jumpers are positioned, the temporary caps will be

removed (inconsequential discharges may occur), and the spools and jumpers connected to the subsea infrastructure at each end. Table 2-7 lists the specifications for the spool and jumpers.

Table 2-7: Spool and jumper specification

Item	Diameter	Nominal length (m)	Material
Spool	6”	77	corrosion-resistant alloy
	14”	77	corrosion-resistant alloy
	26”	96	carbon-steel
Production well jumpers	8”	54	corrosion-resistant alloy
Annulus jumpers	2”	76	flexible pipe

The seabed footprint associated with installing the spools and well jumpers is listed in Table 2-8.

Figure 2-18: Example of spool

2.5.10 Mattress (or alternative) installation

Mattresses (Figure 2-19) or alternative will be installed to:

- support the spools and well jumpers
- support the displacement initiators
- provide scour protection
- mitigate flowline walking, span growth and lateral buckling.

Concrete mattresses are blocks of dense material (typically concrete) bound together by flexible cables (usually artificial fibre ropes) (Figure 2-19). Each concrete mattress varies in size. Typical sizes range from 6 m by 3 m, 14 m by 3 m and 9 m by 6 m depending on the location, type, installation tolerances and seabed topography. Final mattress size will be determined during detailed design. Typical alternatives to concrete mattresses include, but are not limited to:

- weighted edge soft mattresses (with fronds) (Figure 2-20)
- pre-installed geotextile roll out scour skirts (Figure 2-21)
- rock bags (Figure 2-22).

If required, a crane on the reel-lay or construction vessel will lift concrete mattresses from the vessel deck and lower them to the seabed, and an ROV will position and orientate the concrete mattresses before they land on the seabed. The typical alternatives will either be installed separately or pre-installed onto structures and rolled out using an ROV.

The expected total footprint for the mattresses or similar are listed in Table 2-8.

Figure 2-19: Example of concrete mattress

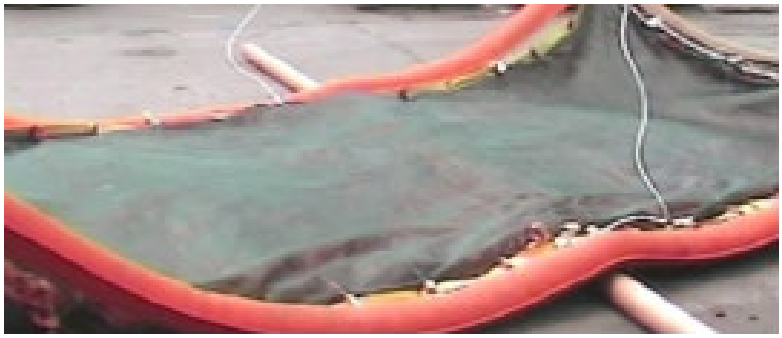


Figure 2-20: Example of weighted edge soft mattresses (with fronds)

Figure 2-21: Example of pre-installed geotextile roll out scour skirts

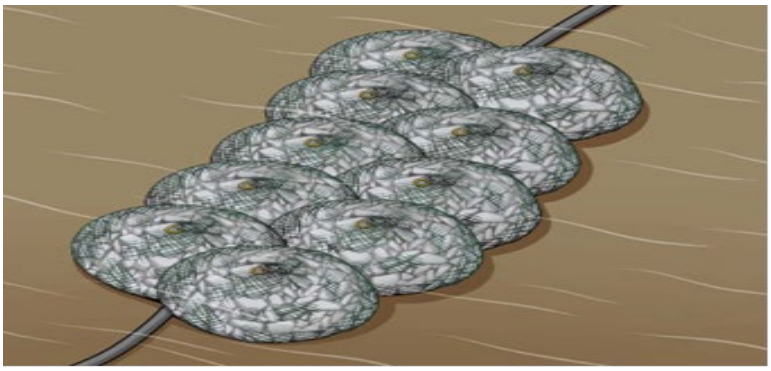


Figure 2-22: Example of rock bags

2.5.11 Refuelling and chemical transfers

The reel-lay and construction vessels may require bunkering (refuelling). A support or supply vessel will transfer MDO (marine diesel oil) or MGO (marine gas oil) (collectively referred to as MDO for the purposes of this EP) to the reel-lay or construction vessel using the ship-to-ship bunkering process. The bunkering schedule will depend on the selected vessels and operational criteria. It is expected that approximately 6 bunkering events will occur during the Activity.

The construction vessel will require 2 transfers of approximately 100 m^3 of MEG during the Activity. A supply vessel will transfer MEG to a construction vessel using the ship-to-ship transfer process via a floating hose. It is expected that the transfer duration will be 3 hours.

Empty helicopter fuel tanks onboard vessels will be replaced with full tanks (typically 2) from a supply vessel using the vessel crane. Refuelling the helicopter with aviation fuel occurs via a fuel hose and a pressure/gravity nozzle from the dispenser unit located in the vicinity of the helideck.

2.5.12 Seabed footprint

The total area of Petroleum Production Licence NT/L1 is approximately 84,100 ha. The estimated overall footprint from the Activity has been estimated by calculating the footprint of the seabed subsea infrastructure described in the previous sections, as listed in Table 2-8.

Table 2-8: Estimated seabed footprint from subsea infrastructure

Subsea infrastructure	Seabed footprint	Description
FPSO mooring system installation	1.93 ha	Includes suction anchors, mooring chains and a section of mooring wire that may contact the seabed, and temporary clump weights and installation aids used during installation.
Flowline supporting structures installation	1.80 ha	Includes displacement initiators, FLET foundations (including wet parking), scour protection, support mattresses, flowline walking mitigation, and temporary installation aids and transponder frames.
Flowline installation	1.28 ha	Calculated based on the length of the flowlines multiplied by the diameter of the flowline (with corrosion coating included). It also includes the footprint for the temporary initiation anchors and wire and installation aids.
Manifolds, spools and well jumpers installation	0.41 ha	Includes manifold foundations, spools, well jumpers, scour mitigation, support mattresses and installation aids.
Riser installation	0.25 ha	Includes footprint of the risers (including wet parking) in contact with seabed, supporting riser tether base structures with scour protection

Subsea infrastructure	Seabed footprint	Description
		and temporary clump weights and installation aids used during installation.
Umbilical installation	0.39 ha	Includes static umbilicals and footprint of the dynamic umbilicals in contact with seabed, supporting riser tether base structures with scour protection, flying leads with stabilisation, and temporary clump weights and installation aids used during installation.
25% contingency	1.52 ha	To address potential footprint increase for structures and optimisation (subject to detailed design) as well as contingency span rectification / infrastructure repositioning (if required).
Estimated total seabed footprint	**7.58 ha**	

2.6 Pre-commissioning activities

Once the key subsea infrastructure listed in Table 2-1 is installed, pre-commissioning activities will be carried out to ensure the integrity and connections of the subsea infrastructure. Depending on the infrastructure, these pre-commissioning activities may include FCGT, dewatering, preconditioning, nitrogen packing, flushing and hydrostatic leak testing (leak testing).

The chemical selection assessment process for the pre-commissioning fluids is described in Section 2.12. The pre-commissioning fluids that will be discharged to the sea include treated freshwater, treated sea water and MEG.

Treated freshwater or treated sea water is freshwater or sea water conditioned with a hydrotest mixture comprising biocide, oxygen scavenger, corrosion inhibitor and leak detection dye. The typical dosage rate is between 400 and 600 mg/L using products similar to Hydrosure or Roemex Hydro 4 and will depend on the length of the preservation period. The hydrotest mixture is typically a mixture of biocides (to prevent biofouling on the internal surfaces), an oxygen scavenger and corrosion inhibitor (to control corrosion of the pipeline) and a dye (allows for leaks to be detected through visual inspections).

MEG refers to MEG/freshwater blends that typically range from 70:30 to 95:05, and includes leak detection dye. Table 2-9 lists the pre-commissioning activity discharge types and volumes.

2.6.1 Flowline flood, clean, gauge and pressure testing (FCGT)

2.6.1.1 Production flowlines

Once installed, the production flowline internal surfaces need to be cleaned and inspected to determine if any unacceptable restrictions and/or obstructions exist in the flowline. This is conducted through pigging (a pig is a pipeline inspection gauge). A series of pigs will be pushed through the production flowline to clean the flowline, gauge the flowline and ensure all air is removed during the flooding process. The pigs are pushed using treated sea water won from the vessel.

In the flooding process, freshwater will separate each pig in the train and will be discharged to sea as each pig completes a run. A slug of freshwater will be injected ahead of the first pig to lubricate the sealing discs on the pig and to control pig speed. Some debris from flowline installation activities may remain within the flowline and this may be discharged with this treated freshwater.

Once the pigging operations are completed and the condition of the gauge plates has been confirmed, the production flowline will undergo a hydrostatic pressure test (hydrotest) using treated sea water. The hydrotest pressure will be held for a period (as per the relevant standard) to test the flowline integrity. Small, localised discharges will occur around each FLET as that subsea

infrastructure is tested and the flowline is depressurised. Hydrotest depressurising treated sea water is expected to be discharged over approximately 6 hours at one of the FLETs.

Production flowline FCGT will discharge freshwater and treated sea water; volumes are listed in Table 2-9.

2.6.1.2 Service flowlines

Once the service flowlines are installed, their internal surfaces need to be cleaned and inspected to determine if any unacceptable restrictions and/or obstructions exist. This is done through pigging. A series of pigs will be pushed through the service flowline to clean the flowline, gauge the flowline and ensure all treated freshwater is removed during the flooding process. The pigs are pushed using MEG.

In the flooding process, MEG will also separate each pig in the train and will be discharged to sea as each pig completes a run. Some debris from flowline installation activities may remain within the flowline and this may be discharged with this water. The treated freshwater and MEG will be discharged at either FLET.

Once the pigging operations are completed and the condition of the gauge plates has been confirmed, the service flowlines will undergo hydrotesting using MEG. The hydrotest pressure will be held for a period (as per the relevant standard) to test the flowline integrity. Small, localised discharges around each FLET may occur as that subsea infrastructure is tested and the flowline is depressurised. Hydrotest depressurising MEG is expected to be discharged over approximately 6 hours at one of the FLETs.

Service flowline FCGT will discharge treated freshwater and MEG; volumes are listed in Table 2-9.

If an issue indicates remedial construction work is required, or if a flowline wet buckle occurs during pipelay, contingency plans will be implemented and the affected lines may be flooded with treated sea water then dewatered to the environment to allow repairs to be undertaken (Section 2.8.1).

2.6.2 Production flowline dewatering and preconditioning

On completion of FCGT, the flooded production flowlines will be dewatered, conditioned with MEG and filled with nitrogen for preservation until commissioning. An unplanned nominal amount of nitrogen may be released during this process. The production flowlines will be dewatered using a train of dewatering pigs separated by freshwater and MEG slugs.

Discharge of the dewatering fluid will occur through a diffuser at one of the FLETs over approximately 6 hours; the discharge volumes are listed in Table 2-9.

2.6.3 Riser flushing and leak testing

When temporary caps are removed from the pre-flooded (with MEG) risers connected to the subsea infrastructure at the subsea end, raw sea water will enter the risers and must be flushed out with MEG. The risers will also undergo a leak test using MEG. The leak test pressure will be held for a period (as per the relevant standard) to test the riser connection integrity. Small, localised discharges will occur as that subsea infrastructure is tested and the riser is depressurised. Leak test depressurising MEG is expected to be discharged over approximately one hour at the FLETs and riser base manifold; the nominal volume of MEG discharged is listed in Table 2-9.

2.6.4 Production manifolds, riser base manifold, spools and jumpers flushing and leak testing

When temporary caps are removed from the pre-filled (with treated freshwater) spools and well jumpers connected to the subsea infrastructure, raw sea water will enter the production and riser base manifolds and must be flushed out with MEG. The spools and well jumpers will also undergo a

leak test using MEG (see Section 2.6 for chemical composition). The leak test pressure will be held for a period (as per the relevant standard) to test the connection integrity. Small, localised discharges will occur as that subsea infrastructure is tested and depressurised. Leak test depressurising MEG is expected to be discharged over approximately one hour at the production and riser base manifolds.

Table 2-9 lists the treated freshwater and MEG volumes discharged.

2.6.5 Umbilical system leak testing

The interconnected umbilicals and steel tube flying leads will undergo a leak test using MEG (see Section 2.6 for chemical composition) for chemical lines and water-based hydraulic control fluid for hydraulic lines. The leak test pressure will be held for a period (as per the relevant standard) to test the connection integrity. Leak test depressurising MEG and hydraulic control fluid will be returned to tanks on the construction vessel via the test downlines.

2.7 Unplanned and non-routine inspection, maintenance and repairs

The preservation period is the interim period from completing the pre-commissioning activities until the activities covered under the Barossa Production Operations EP (BAA-200 0637) commence. During the preservation period, no planned IMR activities of the subsea infrastructure will occur.

However, non-routine IMR activities of the subsea infrastructure may be required during the preservation period due to unplanned events (e.g. unstable seabed conditions, significant earthquake, cyclone events, anchor strike, dropped objects, and trawl gear interference) that could physically damage and affect the integrity of the subsea infrastructure, possibly triggering the requirement for an inspection.

During the preservation period, these unplanned events are not expected to occur; however, they are included in this EP in the very unlikely event that they are required.

Inspection activities that may occur on subsea infrastructure (e.g. cathodic protection surveys and general visual inspections) are typically undertaken from an IMR vessel equipped with ROVs with transponders.

Typical maintenance and repairs undertaken include:

- anode replacement
- cathodic protection system maintenance
- flowline, riser, umbilical, well jumper and spool repairs
- restabilisation
- subsea infrastructure servicing (including leak testing)
- marine growth removal
- fishing nets or other marine debris removal
- recommissioning.

In the unlikely event of flowline failure, the flowline may need to be recovered and a new section of flowline installed in a similar manner to the initial installation (see Section 2.5.4).

2.8 Flowline installation and pre-commissioning contingencies

Unplanned situations may arise during flowline installation. The installation contractor will develop contingency procedures for these unplanned but potential situations. Two contingent activities—wet buckle and a stuck pig—have potential environmental impacts.

2.8.1 Wet buckle

A wet buckle is when a failure in the flowline during installation results in raw/untreated sea water entering the flowline. If this occurs, the untreated sea water must be removed from the flowline. The flowline may also need to be flushed with treated sea water, depending on the cause of the wet buckle and the activities that must be done before flowline lay operations can safely recommence.

If a wet buckle occurs, a detailed incident investigation must be done, and any findings must be satisfactorily addressed before flowline lay can recommence. If modifications are required to the reel-lay vessel or procedures that will result in an extended period (typically 21 days or more) before flowline lay can recommence, then the flowline will be flooded with inhibited sea water to safely preserve it until flowline lay recommences. In this instance, the sea water will be treated with the same chemicals used for FCGT, as described in Section 2.6.1**,** and the flowline will need to be dewatered immediately before flowline lay restarts to allow the pipeline to be recovered to the surface.

The flowline does not need to be temporarily preserved if pipelay can safely be recommenced in a timely manner, typically less than 21 days from the introduction of raw sea water into the flowline. In this instance the raw sea water must be displaced using a series of bidirectional pigs and then flowline lay operations can recommence. Once the flowline lay is completed, FCGT activities will be conducted as detailed in Section 2.6.1.

2.9 Summary of discharges and emissions

Table 2-9 lists the discharge types and volumes for the Activity. Section 2.6 details the chemicals, composition dosage rates and dilution ranges for the pre-commissioning fluids (e.g. treated sea water, treated freshwater and MEG). The chemical selected were assessed using a risk-based approach described in Section 2.12.

Table 2-10 summarises a typical activity vessel, equipment and helicopter emissions and discharges. Other materials and wastes may be temporarily stored on an activity vessel until proper onshore disposal at a licenced facility, facilitated through port facilities.

Table 2-9: Summary of planned activity discharges

Subsea infrastructure	Activity	Discharge type	Estimated total discharge volume (m^3)
Production flowline	FCGT	Treated [2] sea water	426 (~142 m^3 per flowline)
		Freshwater	72 (~24 m^3 per flowline)
	Dewatering	Treated sea water	1,752 (ranging from ~540 m^3 to ~612 m^3 per flowline)
		Freshwater	36 (~12 m^3 per flowline)
		MEG	36 (~12 m^3 per flowline)
Service flowline	FCGT	Treated freshwater	336 (~112 m^3 per flowline)
		MEG	94 (~31 m^3 per flowline)
Risers	Flushing and leak testing	MEG	54 (ranging from ~2.7 m^3 to ~9 m^3 per riser)
Manifolds, spools and well jumpers	Flushing and leak testing	Treated freshwater	125
		MEG	52
Umbilicals	Leak testing	MEG	1
		Hydraulic control fluid	1
STP buoy	Deballasting	Treated sea water	900
Grout downline (contingency)	Flushing	Grout	6 (1.5 m^3 per line)

Table 2-10: Summary of typical activity vessel, other equipment and helicopter emissions and discharges

Type	Description
Emissions	
Atmospheric emissions (hydrocarbon combustion)	• activity vessel engines and associated equipment engines and helicopters • operation of vessel incinerators

[2] Assume "treated" refers to the addition of a hydrotest mixture (such as Roemex or Hydrosure) at a concentration of less than 600 mg/L as described in Section 2.6.

Type	Description
Noise emissions	• vessel activities (e.g. vessel engines, DP thrusters and other machinery) • acoustic positioning systems • nitrogen discharge activities • ROV activities • helicopter activities
Light emissions	• vessel navigation and safety lighting • spot lighting as needed • ROV underwater lighting
Discharges	
Ballast water	Ballast water could potentially be discharged to the marine environment from vessel ballast tanks.
Sewage and greywater	The volume of sewage and greywater directly relates to the POB number. Up to 30–40 L of sewage/greywater may be generated per person per day.
Deck drainage/run-off	Drainage water from activity vessels includes rainwater, sea water and washdown water. Such discharge may potentially contain small residual quantities of oil, grease and detergents if present or used on the decks. During an unplanned fire event, firefighting foam may also be present.
Cooling water	Excess or unused heat in cooling water will be carried away from vessel and equipment components using sea water and returned to the sea with residual sodium hypochlorite.
Bilge water	Oily bilge water will be treated via an oily water filter system to achieve 15 mg/L after treatment, then discharged.
Brine (if a reverse osmosis unit is used for water treatment)	Brine generated from the water supply systems on the vessels will be discharged to the ocean at a salinity of approximately 10% higher than sea water.
Putrescible food waste effluent	Putrescible waste discharge to sea is estimated to be approximately 1 L of food waste per person per day.

2.10 Concurrent activities

The Barossa Development activities under the Barossa Development Drilling and Completions EP (BAD-200 0003) (referred to as the Drilling EP), the NOPSEMA-accepted Barossa Gas Export Pipeline Installation EP (BAA-210 0010) (referred to as the Barossa GEP Installation EP) and this EP are planned to occur concurrently in the OA (referred to as concurrent activities). Concurrent activities include situations where two or more Barossa Development activities occur nearby but continuously remain at a ‘safe’ level of separation. All concurrent activities will be managed under the Barossa Interface Management Plan.

The GEP and the Activity installation activities may occur concurrently for a limited duration of nominally 10 days. Approximately 16 km of the Barossa GEP OA overlaps the Activity OA. The activity vessels (covered under this EP) will not be permitted within the GEP pipelay vessel’s 500 m exclusion zone. Safe level separation distances will be maintained between activity vessels (covered under this EP) and the GEP vessels (e.g. construction and supply/support vessels).

Although unlikely, the GEP and Activity pre-commissioning activities may occur concurrently. The GEP vessels (e.g. construction and supply/support vessels) will operate adjacent to the FPSO PLET for up to nominally 12 days over approximately 4 periods. The GEP pre-commissioning discharges will be released at the FPSO PLET location. For this Activity, the pre-commissioning discharges will likely occur at the FLET for FCGT and the drill centres for dewatering; volumes are listed in Table

2-9 and further described in Section 2.6. The FPSO PLET is approximately 6.5 km from the drill centres and over 250 m from the closest FLET. The chemical selection assessment process for the GEP pre-commissioning fluids is described in Section 2.12. The GEP pre-commissioning fluids that will be discharged include MEG (~1,000 m^3) and treated sea water (~15,000 m^3 flooding, ~2,000 m^3 hydrotest and ~85,000 m^3 dewatering) using a similar hydrotest mixture and dosage rate as described in Section 2.6.

The Drilling OA encompasses the Activity OA. The Drilling activities include the drilling and completion (and ongoing management) of the production wells; refer to Section 2 of the Drilling EP for a detailed description. Concurrent activities will be spatially confined to areas adjacent to or near one of the 3 drill centre locations, determined by the positioning of the mobile offshore drilling unit (MODU) and light well intervention vessel (LWIV). The temporal concurrent overlap may occur approximately 3 times over nominally 7 days. Following the completion of the wells, a 500 m petroleum safety zone (PSZ) will be established and maintained.

The activity vessels (covered under this EP) will not enter the MODU 500 m PSZ and will maintain safe level separation distances with the Drilling vessels (e.g. LWIV, supply/support vessels). The MODU will conduct intermittent and short duration (~2–3 days for each well; up to 9 days total) flaring during well flowback activities.

The main drilling discharges include water-based drill fluids (~7,700 m^3) and cuttings (~1,300 m^3), formation water (oil in water content <30 mg/L; ~2,385 m^3) and cement (~280 m^3). The Drilling EP provides a comprehensive list and assessment of all the drilling discharges. The chemical selection assessment process for the drilling chemicals is described in Section 2.12. There is a potential that during concurrent activities, drilling (drill centre location) and the Activity discharge plumes may overlap. The concurrent Activity discharge volumes will be limited to the dewatering activities (Section 2.6.2) at the FLET adjacent to the MODU and one flowline volume (refer to Table 2-9).

Section 6 provides the cumulative impact assessment from the spatial and temporal overlap of the proposed concurrent activities.

2.11 Decommissioning

The operational life of the subsea infrastructure is expected to be approximately 25 years. Therefore, no decommissioning activities will occur within the 5 years that this EP is valid. Although decommissioning and removal of the subsea infrastructure are outside the scope of this EP, these structures have been designed and selected to meet the regulations required for full removal.

Santos's contractor(s) must maintain a comprehensive inventory of equipment and precise installation locations using the Barossa Manufacturing Record Book Index Requirements (BAA-100 0238). This will ensure that data such as the serial or identification numbers of subsea infrastructure and structures are recorded during installation. The exact location of all subsea infrastructure and structures will be confirmed as part of the as-constructed survey process. This process will create records that will be used to plan for the future decommissioning of Barossa Development infrastructure. The Barossa Decommissioning EP (to be developed) will meet the requirements of the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (Cth) (OPGGS Act) and OPGGS(E)R, and any additional relevant legislation, policies (such as Policy: Section 572 Maintenance and removal of property [NOPSEMA, 2022]) and guidelines (such as the Commonwealth Department of Industry, Science, Energy and Resources Offshore Petroleum Decommissioning Guideline [DISER, 2022]) in force at the time. Decommissioning options will be assessed before the end of project life as per relevant legislative requirements. These decommissioning options will be evaluated to demonstrate that environmental impacts and risks are acceptable and ALARP during the Barossa Decommissioning EP process.

2.12 Chemical assessment

A risk-based approach to select chemical products ranked under the Offshore Chemical Notification Scheme (OCNS) is applied to those chemicals used and discharged or where there is a risk of discharge 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's (UK) Continental Shelf. Chemicals are ranked according to their calculated hazard quotients (HQ) by the Chemical Hazard Assessment and Risk Management (CHARM) mathematical model, which uses aquatic toxicity, biodegradation and bioaccumulation data (CIN, 2005). The HQ is converted to a colour banding—gold and silver colour bands represent the least environmentally hazardous chemicals (Table 2-11).

Table 2-11: OCNS chemical hazard and risk management hazard quotient and ranking

Minimum HQ value	Maximum HQ value	Colour banding	Hazard
>0	<1	Gold	Lowest
≥1	<30	Silver	
≥30	<100	White	
≥100	<300	Blue	
≥300	<1,000	Orange	
≥1,000		Purple	Highest

Chemicals not amenable to the CHARM model (i.e. inorganic substances, hydraulic fluids or chemicals used only in pipelines) are assigned an OCNS grouping based on the worst-case ecotoxicity data—Group E and D represent the least hazard potential (Table 2-12).

Table 2-12: Initial OCNS 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: Centre for Environment, Fisheries and Aquaculture Science (CEFAS), 2022

Santos' Offshore Division Operations Chemical Approval Procedure (EA-91-II-10001) accepts CHARM ranked gold/silver, or non-CHARM ranked Group E/D chemicals for use and discharge without a detailed environmental risk assessment. The same applies to chemicals that are on the pose little or no risk to the environment (PLONOR) List. The PLONOR List, agreed upon by the OSPAR Convention (Oslo–Paris Convention for the Protection of the Marine Environment of the North-East Atlantic), contains a list of substances that pose little or no risk to the environment in offshore waters. If chemicals are ranked lower than gold, silver, Group E or D (i.e. CHARM ranked purple, orange, blue or white, or non-CHARM Group A, B or C ranked chemicals) and no alternatives are available, a risk assessment is conducted to provide technical justification for their use and to show that their use and associated risk is acceptable and ALARP.

Under the Offshore Division Operations Chemical Approval Procedure (EA-91-II-10001) chemicals ranked lower than CHARM gold, silver, Group E or D (i.e. CHARM-ranked purple, orange, blue or white, or non-CHARM Group A, B or C ranked chemicals) require investigation of potential alternatives. There is a preference for chemical options that are CHARM-ranked gold/silver, or non–

CHARM-ranked Group E/D chemicals and/or chemicals that have low aquatic toxicity, are readily biodegradable and do not bioaccumulate (see Sections 2.12.1 to 2.12.3).

Any chemicals that may be discharged to the marine environment and that are 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 (see Sections 2.12.1 to 2.12.3) and assessed for environmental acceptability for discharge to the marine environment.

2.12.1 Ecotoxicity assessment

Table 2-12 and Table 2-13 provide guidance for assessing the ecotoxicity of chemicals when investigating potential alternatives. Table 2-12 is used by CEFAS to group a chemical based on ecotoxicity results, with 'A' representing the highest toxicity/risk to environment and 'E' the lowest risk. Table 2-13 shows classifications/categories of toxicity against aquatic toxicity results.

Table 2-13: Aquatic species toxicity grouping

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

Source: United Nations (2021)

2.12.2 Biodegradation assessment

The biodegradation of chemicals is assessed using the CEFAS biodegradation criteria, which aligns with the categorisation outlined in the Globally Harmonized System Annex 9 Guidance on Hazards to the Aquatic Environment (United Nations, 2021). The below is used as a guide when investigating potential chemical alternatives. Preference is to select readily biodegradable chemicals. CEFAS categorises biodegradation into these groups:

- Readily biodegradable: results of >X% biodegradation in 28 days to an OSPAR harmonised offshore chemical notification format (HOCNF) accepted ready biodegradation protocol.
- Moderately biodegradable: results >20% and <X% to an OSPAR HOCNF accepted ready biodegradation protocol.
- Poorly biodegradable: results from OSPAR HOCNF accepted ready biodegradation protocol.

Where X is equal to:

- 60% in 28 days (OECD 306, Marine BODIS [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 BODIS [biodegradability of insoluble substances]); OR
- 70% in 28 days (OECD 301A, 301E).

2.12.3 Bioaccumulation assessment

The bioaccumulation of chemicals is assessed using the CEFAS bioaccumulation criteria, which aligns with the categorisation outlined in the Globally Harmonized System Annex 9 Guidance on Hazards to the Aquatic Environment (United Nations, 2021). Preference is to select chemicals that are not bioaccumulative.

The following guidance is used by CEFAS:

- Non-bioaccumulative/non-bioaccumulating: Log Pow <3, or results from a bioaccumulation test (preferably using *Mytilus edulis*) demonstrate a satisfactory rate of uptake and depuration, and the molecular mass is greater than or equal to 700.
- Bioaccumulative/bioaccumulates: Log Pow ≥3, or results from a bioaccumulation test (preferably using *Mytilus edulis*) demonstrate an unsatisfactory rate of uptake and depuration, and the molecular mass is less than 700.

All chemicals will be selected in accordance with the Offshore Division Operations Chemical Approval Procedure (EA-91-II-10001).

3 Description of the environment

OPGGS(E)R 2009 Requirements
Regulation 13. Environmental assessment
Description of the environment 13(2) The environment plan must: a. describe the existing environment that may be affected by the activity; and b. include details of the particular relevant values and sensitivities (if any) of that environment. Note: The definition of environment in regulation 4 is as follows: a. ecosystems and their constituent parts, including people and communities; and b. natural and physical resources; and c. the qualities and characteristics of locations, places and areas; and d. the heritage value of places; and includes e. the social, economic and cultural features of the matters mentioned in paragraphs (a), (b), (c) and (d). 13(3) Without limiting paragraph (2)(b), particular relevant values and sensitivities may include any of 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 (Convention on Wetlands of International Importance) wetland within the meaning of that Act; d. the presence of a listed threatened species or listed threatened ecological community within the meaning of that Act; e. the presence of a listed migratory species within the meaning of that Act; f. any values and sensitivities that exist in, or in relation to, part or all of: iii. a Commonwealth marine area within the meaning of that Act; or iv. Commonwealth land within the meaning of that Act.

3.1 Introduction

This section describes the key physical, biological, socioeconomic and cultural features of the existing environment that may be affected by the Activity. The description of the environment applies to the OA (Section 2.3), and any areas surrounding the OA that may be affected by the Activity. In this EP the area that may be affected by the impacts and risks of the Activity is described as the environment that may be affected (EMBA), or in the case of a hydrocarbon spill, low exposure value area (LEVA) (which also defines the modelled EMBA) and moderate exposure value area (MEVA). The low and moderate exposure values are listed in Table 3-1 and shown in Figure 3-1.

3.1.1 Determining the EMBA

Stochastic hydrocarbon dispersion and fate modelling is applied to the worst-case spill scenario for the Activity to inform the EMBA (in this case also the LEVA) and the MEVA. Areas potentially contacted by hydrocarbons were determined using stochastic modelling which overlayed hundreds of individual hypothetical spill simulations from a hydrocarbon spill into a single map, with each simulation subject to a different set of metocean conditions drawn from historical records. Stochastic modelling compensates for the uncertainty associated with any single hydrocarbon spill event such that risk assessment and spill response planning are more robust and conservative by covering a wide range of possible scenarios.

Modelling considers key physical and chemical phases of hydrocarbons that pose differing environmental and socioeconomic risks, being surface, entrained, dissolved aromatic and shoreline accumulated hydrocarbons. Defining the areas that may be contacted by spilled hydrocarbons depends on the concentrations of the hydrocarbons on the sea surface, in the water column and on the shoreline.

Hydrocarbon exposure threshold values defined by NOPSEMA (2019) for each of these phases were applied to the stochastic modelling outputs to determine the areas affected by the MEVA and the LEVA. The MEVA represents an area wherein contact with hydrocarbons may result in harmful impacts to biota, encompassing the maximum extent of biological impact. The LEVA represents the maximum extent of possible contact with hydrocarbons within the depth range between 0–10 m and reflects the range of socioeconomic considerations for spill response planning and scientific monitoring. For this reason, the LEVA has been used to define the modelled EMBA. Importantly, in terms of impacts to environmental values and sensitivities, the extent of a particular impact and risk may not be relevant to the full extent of the modelled EMBA, therefore, the MEVA is also referred to where relevant in this EP.

The worst-case release scenario identified as relevant to the Activity (Section 7.6) is considered to be a release of up to 500 m^3 of MDO caused by a vessel collision[3] rupturing a vessel fuel tank, as this represented the largest spatial extent of potential changes to ambient environment conditions. The MEVA and EMBA are shown in Figure 3-1 and exposure values are provided in Table 3-1. Further information about the reasons why these exposure values have been selected and how their application in defining areas relates to impact and risk assessment and spill response planning is provided in Table 7-9, Table 7-10 and Section 7.6.

It is important to note that the footprint of an actual spill event is more accurately represented by only one of the simulations from the stochastic modelling, resulting in a much smaller spatial footprint in the event of an actual spill. Modelling of a single simulation, representative of a single spill event, is termed deterministic modelling. This is discussed further in Section 7.6.2.2 and applied in the risk assessment where relevant.

Table 3-1: Hydrocarbon exposure values (NOPSEMA, 2019)

Hydrocarbon phase	Exposure value		
	Low	Moderate	High
Surface (g/m^2)	1	10	50
Shoreline accumulation (g/m^2)	10	100	1,000
Dissolved aromatics (ppb)	10	50	400
Entrained (ppb)	10	n/a	100

[3] A typical reel-lay vessel, such as Seven Oceans, has an external unprotected MDO fuel tank with a 504 m^3 capacity, the largest spill scenario volume across the proposed activity vessel fleet.

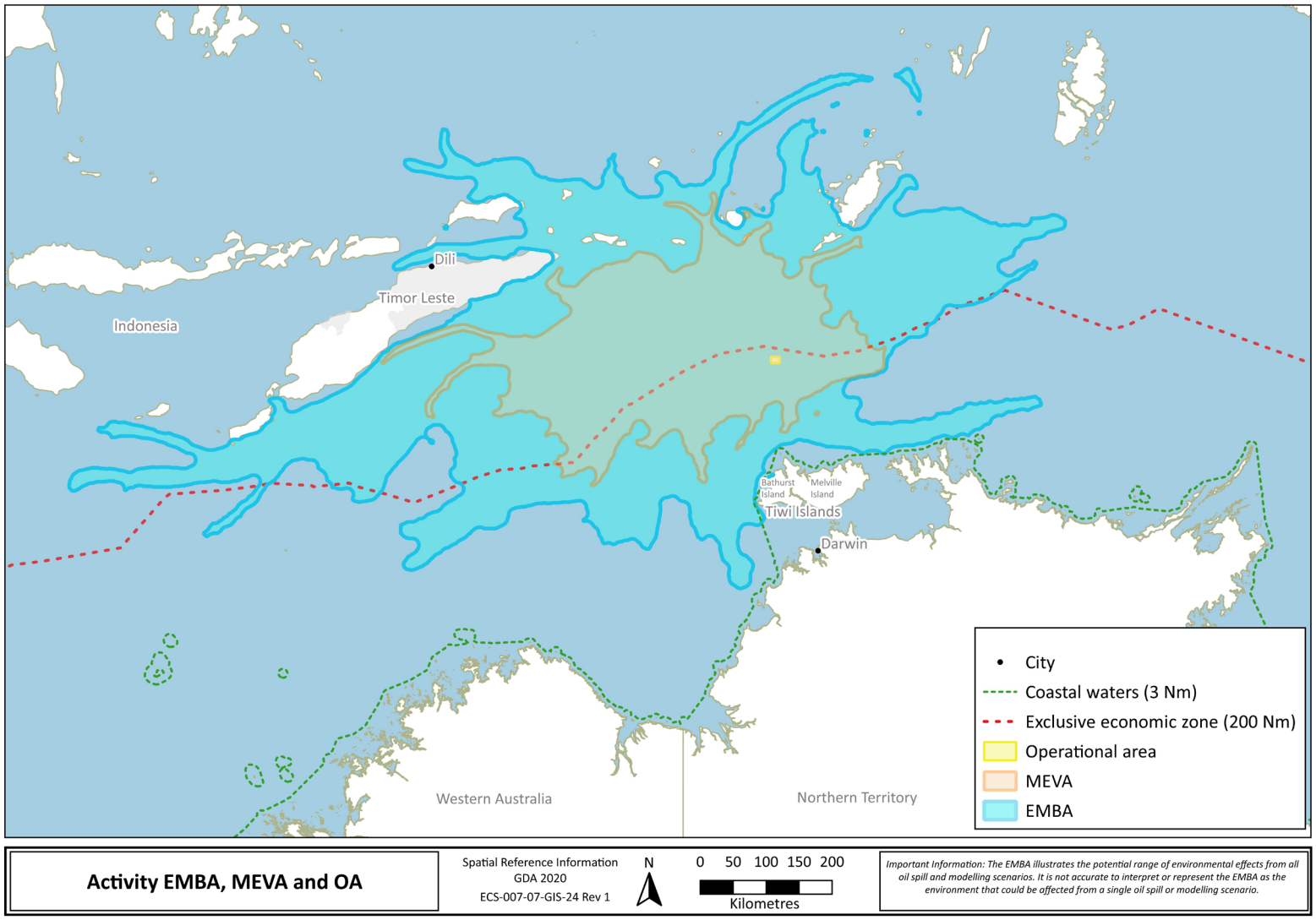


Figure 3-1:The Activity EMBA, MEVA and OA

3.2 Existing Environment

This section summarises the existing environment that may be affected by the Activity and includes details of the particular values and sensitivities values and sensitivities pertaining to the EMBA. Detailed description of these values and sensitivities is provided in Santos' SURF Values & Sensitivities of the Marine Environment (BAS-210 0132, Appendix C) and inclusion was informed by EPBC Act protected matters reports (Appendix D), stated values in the Marine Bioregional Plans for the North Marine Region (NMR) and the North-West Marine Region (NWMR) (CoA, 2012a,b), Barossa environmental studies (BAS-210 0132, Appendix C) and information obtained through consultation. This section also contains some publicly available information regarding the Indonesian and Timor-Leste coast as the EMBA extends into some coastal waters and coastlines of those two countries.

For the purposes of the environmental assessment, identifying potential environmental consequences and developing spill response plans, the environmental values captured by the moderate hydrocarbon exposure threshold values defined by NOPSEMA (2019), representing the thresholds whereby harmful impacts to biota may result, are also identified within the area referred to as the MEVA (Moderate Exposure Value Area) in this section. More information about the reasons why these exposure values have been included and how their application in defining areas relates to impact and risk assessment and spill response planning is provided in Table 7-9, Table 7-10 and Section 7.6.

3.2.1 Physical environment

The OA is located within Commonwealth waters in the Timor Sea, approximately 143 km north of the Tiwi Islands and 300 km north-north-west of Darwin, NT. The OA is located within the NMR, which encompasses approximately 625,689 km^2 of Commonwealth waters from west Cape York Peninsula (Queensland) to the NT/Western Australian (WA) border (CoA, 2008, 2012a) (Figure 3-2).

The EMBA (based on low exposure values) intersects with the NMR (CoA, 2012a) and the North-West Marine Region (CoA, 2012b). The MEVA is within the NMR and intersects the north western boundary of the NWMR with the majority in international waters.

A detailed description of the key physical characteristics of the NMR and NWMR are provided in Santos' SURF Values & Sensitivities of the Marine Environment (BAS-210 0132, Appendix C). A summary of the key physical characteristics of the NMR relevant to the EMBA include (CoA, 2012a):

- a wide continental shelf, with water depths averaging less than 70 m and ranging from approximately 0 m to greater than 7,000 m
- currents driven predominantly by strong winds and tides, a monsoonal climate and complex weather patterns
- Van Diemen Rise, which forms part of a key ecological feature (KEF) (Section 3.2.2.3), includes a range of geomorphic features, such as shelves, shoals, banks, terraces and valleys
- a series of shallow calcium carbonate-based canyons (approximately 80 to 100 m deep and 20 km wide) in the northern section of the region that lead into the Arafura Depression, which forms part of a KEF (Section 3.2.2.3). It consists mainly of calcium carbonate–based sediments (carbonate sand and subfossil shell fragments)
- a concentration of pinnacles along the Australian margin, where local upwellings of nutrient-rich water attract aggregations of fish and turtles, which forms part of a KEF (Section 3.2.2.3)
- the Arafura Shelf, which forms part of a KEF (Section 3.2.2.3) and is up to 350 km wide and has an average water depth of 50 to 80 m, and is characterised by features such as canyons and terraces
- cultural features including sea country (Section 3.2.5).

- The key physical characteristics of the NWMR relevant to the EMBA include (CoA, 2012b):
- the Indonesian Throughflow, a low-salinity water mass that is one of the major elements of the global transfer of heat and water between oceans and which plays a key role in initiating the Leeuwin Current
- Continental slope demersal fish communities, which forms part of a KEF (Section 3.2.2.3) and is valued for high levels of endemism and diversity
- Sahul shelf, which forms part of a key ecological feature (KEF) (Section 3.2.2.3), includes a range of geomorphic features, such as terraces, banks, channels and valleys
- a concentration of pinnacles along the Australian margin, where local upwellings of nutrient-rich water attract aggregations of fish, seabirds and turtles, which forms part of a KEF (Section 3.2.2.3)
- extensive areas of continental shelf and slope, plateaux and terraces including the Sahul Shelf, which forms part of a KEF (Section 3.2.2.3)
- cultural features including sea country (Section 3.2.5).

The EMBA overlaps territorial waters of Indonesia and Timor-Leste and, in the event of a worst-case hydrocarbon spill, residual entrained hydrocarbons may reach the coastlines of Indonesia and Timor-Leste. These territorial waters (belonging to Indonesia and Timor-Leste) are broadly comparable to the Australian oceanic waters within the EMBA, with no remarkable variation in water quality parameters or significant variation in sea state conditions expected (Nurlatifah et al., 2021). The Lesser Sunda Ecoregion encompass the chain of islands and surrounding waters from Bali (Indonesia) to Timor-Leste. The EMBA also overlaps a small portion of the southern boundary of the Coral Triangle on the south coast of Timor-Leste and West Timor. The Coral Triangle is located in South-East Asia and the Pacific, and encompasses the tropical marine waters of Indonesia, Malaysia, Papua New Guinea, Philippines, Solomon Islands and Timor-Leste. It is considered to be the planet's richest centre of marine life and coral diversity (Cross et al., 2014).

3.2.1.1 Provincial bioregions

Based on the Integrated Marine and Coastal Regionalisation of Australia (IMCRA; Department of the Environment and Heritage [DoEH], 2006), the bioregions relevant to the OA and the EMBA (LEVA) are listed in Table 3-2 and shown in Figure 3-2. The OA is situated within the Timor Transition Bioregion of the NMR (DoEH, 2006) that primarily features shelf slope and plateau to the west, and canyon and ridge to the east. It includes the Arafura Shelf, mentioned previously, which is recognised as a KEF (Section 3.2.2.3). Bioregions within international waters of the EMBA have not been formally classified, although the habitats within these waters have been described by published scientific literature. A detailed description of these provincial bioregions is provided in Santos' SURF Values & Sensitivities of the Marine Environment (BAS-210 0132, Appendix C).

Table 3-2: IMCRA provincial bioregions within the OA, MEVA and EMBA

Bioregion	OA	MEVA	EMBA
Northern Shelf Province	✗	✓	✓
Northwest Shelf Transition	✗	✓	✓
Timor Province	✗	✗	✓
Timor Transition	✓	✓	✓

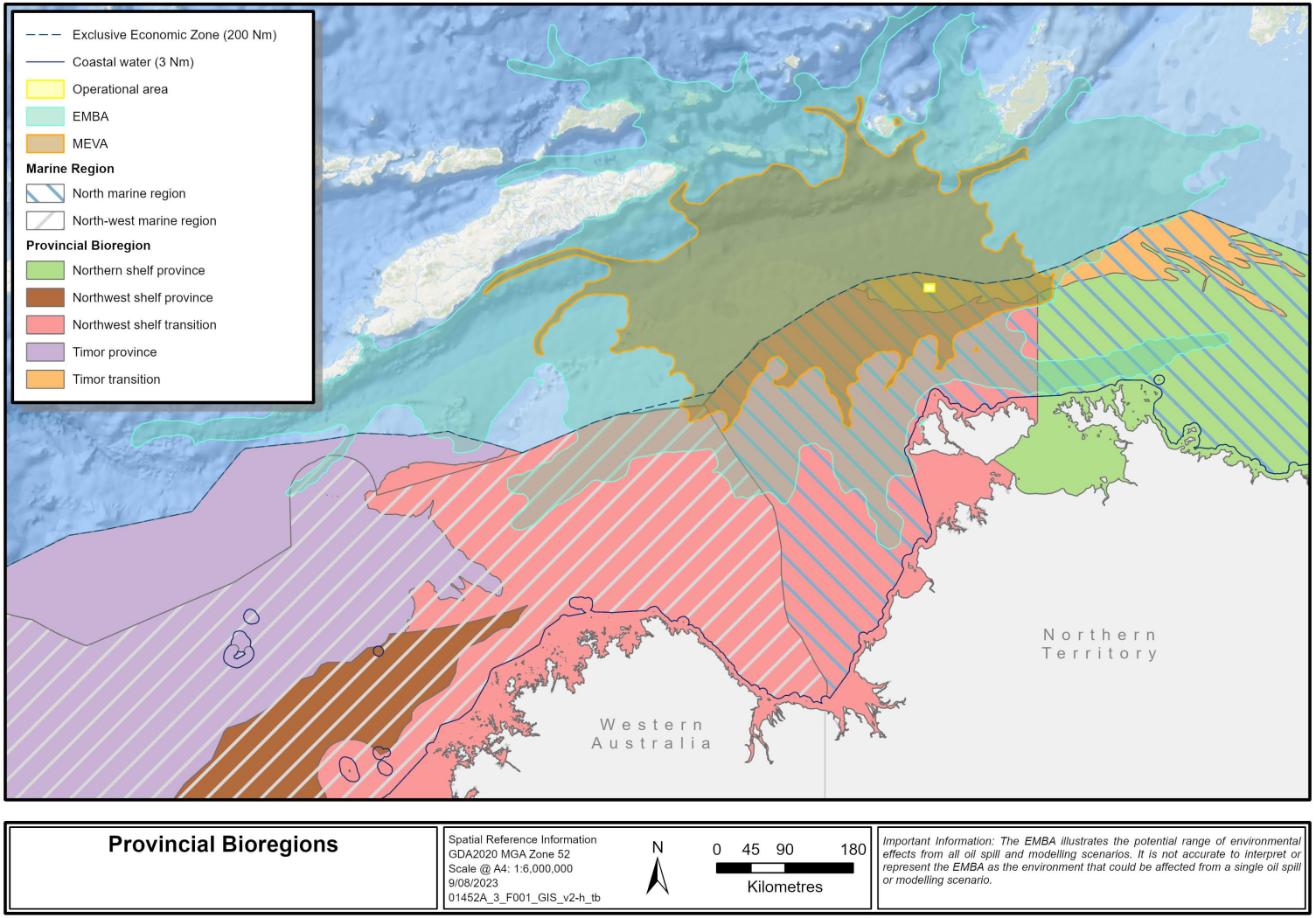


Figure 3-2: IMCRA provincial bioregions in relation to the EMBA

3.2.1.2 Summary of Barossa studies

The studies that were considered when developing this EP are summarised in Santos' SURF Values & Sensitivities of the Marine Environment (BAS-210 0132, Appendix C). Further detail and copies of the studies are provided in Section 5, Appendix C and Appendix D of the OPP (ConocoPhillips, 2018).

3.2.1.3 Benthic habitats

The mean sea level water depths within the OA range from approximately 227 m to 269 m and within the EMBA range from lowest astronomical tide to greater than 7,000 m deep.

The seabed within the OA is generally flat and on a plain that is devoid of any significant bathymetric features (Jacobs, 2016). The geophysical surveys undertaken also reported that the seabed was smooth and featureless with the sediments interpreted to comprise predominantly fine clayey sand (Fugro, 2016). The only relic seabed features observed were slight undulating sand waves (<25 cm high) and widespread bioturbation (i.e. burrows, mounds and tracks) (Jacobs, 2016).

In general, the benthic habitats observed in these studies (which included the OA) were typical of those expected in offshore environments and were consistent with studies conducted both in areas with similar features and in areas of a similar geographic location (Jacobs, 2016). Santos is not aware of any information indicating that the OA contains any sensitive habitat or any benthic habitats that are not represented across other areas and/or regions.

Within the EMBA and MEVA there are several submerged and emergent shoals and banks, including Evans Shoal, Tassie Shoal and Lynedoch Bank. Research undertaken as part of the Barossa marine studies program has included surveys of these features (refer to Santos' SURF Values & Sensitivities of the Marine Environment [BAS-210 0132, Appendix C]). Table 3-3 lists the distances to the nearest shoals and banks (within the MEVA and EMBA) from the OA. Table 3-4 summarises the benthic habitats within the OA, MEVA and EMBA with a detailed description provided in Santos' SURF Values & Sensitivities of the Marine Environment (BAS-210 0132, Appendix C).

The OA and EMBA overlap several key ecological features (KEFs), which include values relating to their seabed features (CoA, 2012a; CoA, 2012b). These are discussed in more detail in Section 3.2.2.2.

Table 3-3: Distances to the nearest shoals and banks from OA

Geomorphic feature	MEVA	EMBA	Water depth range (m)	Approximate distance/direction from OA
Lynedoch Bank	✓	✓	60–100	56 km south-east
Evans Shoal	✓	✓	20–110	67 km west
Tassie Shoal	✓	✓	20–90	76 km south-west
Blackwood Shoal	✓	✓	30–80	86 km west
Goodrich Bank	✗	✓	20–60	88 km south
Franklin Shoal	✓	✓	20–90	97 km west
Flinders Shoal	✓	✓	20–80	100 km west
Marie Shoal	✗	✓	20–50	114 km south
Cootamundra Shoal	✓	✓	30–80	132 km south-west

Geomorphic feature	MEVA	EMBA	Water depth range (m)	Approximate distance/direction from OA
Moss Shoal	✗	✓	30–50	141 km south
Martin Shoal	✓	✓	20–90	147 km west
Calder Shoal	✓	✓	40–70	150 km south-west
Parry Shoal	✗	✓	20–60	150 km south
Margaret Harries Bank	✓	✓	40–120	164 km west
Loxton Shoal	✓	✓	30–90	165 km west
Troubadour Shoals	✓	✓	20–110	179 km west
Sunset Shoal	✓	✓	30–100	184 km west
Afghan Shoal	✗	✓	30–50	222 km south
Sunrise Bank	✓	✓	70–90	225 km west
Shepparton Shoal	✗	✓	30–50	240 km south-west
Jones Shoal	✗	✓	20–30	243 km south-east
Newby Shoal	✗	✓	30–60	247 km south-west
The Boxers	✗	✓	40–90	256 km south-west
Flat Top Bank	✗	✓	30–60	280 km south
Bellona Banks	✓	✓	50–120	312 km west
Echo Shoals	✓	✓	30–460	352 km west
Big Bank Shoals	✗	✓	10–320	457 km south-west
Karmt Shoal	✗	✓	20–360	505 km south-west

Table 3-4: Habitats associated with receptors identified within the OA, MEVA and EMBA

Category	Receptor	OA presence	MEVA presence	EMBA presence				
				Northern Shelf Province	Northwest Shelf Transition	Timor Province	Timor Transition	Non-Australian territorial waters
Benthic habitats	Coral reefs	✗	✓	✓	✓	✓	✗	✓
	Seagrass	✗	✓	✓	✓	✓	✗	✓
	Macroalgae	✗	✓	✓	✓	✓	✓	✓
	Non-coral benthic invertebrates	✓	✓	✓	✓	✓	✓	✓
Shoreline habitats	Mangroves	✗	✗	✗	✗	✓	✗	✓
	Intertidal platforms	✗	✗	✗	✗	✗	✗	✓
	Sandy beaches	✗	✗	✗	✗	✓	✗	✓
	Rocky shorelines	✗	✗	✗	✗	✗	✗	✓

3.2.2 Protected and significant areas

Protected and significant areas identified in the OA, MEVA and EMBA are listed in Table 3-5 and are illustrated in Figure 3-3 and Figure 3-4.

Table 3-5: Presence of protected areas and KEFs within the OA, MEVA and EMBA, including the distance to the OA

Value/sensitivity name	Within OA	Within MEVA	Within EMBA	Distance to OA (~km)
Australian marine parks				
Oceanic Shoals Marine Park	✗	✓	✓	44
Arafura Marine Park	✗	✗	✓	250
Key ecological features				
North-West Marine Region				
Carbonate bank and terrace system of the Sahul Shelf	✗	✓	✓	326
Continental Slope Demersal Fish Communities	✗	✗	✓	776
Pinnacles of the Bonaparte Basin	✗	✓	✓	327
North Marine Region				
Carbonate bank and terrace system of the Van Diemen Rise	✗	✓	✓	55
Pinnacles of the Bonaparte Basin	✗	✓	✓	195
Shelf break and slope of the Arafura Shelf	✓	✓	✓	0
Tributary Canyons of the Arafura Depression	✗	✗	✓	264

3.2.2.1 Australian, WA/NT and international marine parks and reserves

The OA does not intersect any Australian Marine Parks (AMPs); however, the MEVA overlaps one AMP—Oceanic Shoals Marine Park, and the EMBA overlaps 2 AMPs—Oceanic Shoals Marine Park and Arafura Marine Park (Figure 3-3, with the distances from the OA provided in Table 3-5). The AMPs are divided into management zones (Figure 3-3) and managed in accordance with the North-West Marine Park Network Management Plan (MPNMP) (Director of National Parks [DNP], 2018b) and North MPNMP (DNP, 2018a); the values for these AMPs within the EMBA are summarised in Table 3-7. Section 3.2.5 provides information on cultural features and sea country within the AMPs and the surrounds. The AMPs and associated cultural features are further described in Santos' SURF Values & Sensitivities of the Marine Environment (BAS-210 0132, Appendix C).

Management plans for AMPs have been developed and came into force on 1 July 2018. Under these plans AMPs are allocated conservation objectives (International Union for Conservation of Nature [IUCN] Protected Area Category) based on the Australian IUCN Reserve Management Principles in Schedule 8 of the EPBC Regulations 2000. These principles determine what activities are acceptable within the different zones of the AMP network. The applicable AMP management conditions for the activities in this EP are described in Table 3-6.

No WA/NT marine parks and reserves are located within the EMBA. The closest designated reserve is approximately 7 km from the EMBA—Garig Gunak Barlu, hence not discussed further within this EP.

The OA and MEVA do not intersect any international marine parks; however, the EMBA overlaps 2 international marine parks—Laut Sawu Marine National Park, Indonesia and Nino Konis Santana National Park, Timor-Leste. These international marine parks are described in Santos' SURF Values & Sensitivities of the Marine Environment (BAS-210 0132, Appendix C).

Table 3-6: Relevant prescription/condition from the North-West and North Marine Parks Network management plans (DNP, 2018a, 2018b

Prescription/ condition number	Prescription/condition	Relevant section of EP
4.2.9.8	…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 without an authorisation issued by the Director, provided that the actions are taken in accordance with an environment plan 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.	Section 3.2.5.10, reporting under Section 8 and the OPEP (BAS-210 0109).

Table 3-7: MPNMP listed AMP values overlapping the EMBA

AMP	Management Zone(s)	AMP Values Overlapping the EMBA
Arafura	• Multiple Use Zone (IUCN VI) • Special Purpose Zone (Trawl) (IUCN VI)	The Arafura Marine Park values (DNP, 2018a): • ecosystems representative of the Northern Shelf Province and Timor Transition Province • one KEF (the tributary canyons of the Arafura Depression) • a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act • biologically important areas (BIAs) that include internesting and nesting habitat for marine turtles • sea country, which is valued for Indigenous cultural identity, health and wellbeing • commercial fishing, tourism, and recreation, including recreational fishing, are important socioeconomic activities in the Marine Park.
Oceanic Shoals	• Special Purpose Zone (Trawl) (IUCN VI) • Multiple Use Zone (IUCN VI) • National Park Zone (IUCN II) • Habitat Protection Zone (IUCN IV)	The Oceanic Shoals Marine Park values (DNP, 2018a):

AMP	Management Zone(s)	AMP Values Overlapping the EMBA

		• ecosystems representative of the Northwest Shelf Transition and the Timor Transition Province
		• 4 KEFs:
		  ○ carbonate bank and terrace systems of the Van Diemen Rise
		  ○ carbonate bank and terrace systems of the Sahul Shelf
		  ○ pinnacles of the Bonaparte Basin
		  ○ shelf break and slope of the Arafura Shelf
		• a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act
		• BIAs that include foraging, nesting and internesting habitat for marine turtles
		• sea country, which is valued for Indigenous cultural identity, health and wellbeing
		• commercial fishing and mining are important activities.

3.2.2.2 Wetlands of international and national importance

No wetlands of international or national importance are located within the OA or EMBA. The closest designated Ramsar wetland is approximately 15 km from the EMBA—Ashmore Reef. The closest designated nationally important wetland is approximately 7 km from the EMBA—Cobourg Peninsula System.

3.2.2.3 Key ecological features

KEFs are those components of the marine ecosystem that are important for biodiversity or the ecosystem function and integrity of a Commonwealth marine area.

The OA overlaps one identified KEF—Shelf break and slope of the Arafura Shelf. The sea floor features associated with this KEF (i.e. the shelf break and patch reefs, hard substrate pinnacles and submerged reefs of the shelf slope) were not observed during the Barossa marine studies program, nor are these topographically distinct features evident from the bathymetry data derived from multiple surveys undertaken across this area. Therefore, the activity covered by this EP is not expected to impact the sea floor features of the KEF. However, other values of the KEF that require evaluation include the oceanic currents, demersal fish species, whale sharks, sharks and marine turtles.

Table 3-5 lists the identified KEFs within the MEVA and EMBA, together with their distance from the OA. Further detail on the values of the KEFs are provided in Santos' SURF Values & Sensitivities of the Marine Environment (BAS-210 0132, Appendix C).

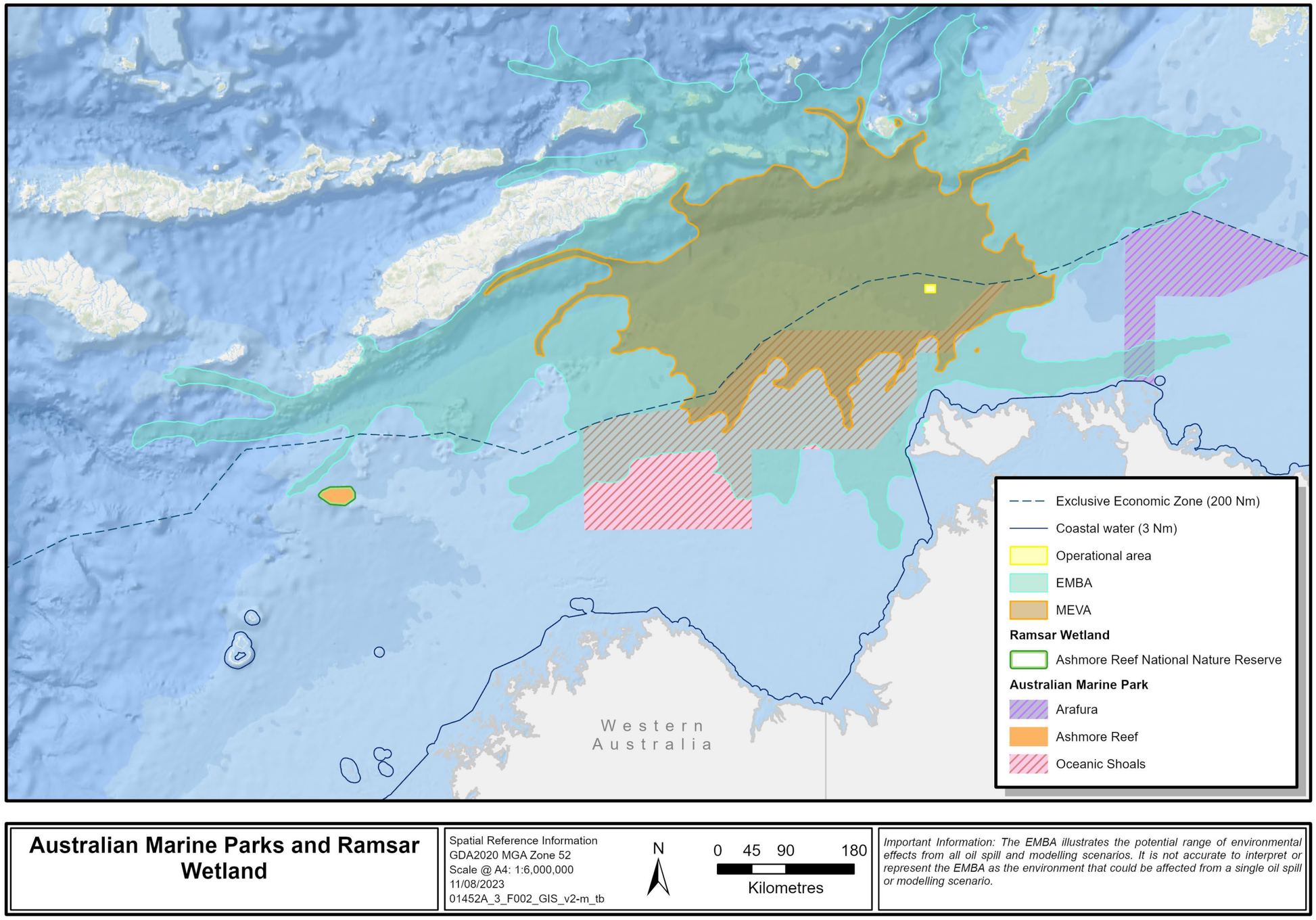


Figure 3-3: Australian marine parks and Ramsar wetlands proximal to or within the EMBA

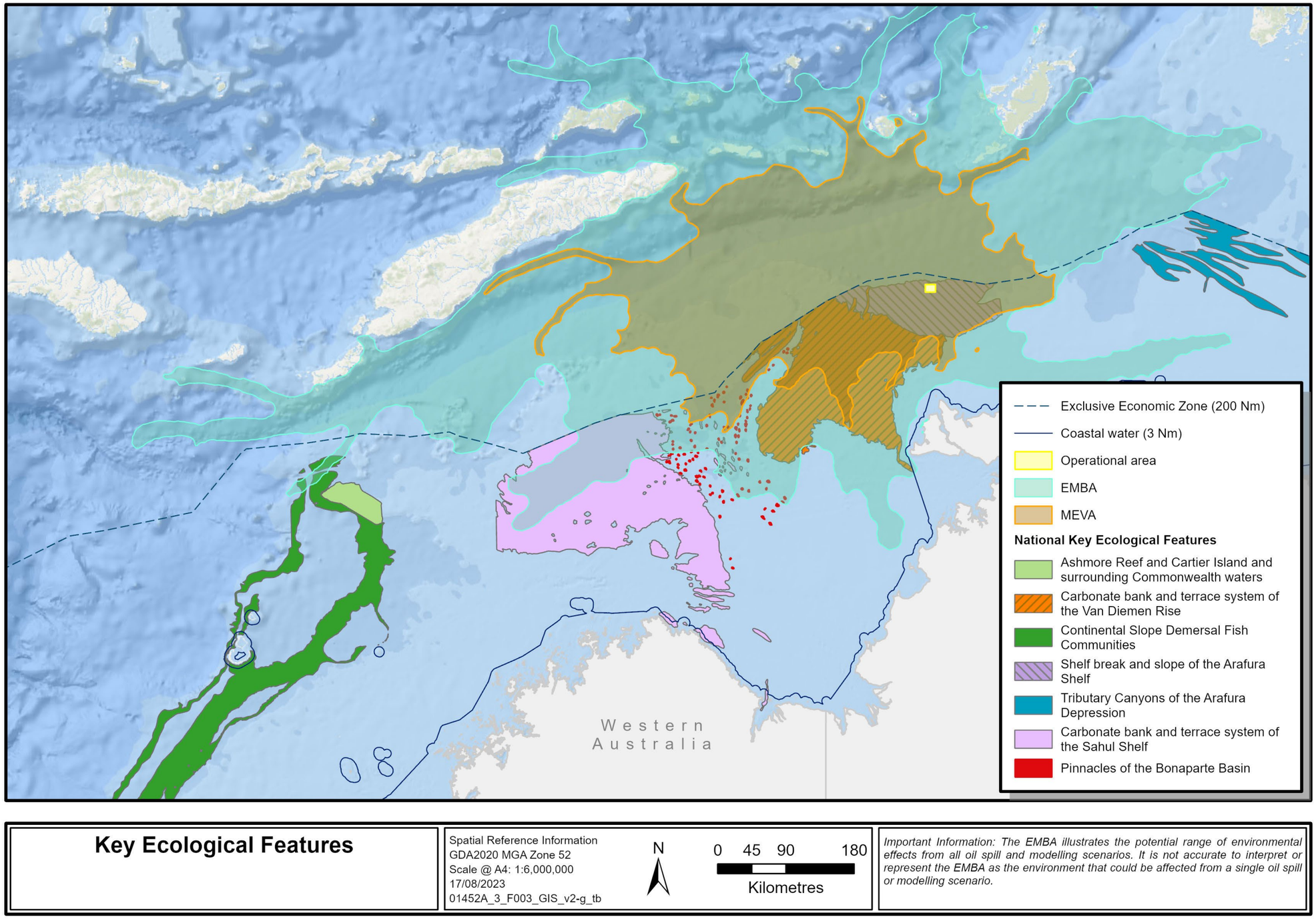


Figure 3-4: Key ecological features within the EMBA

3.2.3 Threatened and migratory fauna

Table 3-8 lists the environmental values and sensitivities (threatened and migratory species) within the OA and EMBA. Threatened and migratory species are Matters of National Environmental Significance (MNES) protected under the EPBC Act. The EPBC Act protected matters reports (Appendix D) also provide a list of the identified listed marine and cetacean species (other matters protected under the EPBC Act).

One additional species, the grey nurse shark (*Carcharias taurus*; EPBC Act listed 'Vulnerable'), has been included in the following sections as it was reported as occurring within or near the OA as part of the Barossa marine studies program. For each species identified, the extent of the likely presence is listed in Table 3-8 and described in Santos' SURF Values & Sensitivities of the Marine Environment (BAS-210 0132, Appendix C).

The scalloped hammerhead shark (*Sphyrna lewini*) and southern bluefin tuna (*Thunnus maccoyii)* are EPBC Act listed as conservation dependent and under threatened listing assessment (at the time of writing this EP). As a result, these species were included for assessment as their listing status could potentially be revised to a threatened species during the Activity.

A compilation of tracking data from marine turtle telemetry studies on and around the Tiwi Islands indicates turtle foraging areas and migration pathways did not overlap with the OA (Pendoley, 2023). Apart from isolated movements of olive ridley turtles, the tracking data indicates that marine turtle migratory pathways are largely restricted to the waters inside the 100m depth contour (waters less than 100m deep) which is outside the OA, noise and light assessment boundaries, and MEVA.

Note that terrestrial species (such as terrestrial mammals, reptiles and bird species) that appear in the EPBC Act protected matters report for the EMBA and do not have habitats along shorelines, are not relevant to the activity impacts and risks have been excluded from Table 3-8. Noting that the MEVA does not reach any Australian shoreline, these species are unlikely to come into contact with a hydrocarbon spill and therefore are not discussed further.

3.2.3.1 Biologically important areas and habitat critical to the survival of marine turtles

No known BIAs for marine species or habitat critical to the survival of a marine turtle species occur within the OA. BIA behaviours (such as breeding, resting, nesting, internesting, distribution or migratory routes) for marine species that overlap the EMBA are listed in Table 3-9 and shown in Figure 3-5 to Figure 3-12. Figure 3-7 to Figure 3-11 show the habitat critical to the survival of a marine turtle species. Although there are only 4 known BIAs within the MEVA, other marine fauna species could aggregate and forage at shoals and banks within the MEVA (Section 3.2.1.3). The BIAs and habitat critical to the survival of a marine turtle species are described in Santos' SURF Values & Sensitivities of the Marine Environment (BAS-210 0132, Appendix C).

Table 3-8: Environmental values and sensitivities within the EMBA and OA – threatened and migratory marine fauna

Value/sensitivity – Marine fauna		EPBC Act status	OA		MEVA		EMBA	
Common name	Scientific name		May be present	Particular values or sensitivities	May be present	Particular values or sensitivities	May be present	Particular values or sensitivities
Marine mammals								
Blue whale[4]	*Balaenoptera musculus*	Endangered, Migratory	✓	Species or species habitat likely to occur within area	✓	Species or species habitat likely to occur within area	✓	Migration route known to occur within area
Bryde's whale	*Balaenoptera edeni*	Migratory	✓	Species or species habitat may occur within area	✓	Species or species habitat likely to occur within area	✓	Species or species habitat likely to occur within area
Fin whale	*Balaenoptera physalus*	Vulnerable, Migratory	✓	Species or species habitat likely to occur within area	✓	Species or species habitat likely to occur within area	✓	Species or species habitat likely to occur within area
Humpback whale	*Megaptera novaeangliae*	Migratory	✓	Species or species habitat may occur within area	✓	Species or species habitat likely to occur within area	✓	Species or species habitat likely to occur within area
Killer whale, orca	*Orcinus orca*	Migratory	✓	Species or species habitat may occur within area	✓	Species or species habitat likely to occur within area	✓	Species or species habitat may occur within area
Sei whale	*Balaenoptera borealis*	Vulnerable, Migratory	✓	Species or species habitat likely to occur within area	✓	Species or species habitat likely to occur within area	✓	Species or species habitat likely to occur within area
Sperm whale	*Physeter macrocephalus*	Migratory	✓	Species or species habitat may occur within area	✓	Species or species habitat likely to occur within area	✓	Species or species habitat may occur within area
Spotted bottlenose dolphin (Arafura/Timor Sea populations)	*Tursiops aduncus (Arafura/Timor Sea populations)*	Migratory	✓	Species or species habitat may occur within area	✓	Species or species habitat likely to occur within area	✓	Species or species habitat known to occur within area
Australian Humpback Dolphin	*Sousa sahulensis*	Migratory	✗	Not applicable (N/A)	✓	Species or species habitat likely to occur within area	✓	Species or species habitat known occur within area
Australian snubfin dolphin	*Orcaella heinsohni*	Migratory	✗	Not applicable (N/A)	✓	Species or species habitat may occur within area	✓	Species or species habitat known occur within area
Dugong	*Dugong dugon*	Migratory Marine	✗	N/A	✓	Species or species habitat known to occur within area	✓	Species or species habitat known to occur within area
Marine reptiles								
Flatback turtle	*Natator depressus*	Vulnerable, Migratory Marine	✓	Species or species habitat known to occur within area	✓	Foraging, feeding or related behaviour known to occur within area	✓	Breeding known to occur within area
Green turtle	*Chelonia mydas*	Vulnerable, Migratory Marine	✓	Species or species habitat known to occur within area	✓	Foraging, feeding or related behaviour known to occur within area	✓	Breeding known to occur within area
Hawksbill turtle	*Eretmochelys imbricata*	Vulnerable, Migratory Marine	✓	Species or species habitat likely to occur within area	✓	Species or species habitat known to occur within area	✓	Foraging, feeding or related behaviour known to occur within area
Leatherback turtle, leathery turtle, luth	*Dermochelys coriacea*	Endangered, Migratory Marine	✓	Species or species habitat likely to occur within area	✓	Foraging, feeding or related behaviour likely to occur within area	✓	Congregation or aggregation known to occur within area
Loggerhead turtle	*Caretta caretta*	Endangered, Migratory Marine	✓	Species or species habitat likely to occur within area	✓	Species or species habitat known to occur within area	✓	Foraging, feeding or related behaviour known to occur within area

[4] In Australian waters there are two subspecies of blue whale, the pygmy blue whale (*B. m. brevicauda*) and the Antarctic blue whale (*B. m. intermedia*). It is more likely that the pygmy blue whale could be encountered given the presence of a BIA within the EMBA

Value/sensitivity – Marine fauna		EPBC Act status	OA		MEVA		EMBA	
Common name	Scientific name		May be present	Particular values or sensitivities	May be present	Particular values or sensitivities	May be present	Particular values or sensitivities
Olive ridley turtle, Pacific ridley turtle	*Lepidochelys olivacea*	Endangered, Migratory Marine	✓	Species or species habitat likely to occur within area	✓	Foraging, feeding or related behaviour known to occur within area	✓	Breeding known to occur within area
Short-nosed seasnake	*Aipysurus apraefrontalis*	Critically Endangered, Marine	✗	N/A	✗	N/A	✓	Species or species habitat likely to occur within area
Salt-water crocodile, estuarine crocodile	*Crocodylus porosus*	Migratory Marine	✗	N/A	✗	N/A	✓	Species or species habitat likely to occur within area
Leaf-scaled seasnake	*Aipysurus foliosquama*	Critically Endangered, Marine	✗	N/A	✗	N/A	✓	Species or species habitat may occur within area
Fish and sharks								
Freshwater sawfish, largetooth sawfish, river sawfish, Leichhardt's sawfish, northern sawfish	*Pristis pristis*	Vulnerable, Migratory Marine	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	✓	Species or species habitat likely occur within area
Giant manta ray	*Mobula birostris*	Migratory Marine	✓	Species or species habitat may occur within area	✓	Species or species habitat likely to occur within area	✓	Species or species habitat likely to occur within area
Green sawfish, dindagubba, narrowsnout sawfish	*Pristis zijsron*	Vulnerable, Migratory Marine	✓	Species or species habitat known to occur within area	✓	Species or species habitat known to occur within area	✓	Species or species habitat known to occur within area
Grey nurse shark	*Carcharias taurus*	Vulnerable	✓	Reported as occurring within or near the OA as part of the Barossa marine studies program.	✓	Reported as occurring within or near the OA as part of the Barossa marine studies program.	✓	Reported as occurring within or near the OA as part of the Barossa marine studies program.
Longfin mako	*Isurus paucus*	Migratory Marine	✓	Species or species habitat likely to occur within area	✓	Species or species habitat likely to occur within area	✓	Species or species habitat likely to occur within area
Narrow sawfish, knifetooth sawfish	*Anoxypristis cuspidata*	Migratory Marine	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	✓	Species or species habitat known to 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	✓	Species or species habitat may occur within area
Oceanic whitetip shark	*Carcharhinus longimanus*	Migratory Marine	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area
Scalloped hammerhead	*Sphyrna lewini*	Conservation Dependent	✓	Species or species habitat may occur within area	✓	Species or species habitat likely to occur within area	✓	Species or species habitat known to occur within area
Speartooth shark	*Glyphis glyphis*	Critically Endangered	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area
Whale shark	*Rhincodon typus*	Vulnerable, Migratory Marine	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	✓	Foraging, feeding or related behaviour known to occur within area
White shark, great white shark	*Carcharodon carcharias*	Vulnerable, Migratory Marine	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area
Dwarf sawfish, Queensland sawfish	*Pristis clavata*	Vulnerable, Migratory Marine	✗	N/A	✓	Species or species habitat known to occur within area	✓	Species or species habitat known to occur within area

Value/sensitivity – Marine fauna		EPBC Act status	OA		MEVA		EMBA	
Common name	Scientific name		May be present	Particular values or sensitivities	May be present	Particular values or sensitivities	May be present	Particular values or sensitivities
Reef manta ray, coastal manta ray[5]	*Mobula alfredi*	Migratory Marine	✗	N/A	✓	Species or species habitat likely to occur within area	✓	Species or species habitat likely to occur within area
Shortfin mako, mako shark	*Isurus oxyrinchus*	Migratory Marine	✗	N/A	✓	Species or species habitat likely to occur within area	✓	Species or species habitat likely to occur within area
Southern bluefin tuna	*Thunnus maccoyii*	Conservation Dependent	✗	N/A	✓	Species or species habitat likely to occur within area	✓	Breeding known to occur within area
Birds								
Common noddy	*Anous stolidus*	Migratory Marine	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	✓	Foraging, feeding or related behaviour known to occur within area
Common sandpiper	*Actitis hypoleucos*	Migratory Wetlands	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area
Curlew sandpiper	*Calidris ferruginea*	Critically Endangered, Migratory Wetlands, Overfly Marine	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area
Eastern curlew, far eastern curlew	*Numenius madagascariensis*	Critically Endangered, Migratory Wetlands, Marine	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area
Great frigatebird, greater frigatebird	*Fregata minor*	Migratory Marine	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	✓	Species or species habitat likely to occur within area
Lesser frigatebird, least frigatebird	*Fregata ariel*	Migratory Marine	✓	Species or species habitat may occur within area	✓	Species or species habitat likely to occur within area	✓	Species or species habitat likely to occur within area
Pectoral sandpiper	*Calidris melanotos*	Migratory Wetlands	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area
Red knot, knot	*Calidris canutus*	Endangered, Migratory Wetlands, Overfly marine	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	✓	Species or species habitat likely to occur within area
Sharp-tailed sandpiper	*Calidris acuminata*	Migratory Wetlands	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area
Streaked shearwater	*Calonectris leucomelas*	Migratory Marine	✓	Species or species habitat likely to occur within area	✓	Species or species habitat likely to occur within area	✓	Species or species habitat known to occur within area
White-tailed tropicbird	*Phaethon lepturus*	Migratory Marine	✓	Species or species habitat may occur within area	✓	Species or species habitat likely to occur within area	✓	Species or species habitat likely to occur within area
Nunivak bar-tailed godwit, Western Alaskan bar-tailed godwit	*Limosa lapponica baueri*	Vulnerable	✗	N/A	✗	N/A	✓	Species or species habitat known to occur within area
Abbott's booby	*Papasula abbotti*	Endangered, Marine	✗	N/A	✗	N/A	✓	Species or species habitat may occur within area
Australian lesser noddy	*Anous tenuirostris melanops*	Vulnerable, Marine	✗	N/A	✗	N/A	✓	Breeding known to occur within area
Australian painted snipe	*Rostratula australis*	Endangered, Overfly Marine	✗	N/A	✗	N/A	✓	Species or species habitat may occur within area

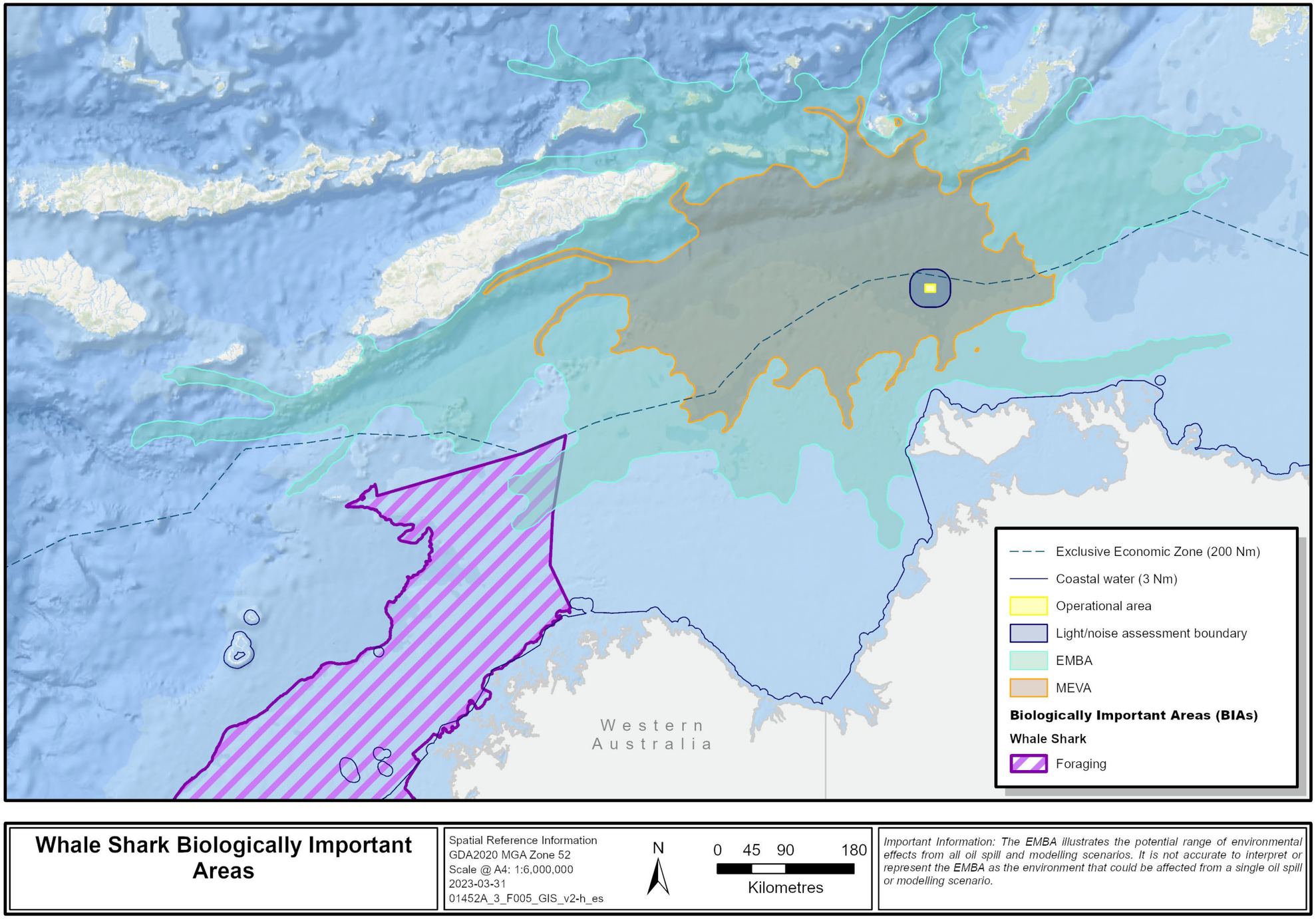
[5] Species or species habitat may occur within the light / noise boundary (20 km buffer around the OA)

Value/sensitivity – Marine fauna		EPBC Act status	OA		MEVA		EMBA	
Common name	Scientific name		May be present	Particular values or sensitivities	May be present	Particular values or sensitivities	May be present	Particular values or sensitivities
Barn swallow	*Hirundo rustica*	Migratory Terrestrial, Overfly Marine	✗	N/A	✗	N/A	✓	Species or species habitat may occur within area
Bar-tailed godwit	*Limosa lapponica*	Migratory Wetlands	✗	N/A	✗	N/A	✓	Species or species habitat may occur within area
Brown booby	*Sula leucogaster*	Migratory Marine	✗	N/A	✗	N/A	✓	Breeding known to occur within area
Fork-tailed swift	*Apus pacificus*	Migratory Marine, Overfly Marine	✗	N/A	✗	N/A	✓	Species or species habitat likely to occur within area
Greater crested tern	*Thalasseus bergii*	Migratory Wetlands	✗	N/A	✗	N/A	✓	Breeding likely to occur within area
Greater sand plover, large sand plover	*Charadrius leschenaultii*	Vulnerable, Migratory Wetlands, Marine	✗	N/A	✗	N/A	✓	Species or species habitat likely to occur within area
Little tern	*Sternula albifrons*	Migratory Marine	✗	N/A	✗	N/A	✓	Congregation or aggregation known to occur within area
Northern Siberian bar-tailed godwit, russkoye bar-tailed godwit	*Limosa lapponica menzbieri*	Critically Endangered	✗	N/A	✗	N/A	✓	Species or species habitat known to occur within area
Oriental cuckoo, horsfield's cuckoo	*Cuculus optatus*	Migratory Terrestrial	✗	N/A	✗	N/A	✓	Species or species habitat may occur within area
Oriental plover, oriental dotterel	*Charadrius veredus*	Migratory wetlands, Overfly Marine	✗	N/A	✗	N/A	✓	Species or species habitat may occur within area
Oriental pratincole	*Glareola maldivarum*	Migratory wetlands, Overfly Marine	✗	N/A	✗	N/A	✓	Species or species habitat may occur within area
Oriental reed-warbler	*Acrocephalus orientalis*	Migratory Wetlands	✗	N/A	✗	N/A	✓	Species or species habitat may occur within area
Osprey	*Pandion haliaetus*	Migratory Wetlands	✗	N/A	✗	N/A	✓	Species or species habitat known to occur within area
Red-footed booby	*Sula sula*	Migratory Marine	✗	N/A	✗	N/A	✓	Breeding known to occur within area
Red-rumped swallow	*Cecropis daurica*	Migratory Terrestrial, Overfly Marine	✗	N/A	✗	N/A	✓	Species or species habitat may occur within area
Roseate tern	*Sterna dougallii*	Migratory Marine	✗	N/A	✗	N/A	✓	Foraging, feeding or related behaviour likely to occur within area
Rufous fantail	*Rhipidura rufifrons*	Migratory Terrestrial, Overfly Marine	✗	N/A	✗	N/A	✓	Species or species habitat likely to occur within area

Table 3-9: Biologically important areas identified within the EMBA

Species	BIA behaviour	Distance to OA (km)	MEVA	EMBA	Habitat critical to the survival of marine turtles within EMBA and distance to OA
Whale shark	Foraging	510	✗	✓	N/A
Pygmy blue whale	Distribution	63	✓	✓	N/A
	Migration	179	✓	✓	N/A
Leatherback turtle	Internesting	242	✗	✓	✓ 200 km
Loggerhead turtle	Foraging	363	✗	✓	N/A
Green turtle	Foraging	813	✗	✓	✓ 76 km
	Internesting buffer	800	✗	✓	
	Internesting	123	✗	✓	
Hawksbill turtle	Internesting buffer	254	✗	✓	✓ 298
	Internesting	800	✗	✓	
Flatback turtle	Foraging	363	✗	✓	✓ 222 km
	Internesting	54	✓	✓	
Olive ridley turtle	Foraging	255	✓	✓	✓ 116 km
	Internesting	255	✗	✓	
Bridled tern	Breeding	240	✗	✓	N/A
Brown booby	Breeding	774	✗	✓	N/A
Crested tern	Breeding	115	✗	✓	N/A
	Breeding (high numbers)	235	✗	✓	
Greater frigatebird	Breeding	712	✗	✓	N/A
Lesser frigatebird	Breeding	719	✗	✓	N/A
Lesser crested tern	Breeding	794	✗	✓	N/A
Little tern	Resting	804	✗	✓	N/A
Red-footed booby	Breeding	712	✗	✓	N/A
Roseate tern	Breeding	794	✗	✓	N/A

Species	BIA behaviour	Distance to OA (km)	MEVA	EMBA	Habitat critical to the survival of marine turtles within EMBA and distance to OA
Wedge-tailed shearwater	Breeding	718	✗	✓	N/A
White-tailed tropicbird	Breeding	721	✗	✓	N/A



Whale Shark Biologically Important Areas

Spatial Reference Information
GDA2020 MGA Zone 52
Scale @ A4: 1:6,000,000
2023-03-31
01452A_3_F005_GIS_v2-h_es

N

0 45 90 180
Kilometres

Important Information: The EMBA illustrates the potential range of environmental effects from all oil spill and modelling scenarios. It is not accurate to interpret or represent the EMBA as the environment that could be affected from a single oil spill or modelling scenario.

Figure 3-5: Whale shark BIA proximal to the EMBA

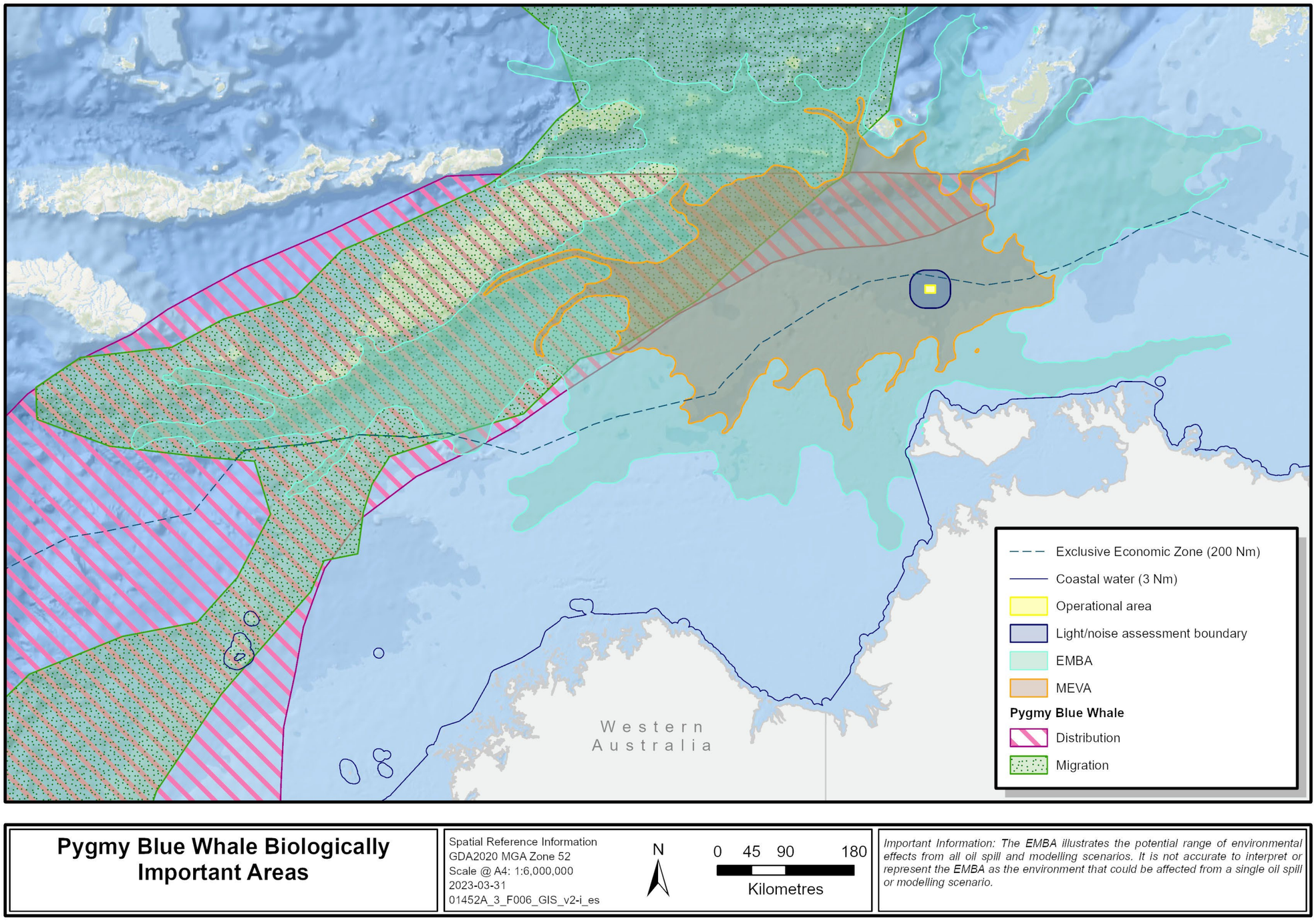
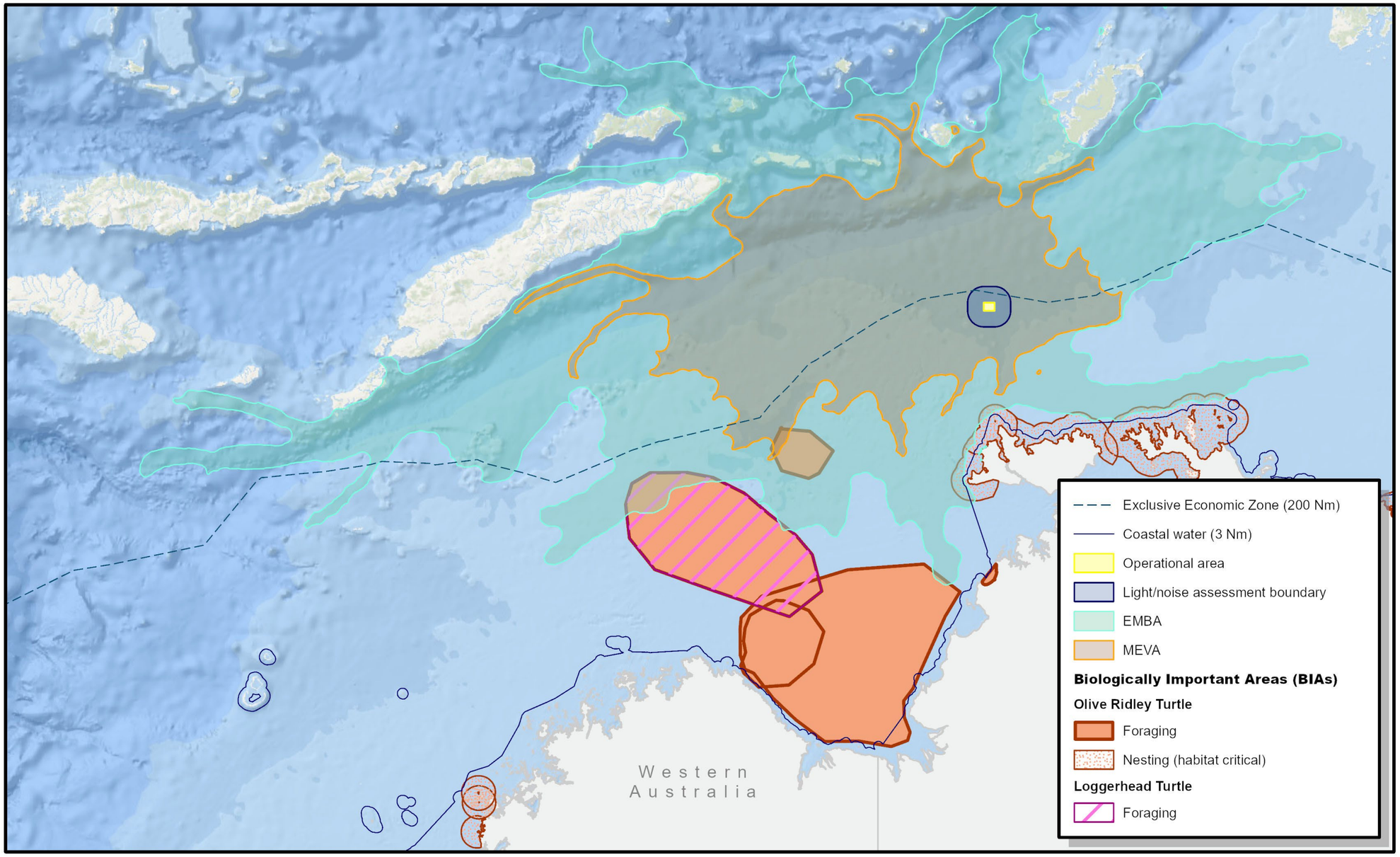


Figure 3-6: Pygmy blue whale BIAs overlapping the EMBA



Loggerhead and Olive Ridley Turtle Habitat Critical and Biologically Important Areas

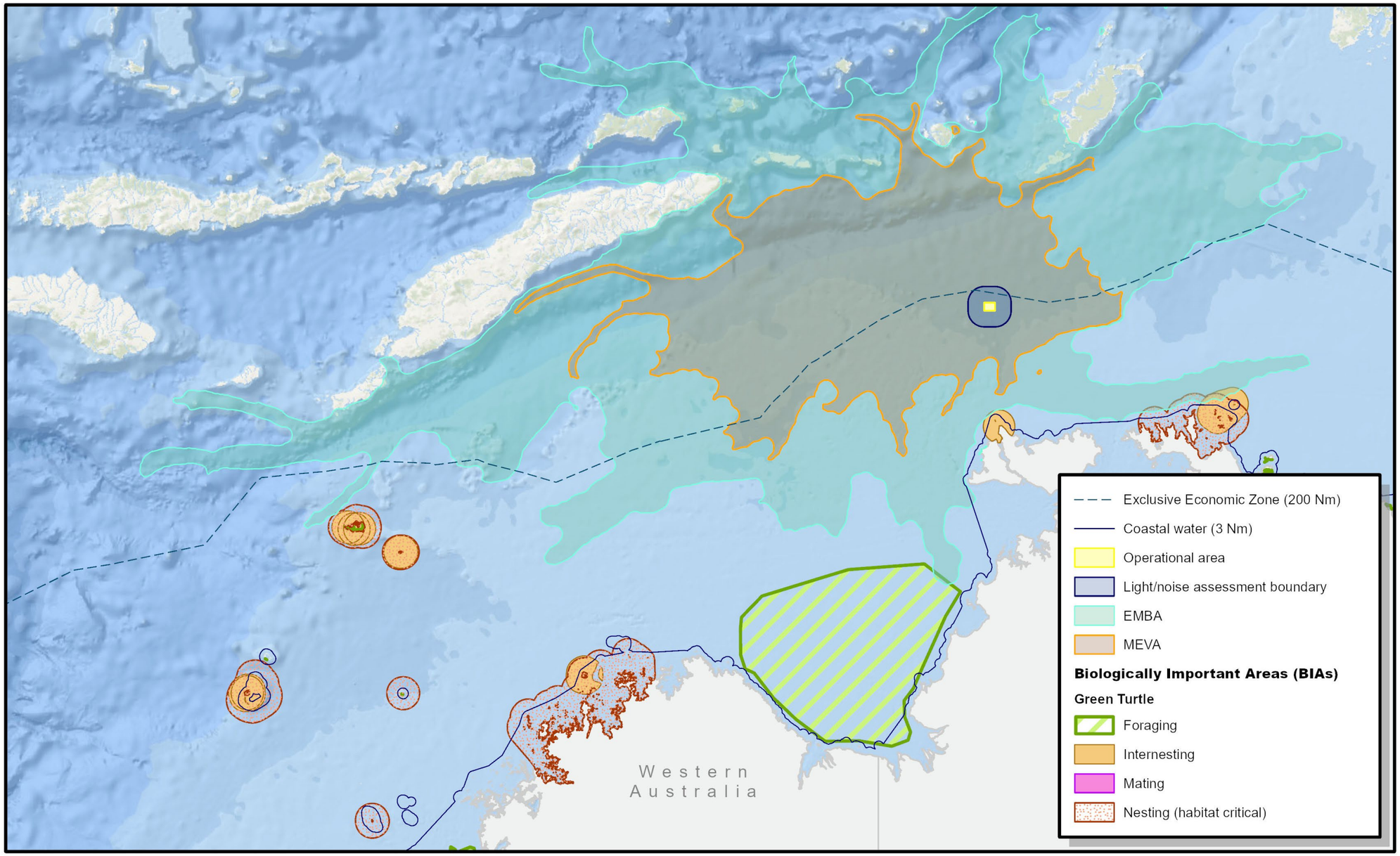
Spatial Reference Information
GDA2020 MGA Zone 52
Scale @ A4: 1:6,000,000
2023-03-31
01452A_3_F007_GIS_v2-j_es

N

0 45 90 180
Kilometres

Important Information: The EMBA illustrates the potential range of environmental effects from all oil spill and modelling scenarios. It is not accurate to interpret or represent the EMBA as the environment that could be affected from a single oil spill or modelling scenario.

Figure 3-7: Olive ridley and loggerhead turtle habitat critical and BIAs overlapping or proximal to the EMBA



Green Turtle Habitat Critical and Biologically Important Areas

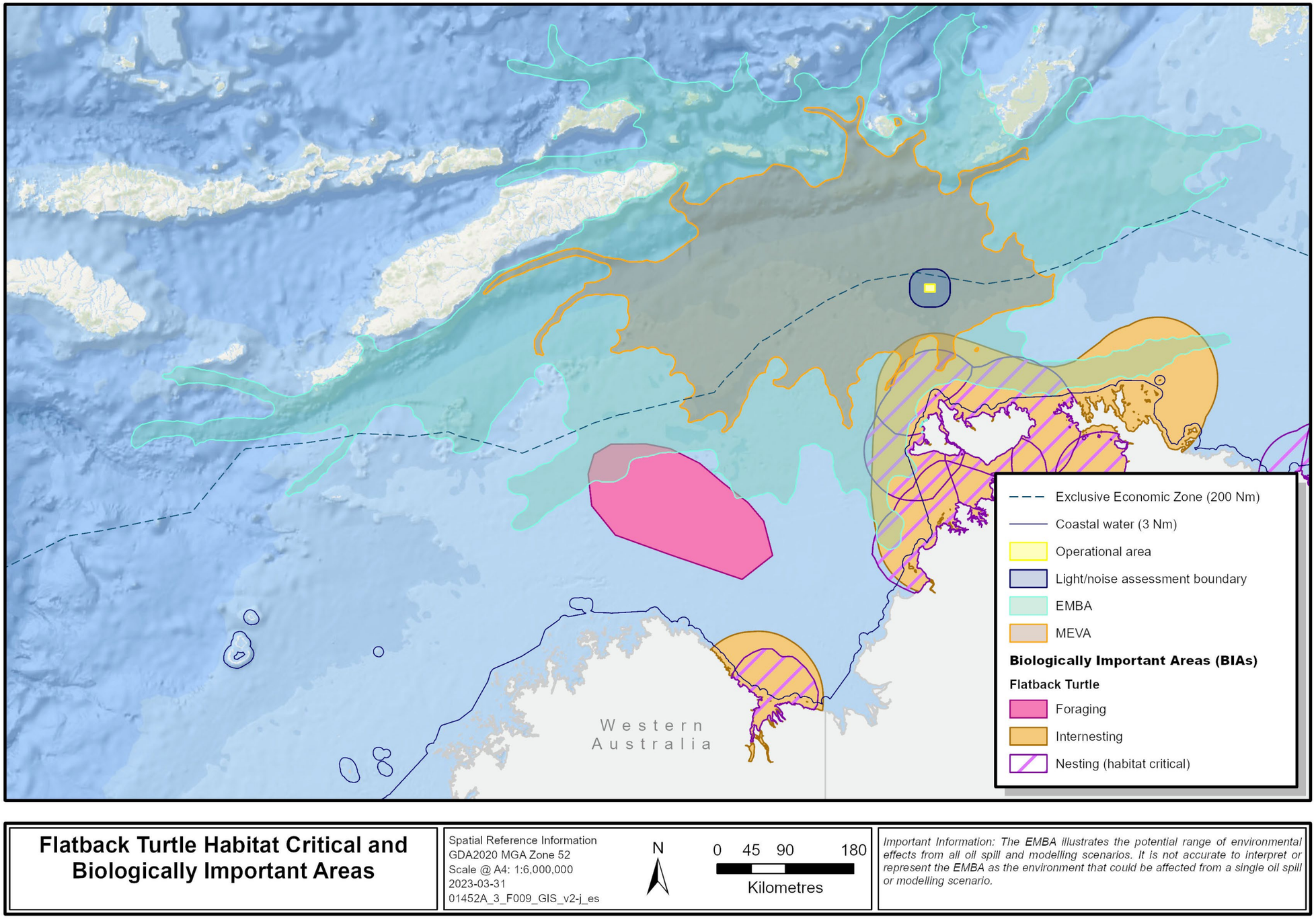
Spatial Reference Information
GDA2020 MGA Zone 52
Scale @ A4: 1:6,000,000
2023-03-31
01452A_3_F008_GIS_v2-i_es

N

0 45 90 180
Kilometres

Important Information: The EMBA illustrates the potential range of environmental effects from all oil spill and modelling scenarios. It is not accurate to interpret or represent the EMBA as the environment that could be affected from a single oil spill or modelling scenario.

Figure 3-8: Green turtle habitat critical and BIAs overlapping the EMBA



Flatback Turtle Habitat Critical and Biologically Important Areas

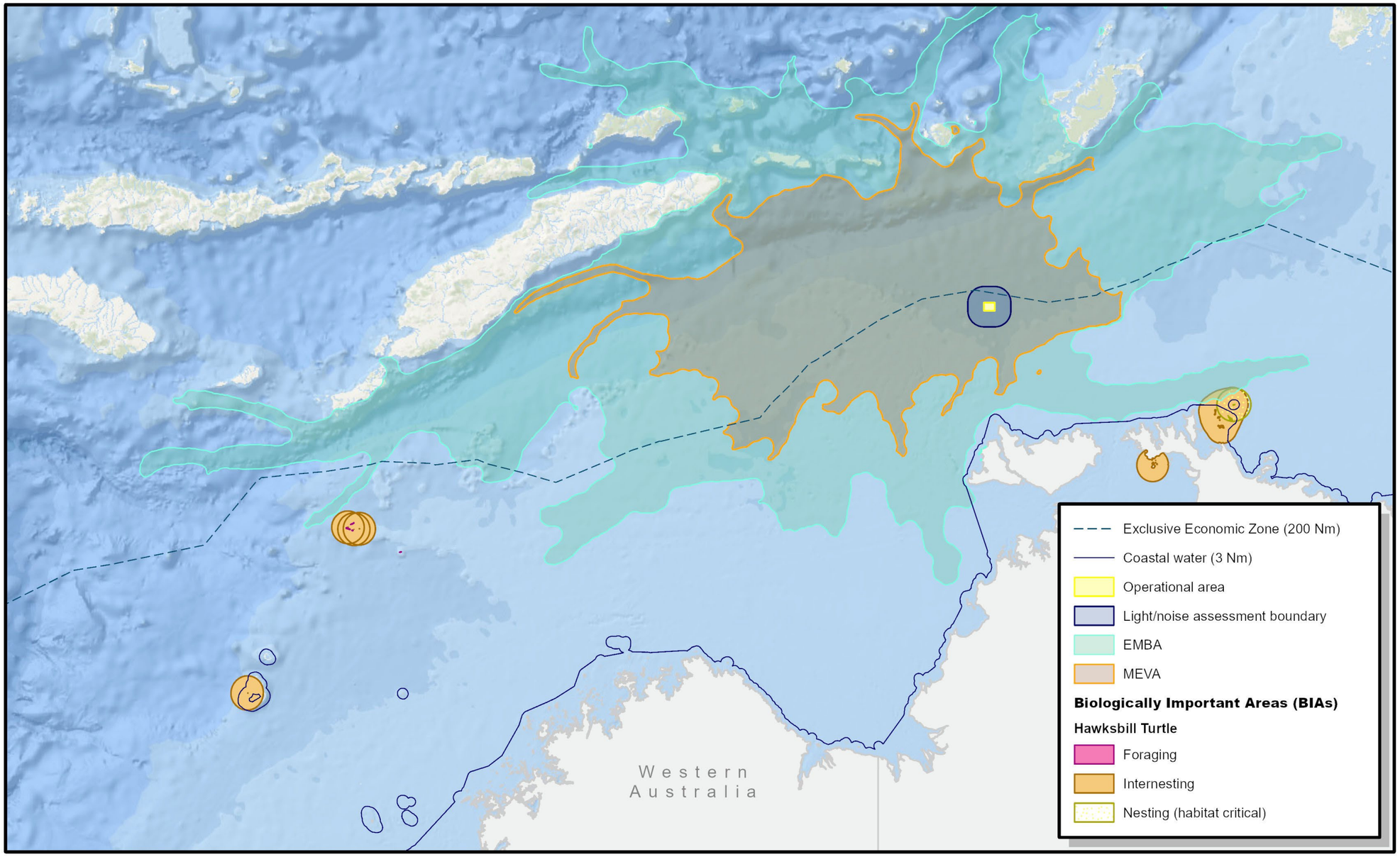
Spatial Reference Information
GDA2020 MGA Zone 52
Scale @ A4: 1:6,000,000
2023-03-31
01452A_3_F009_GIS_v2-j_es

N

0 45 90 180
Kilometres

Important Information: The EMBA illustrates the potential range of environmental effects from all oil spill and modelling scenarios. It is not accurate to interpret or represent the EMBA as the environment that could be affected from a single oil spill or modelling scenario.

Figure 3-9: Flatback turtle habitat critical and BIAs overlapping or proximal to the EMBA



Hawksbill Turtle Biologically Important Areas

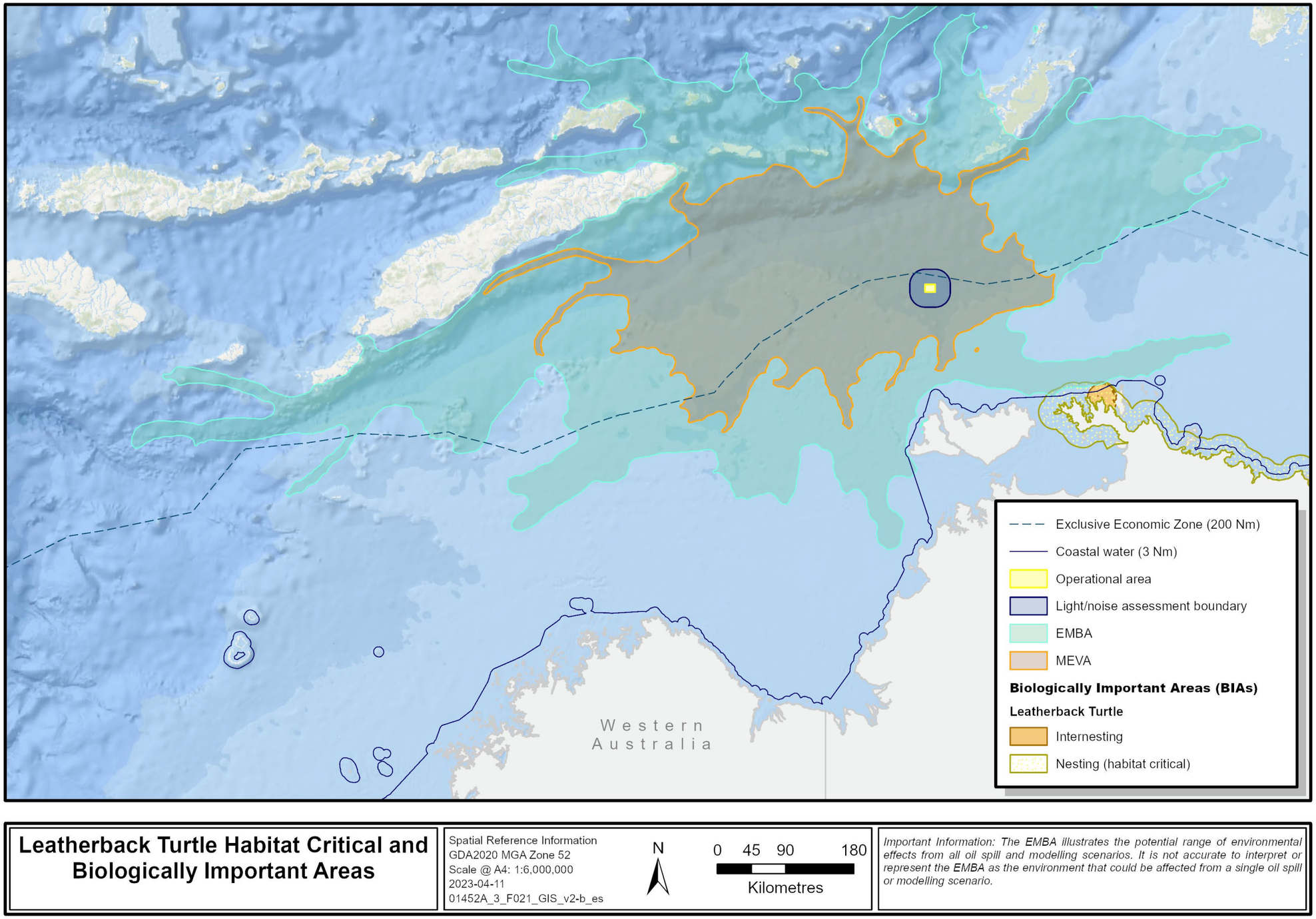
Spatial Reference Information
GDA2020 MGA Zone 52
Scale @ A4: 1:6,000,000
2023-03-31
01452A_3_F010_GIS_v2-i_es

N

0 45 90 180
Kilometres

Important Information: The EMBA illustrates the potential range of environmental effects from all oil spill and modelling scenarios. It is not accurate to interpret or represent the EMBA as the environment that could be affected from a single oil spill or modelling scenario.

Figure 3-10: Hawksbill turtle habitat critical and BIAs overlapping or proximal to the EMBA



Leatherback Turtle Habitat Critical and Biologically Important Areas

Spatial Reference Information
GDA2020 MGA Zone 52
Scale @ A4: 1:6,000,000
2023-04-11
01452A_3_F021_GIS_v2-b_es

N

0 45 90 180
Kilometres

Important Information: The EMBA illustrates the potential range of environmental effects from all oil spill and modelling scenarios. It is not accurate to interpret or represent the EMBA as the environment that could be affected from a single oil spill or modelling scenario.

Figure 3-11: Leatherback turtle habitat critical and BIAs overlapping or proximal to the EMBA

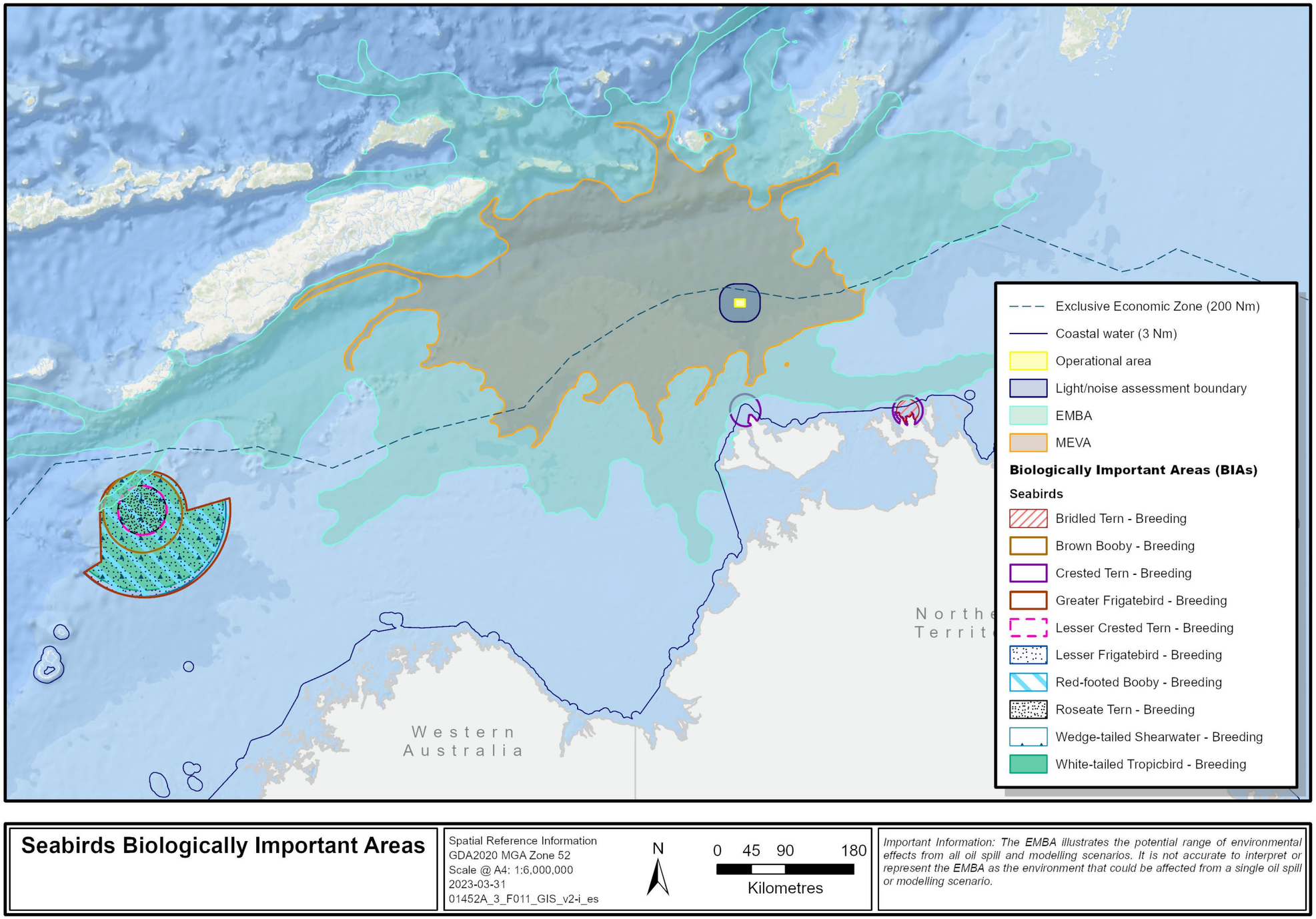


Figure 3-12: Seabird BIAs overlapping the EMBA

3.2.3.2 Conservation advice, recovery plans and management plans

Table 3-10 summarises the actions relevant to the Activity and includes more information on the requirements of the relevant plans of management for those species (including conservation advice, recovery plans and management plans for marine fauna), and lists the sections in this EP where those management requirements are considered.

Table 3-10: Relevant threats identified in recovery plans, conservation advice and management plans for species that occur or may occur within the OA and EMBA

Name	Recovery plan/conservation advice/management plan	Relevant objectives	Threats identified as relevant to the Activity	Relevant conservation actions	Addressed (where relevant) in EP
All					
All vertebrate fauna	Threat Abatement Plan for the Impacts of Marine Debris on the Vertebrate Wildlife of Australia's Coasts and Oceans (DoEE, 2018) (DoEE, 2018)	There are 4 main objectives: • contribute to the long-term prevention of the incidence of harmful marine debris • remove existing harmful marine debris from the marine environment • mitigate the impacts of harmful marine debris on marine species and ecological communities • monitor the quantities, origins and impacts of marine debris and assess the effectiveness of management arrangements over time for the strategic reduction of debris.	Marine debris	No explicit management actions for non–fisheries-related industries (note that management actions in the plan relate largely to managing fishing waste (e.g. 'ghost' gear), and state, territory and Commonwealth management through regulation.	7.1
Fish and sharks					
All sawfish and river sharks including: • green sawfish • largetooth sawfish • speartooth shark • northern river shark	Sawfish and River Sharks Multispecies Recovery Plan (CoA, 2015b)	The primary objective of this recovery plan is to assist the recovery of sawfish and river sharks with a view to: • improving the population status leading to the removal of the sawfish and river shark species from the threatened species list of the EPBC Act • ensuring that anthropogenic activities do not hinder recovery in the near future, or impact the conservation status of the species in the future. The specific objectives of the recovery plan (relevant to industry) are: • Objective 5: Reduce and, where possible, eliminate adverse impacts of habitat degradation and modification on sawfish and river shark species • Objective 6: Reduce and, where possible, eliminate any adverse impacts of marine debris on sawfish and river shark species noting the linkages with the Threat Abatement Plan for the Impacts of Marine Debris on the Vertebrate Wildlife of Australia's Coasts and Oceans (DoEE, 2018).	Habitat degradation and modification	Identify risks to important sawfish and river shark habitat and measures needed to reduce those risks.	7.6, 7.7
Dwarf Sawfish[7]	Approved Conservation Advice for *Pristis clavata* (Dwarf Sawfish) (DEWHA, 2009)	No explicit relevant objectives	Habitat degradation and modification	No explicit management actions for industry.	N/A
Green sawfish	Approved conservation advice for Green Sawfish (DEWHA, 2008a)	No explicit relevant objectives	Habitat degradation and modification	No explicit relevant management actions.	7.6, 7.7
Largetooth sawfish	Approved Conservation Advice for *Pristis pristis* (Largetooth Sawfish) (TSSC, 2014b)	No explicit relevant objectives	Habitat degradation and modification	Implement measures to reduce adverse impacts of habitat degradation and/or modification.	7.6, 7.7
Northern river shark	Approved Conservation Advice for *Glyphis garricki* (northern river shark) (TSSC, 2014a)	No explicit relevant objectives	Habitat degradation and modification	Implement measures to reduce adverse impacts of habitat degradation and/or modification.	7.6, 7.7
			Marine debris	No explicit relevant management actions.	7.1

Name	Recovery plan/conservation advice/management plan	Relevant objectives	Threats identified as relevant to the Activity	Relevant conservation actions	Addressed (where relevant) in EP
Speartooth shark	Approved Conservation Advice for *Glyphis glyphis* (speartooth shark) (DoE, 2014)	No explicit relevant objectives	Habitat degradation and modification	Implement measures to reduce adverse impacts of habitat degradation and/or modification.	7.6, 7.7
			Marine debris	No explicit management actions for industry (note that the responsibility for the action identified is for Commonwealth Government to implement).	7.1
Grey nurse shark (west coast population)	Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) (DoE, 2014a)	The overarching objective of this recovery plan is to assist the recovery of the grey nurse shark in the wild with a view to: • improving the population status • ensuring that anthropogenic activities do not hinder the recovery of the grey nurse shark.	Pollution and disease	Review and assess the potential threat of introduced species, pathogens and pollutants.	6.6, 6.7, 7.4, 7.5, 7.6, 7.7
			Ecosystem effects as a result of habitat modification	Review the level and spatial extent of protection measures at key aggregation sites to ensure appropriate levels of protection, and a consistent approach to the designation and implementation of protective measures, are applied. Use BIAs to help inform the development of appropriate conservation measures, including applying advice in the marine bioregional plans on the types of actions that are likely to have a significant impact on the species and updating such conservation measures as new information becomes available.	7.6, 7.7
White shark	Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013)	The overarching objective of this recovery plan is to assist the recovery of the white shark in the wild throughout its range with a view to: • improving the population status leading to future removal of the white shark from the threatened species list of the EPBC Act • ensuring that anthropogenic activities do not hinder recovery in the near future, or impact the conservation status of the species in the future. The specific objective of the recovery plan (relevant to industry) is: • Objective 7: Continue to identify and protect habitat critical to the survival of the white shark and minimise the impact of threatening processes within these areas.	Ecosystem effects as a result of habitat modification	No explicit relevant management actions.	7.6, 7.7
Whale shark	Conservation Advice for *Rhincodon typus* (whale shark) (TSSC, 2015g)	To maintain existing levels of protection for the whale shark in Australia while working to increase the level of protection afforded to the whale shark within the Indian Ocean and Southeast Asian region to enable population growth so that the species can be removed from the threatened species list of the EPBC Act.	Boat strike from large vessels	Minimise offshore developments and transit time of large vessels in areas close to marine features likely to correlate with whale shark aggregations along the northward migration route that follows the northern WA coastline along the 200 m isobath (TSSC, 2015g)	7.3
			Habitat disruption from mineral exploration, production and transportation	Implement measures to reduce adverse impacts of habitat degradation and/or modification.	7.6, 7.7
			Marine debris	No explicit relevant management actions.	7.1

Name	Recovery plan/conservation advice/management plan	Relevant objectives	Threats identified as relevant to the Activity	Relevant conservation actions	Addressed (where relevant) in EP
Marine mammals					
Cetaceans and other marine megafauna	National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (CoA, 2017)	The overarching goal of the strategy is to provide guidance on understanding and reducing the risk of vessel collisions and the impacts they may have on marine megafauna. The specific objective of the strategy (relevant to industry) is: • Objective 3: Mitigation – reduce the likelihood and severity of megafauna vessel collision.	Vessel collision	Encourage innovation and collaboration between research organisations and industry.	7.3
Blue whale (includes pygmy blue whale)	Conservation Management Plan for the Blue Whale 2015–2025 (CoA, 2015a)	The long-term recovery objective is to minimise anthropogenic threats to allow the conservation status of the blue whale to improve so that it can be removed from the threatened species list under the EPBC Act.	Noise interference assess and address anthropogenic noise:	Assess and address anthropogenic noise: shipping, industrial and seismic noise.	6.3
			Habitat modification	No explicit relevant management actions.	7.6, 7.7
			Vessel disturbance	• Minimise vessel collisions: • develop a national vessel strike strategy that investigates the risk of vessel strike on blue whales and also identifies potential mitigation measures • ensure all vessel strike incidents are reported in the National Ship Strike database[6] • ensure the risk of vessel strikes on blue whales is considered when assessing actions that increase vessel traffic in areas where blue whales occur and, if required, appropriate mitigation measures are implemented.	7.3
			Marine debris	No explicit relevant management actions.	7.1
Fin whale	Conservation Advice for *Balaenoptera physalus* (fin whale) (TSSC, 2015c)	Determine population abundance, trends and population structure for fin whales, and establish a long-term monitoring program.	Habitat degradation including pollution (increasing port expansion and coastal development)	No explicit relevant management actions.	6.6, 6.7, 7.4, 7.5, 7.6, 7.7
			Anthropogenic noise	Once the spatial and temporal distribution (including BIAs) of fin whales is further defined, assess the impacts of increasing anthropogenic noise (including seismic surveys, port expansion, and coastal development).	6.3
			Vessel strike	Develop a national vessel strike strategy that investigates the risk of vessel strikes on fin whales and identifies potential mitigation measures. Ensure all vessel strike incidents are reported in the National Ship Strike database[6].	7.3
Sei whale	Conservation Advice for *Balaenoptera borealis* (sei whale) (TSSC, 2015b)	Determine population abundance, trends and population structure for sei whales, and establish a long-term monitoring program.	Anthropogenic noise	Once the spatial and temporal distribution (including BIAs) of sei whales is further defined, assess the impacts of increasing anthropogenic noise (including seismic surveys, port expansion, and coastal development).	6.3
			Vessel strike	Minimise vessel collisions:	7.3

[6] https://data.marinemammals.gov.au/report/shipstrike/new

Name	Recovery plan/conservation advice/management plan	Relevant objectives	Threats identified as relevant to the Activity	Relevant conservation actions	Addressed (where relevant) in EP
				• develop a national vessel strike strategy that investigates the risk of vessel strikes on sei whales and also identifies potential mitigation measures • ensure all vessel strike incidents are reported in the National Ship Strike database[6].	
			Habitat degradation	No explicit relevant management actions.	7.6, 7.7
Reptiles					
All marine turtles (flatback, green, hawksbill, leatherback, loggerhead, olive ridley)	National Light Pollution Guidelines for Wildlife (DCCEEW, 2023b)	Lighting objectives will need to consider the regulatory requirements and Australian standards relevant to the activity, location and wildlife present. Objectives should be described in terms of specific locations and times for which artificial light is necessary. Consideration should be given to whether colour differentiation is required and if some areas should remain dark, either to contrast with lit areas or to avoid light spill. Where relevant, wildlife requirements should form part of the lighting objectives. A lighting installation will be deemed a success if it meets the lighting objectives (including wildlife needs) and areas of interest can be seen by humans clearly, easily, safely and without discomfort.	Light pollution	Best practice lighting design incorporates these design principles: • start with natural darkness and only add light for specific purposes • use adaptive light controls to manage light timing, intensity and colour • light only the object or area intended – keep lights close to the ground, directed and shielded to avoid light spill • use the lowest intensity lighting appropriate for the task • use non-reflective, dark-coloured surfaces • use lights with reduced or filtered blue, violet and ultraviolet wavelengths.	6.4
	Recovery Plan for Marine Turtles in Australia 2017–2027 (CoA, 2017b)	Long-term recovery objective: • minimise anthropogenic threats to allow for the conservation status of marine turtles to improve so that they can be removed from the EPBC Act threatened species list. Interim objective 3: • anthropogenic threats are demonstrably minimised.	Marine debris	Reduce the impacts from marine debris: • support the implementation of the EPBC Act Threat Abatement Plan for the Impacts of Marine Debris on the Vertebrate Wildlife of Australia's Coasts and Oceans (DoEE, 2018).	7.1
			Chemical and terrestrial discharge	Minimise chemical and terrestrial discharge.	6.6, 6.7, 7.4, 7.5, 7.6
			Vessel disturbance	No specific management actions in relation to vessels prescribed in the plan.	7.3
			Light pollution	Minimise light pollution: • manage artificial light within or adjacent to habitat critical to the survival of marine turtles such that marine turtles are not displaced from these habitats • develop and implement best practice light management guidelines for existing and future developments adjacent to marine turtle nesting beaches • identify the cumulative impact on turtles from multiple sources of onshore and offshore light pollution.	6.4
			Noise interference	Assess and address anthropogenic noise: • understand the impacts of anthropogenic noise on marine turtle behaviour and biology.	6.3

Name	Recovery plan/conservation advice/management plan	Relevant objectives	Threats identified as relevant to the Activity	Relevant conservation actions	Addressed (where relevant) in EP
			Habitat modification	Manage anthropogenic activities to ensure marine turtles are not displaced from identified habitat critical to their survival. Manage anthropogenic activities in BIAs to ensure that biologically important behaviour can continue.	7.6, 7.7
Leatherback turtle	Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle) (DEWHA, 2008b)	No explicit relevant objectives	Boat strike	No explicit relevant management actions.	7.3
			Habitat degradation (changes to breeding sites and degradation to foraging areas)	Identify and protect migratory corridors between nesting beaches and common foraging areas to facilitate colonisation.	7.6, 7.7
			Marine debris	No explicit relevant management actions.	7.1
Short-nosed seasnake	Approved Conservation Advice on *Aipysurus apraefrontalis* (Short-nosed seasnake) (DSEWPaC, 2011a)	No explicit relevant objectives	Habitat degradation	Ensure there is no anthropogenic disturbance in areas where the species occurs, excluding necessary actions to manage the conservation of the species.	7.6
Leaf-scaled seasnake[7]	Approved Conservation Advice on *Aipysurus foliosquama* (Leaf-scaled seasnake) (DSEWPaC, 2011b)	No explicit relevant objectives	No explicit relevant threats	No explicit relevant management actions.	N/A
Seabirds and shorebirds					
All seabirds and shorebirds	National Light Pollution Guidelines for Wildlife (DCCEEW, 2023b)	Lighting objectives will need to consider the regulatory requirements and Australian standards relevant to the activity, location and wildlife present. Objectives should be described in terms of specific locations and times for which artificial light is necessary. Consideration should be given to whether colour differentiation is required and if some areas should remain dark, either to contrast with lit areas or to avoid light spill. Where relevant, wildlife requirements should form part of the lighting objectives. A lighting installation will be deemed a success if it meets the lighting objectives (including wildlife needs) and areas of interest can be seen by humans clearly, easily, safely and without discomfort.	Light pollution	Best practice lighting design incorporates these design principles: • start with natural darkness and only add light for specific purposes • use adaptive light controls to manage light timing, intensity and colour. • light only the object or area intended – keep lights close to the ground, directed and shielded to avoid light spill. • use the lowest intensity lighting appropriate for the task. • use non-reflective, dark-coloured surfaces. • use lights with reduced or filtered blue, violet and ultraviolet wavelengths.	6.4
Black noddy Bridled tern Brown booby Caspian tern Common noddy Great frigatebird Greater crested tern Lesser crested tern Lesser frigatebird Little tern Masked booby Osprey	Wildlife Conservation Plan for Seabirds (COA, 2020)	Seabirds and their habitats are protected and managed in Australia.	Pollution (marine debris, light, water)	Enhance contingency plans to prevent and/or respond to environmental emergencies that impact seabirds and their habitats.	6.4, 6.6, 7.1, 7.6, 7.7
			Habitat loss and degradation from pollution	No explicit relevant management actions.	7.6, 7.7
			Anthropogenic disturbance	Ensure all areas of important habitat for seabirds are considered in the development assessment process. Manage the effects of anthropogenic disturbance to seabird breeding and roosting areas.	7.3
			Invasive species	Ensure seabirds are protected from the adverse effects of invasive species.	7.2

Name	Recovery plan/conservation advice/management plan	Relevant objectives	Threats identified as relevant to the Activity	Relevant conservation actions	Addressed (where relevant) in EP
Red-footed booby Red-tailed tropicbird Roseate tern Streaked shearwater Wedge-tailed shearwater White-tailed tropicbird					
Bar-tailed godwit Curlew sandpiper Eastern curlew Red knot Streaked shearwater	Wildlife Conservation Plan for Migratory Shorebirds (CoA, 2015c)	Anthropogenic threats to migratory shorebirds in Australia are minimised or, where possible, eliminated.	Habitat degradation / modification	No explicit relevant management actions.	7.6, 7.7
			Anthropogenic disturbance	Investigate the significance of cumulative impacts on migratory shorebird habitat and populations in Australia. Ensure all areas important to migratory shorebirds in Australia continue to be considered in development assessment processes (specifically for coastal developments).	7.3
Abbott's booby[7]	Conservation Advice for the Abbott's booby *Papasula abbotti* (TSSC, 2020a)	Long-term objective is to reduce anthropogenic threats to allow the conservation status of Papasula abbotti (Abbott's booby) to improve so that it can be removed from the threatened species list of the EPBC Act.	Marine debris – plastics	No explicit relevant management actions.	7.1
Australian lesser noddy[7]	Conservation Advice *Anous tenuirostris melanops* Australian lesser noddy (TSSC, 2015a)	No explicit relevant objectives	Habitat loss, disturbance and modification	No explicit relevant management actions.	7.7
			Pollution	No explicit relevant management actions.	N/A
			Oil spills	No explicit relevant management actions.	N/A
Australian painted snipe[7]	Approved Conservation Advice for *Rostratula australis* (Australian painted snipe) (TSSC, 2013)	No explicit relevant objectives	No explicit relevant threats	No explicit relevant management actions.	N/A
Curlew sandpiper	Approved Conservation Advice for *Calidris ferruginea* (Curlew Sandpiper) (TSSC, 2015e)	Australian objective: • reduce disturbance at key roosting and feeding sites.	Habitat loss and degradation from pollution	No explicit relevant management actions.	6.6, 7.4, 7.5, 7.6, 7.7
Eastern curlew	Approved Conservation Advice for *Numenius madagascariensis* (Eastern Curlew) (TSSC, 2015f)	Australian objectives: • achieve a stable or increasing population • maintain and enhance important habitat • reduce disturbance at key roosting and feeding sites.	Habitat loss and degradation from pollution	No explicit relevant management actions.	6.6, 7.4, 7.5, 7.6, 7.7
Greater sand plover[7]	Conservation Advice *Charadrius leschenaultii* (Greater sand plover) (TSSC, 2016)	No explicit relevant objectives	No explicit relevant threats	No explicit relevant management actions.	N/A
Northern Siberian bar-tailed godwit[7]	Conservation Advice *Limosa lapponica menzbieri* (Bar-tailed godwit [Northern Siberian]) (TSSC, 2016c)	No explicit relevant objectives	No explicit relevant threats	No explicit relevant management actions.	N/A

[7] Species or species habitat is not known to be present within planned or unplanned impact areas (e.g. OA, light assessment boundary and MEVA), or threats identified are not relevant to the Activity. Therefore, conservation advice or recovery is not evaluated within Section 6 or Sections 7.1–7.6.

Name	Recovery plan/conservation advice/management plan	Relevant objectives	Threats identified as relevant to the Activity	Relevant conservation actions	Addressed (where relevant) in EP
Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit[7]	Conservation Advice *Limosa lapponica baueri* (Bar-tailed godwit [western Alaska]) (TSSC, 2016d)	No explicit relevant objectives	No explicit relevant threats	No explicit relevant management actions.	N/A
Red knot[7]	Approved Conservation Advice for *Calidris canutus* (Red knot) (TSSC, 2016b)	No explicit relevant objectives	Pollution/contamination impacts	No explicit relevant management actions.	N/A
			Habitat loss and degradation	Protect important habitat in Australia. Maintain and improve protection of roosting and feeding sites in Australia.	7.7

3.2.4 Socioeconomic receptors

The OA and EMBA are located within the Commonwealth marine area, which includes any part of the sea, including the waters, seabed and airspace, within Australia's Exclusive Economic Zone (EEZ) and extends beyond the EEZ into parts of Indonesian and Timor-Leste territorial waters (Figure 3-1). The Commonwealth marine area stretches from three to 200 nautical miles (Nm) from the coast. The EMBA extends to the Indonesian and Timor-Leste coastlines, greater than 145 km and 345 km from the OA respectively.

Socioeconomic activities that may occur in the OA and EMBA are set out in this section and summarised in Table 3-11. The broader cultural features of the OA and the EMBA are addressed in Section 3.2.5.

More detailed descriptions of socioeconomic considerations are provided in Santos' SURF Values & Sensitivities of the Marine Environment (BAS-210 0132, Appendix C).

Table 3-11: Socioeconomic-related activities and features that occur or may occur in the OA and EMBA

Value/sensitivity	OA presence	EMBA presence
Commercial fisheries – Commonwealth (see Section 3.2.4.1)	Commonwealth-managed fisheries that overlap the OA (see Figure 3-13 and Table 3-12): • Northern Prawn Fishery • Southern Bluefin Tuna Fishery • Western Skipjack Tuna Fishery • Western Tuna and Billfish Fishery	Commonwealth-managed fisheries that overlap the EMBA are described in Table 3-12 and shown in Figure 3-13.
Commercial fisheries – state/territory (see Section 3.2.4.1)	NT-managed fisheries that overlap the OA (see Figure 3-14 and Table 3-12): • Aquarium Fishery • Offshore Net and Line Fishery • Timor Reef Fishery • Spanish Mackerel Fishery • Pearl Oyster Fishery[8]	NT- and WA-managed fisheries that overlap the EMBA are described in Table 3-12 and shown in Figure 3-14 and Figure 3-15.
Aquaculture	No aquaculture activities operate within the OA.	A range of aquacultural production systems are used off the Indonesian and Timor-Leste coastlines to produce a range of species including seaweed, fish and shrimp.
Indonesian and Timorese commercial and subsistence fishing (see Section 3.2.4.2)	Given the water depths in the OA and that the Perth Treaty Area is outside of the OA, commercial and traditional Indonesian and Timorese fishing activity is not expected. However, Indonesian and Timorese fishers may transit the OA when travelling between sites.	Commercial and traditional Indonesian and Timorese fishers, are expected to transit and fish in the EMBA.
Energy industry (see Section 3.2.4.3)	There are no established petroleum operations within, or immediately adjacent to the OA.	The nearest offshore operating facility is the Santos-operated Bayu–Undan platform, approximately 410 km south west of the OA. Energy exploration permits are operated by other titleholders throughout the EMBA.
Telecommunications cables (see Section 3.2.4.4)	The North-West Cable System is located approximately 227 km south of the OA.	This cable system intersects the EMBA though a hydrocarbon spill will not have any impact on submarine cables.
Defence (see Section 3.2.4.5)	There are no designated military/defence exercise areas within or in the immediate vicinity of the OA. During their surveillance, Australian Border Force vessels may transit the OA.	The EMBA intersects a practice area of the north Australian exercise area (practice and training restricted areas) (Figure 3-16). During their surveillance, Australian Border Force vessels may transit the EMBA.
Shipping (see Section 3.2.4.6)	The closest major commercial port to the OA is Darwin Port, ~300 km away. No designated shipping channels intersect the OA.	The main commercial shipping channel within the EMBA is west of the OA. Vessel traffic is expected within the EMBA. In 2020–2021, there were 1,416 vessel calls to Darwin port (Landbridge Darwin Port, 2021).
Recreation and tourism (see Section 3.2.4.7)	The OA is located in offshore waters that are highly unlikely to be accessed for tourism activities (e.g. recreational fishing and boating and charter boat operations). These activities tend to be centred around nearshore waters, islands and coastal areas.	There are several offshore shoals, banks, coral reefs, shipwrecks within the EMBA. These areas may be visited by small numbers of recreational fishers, fishing charter vessels, scuba diving, snorkelling and other charter vessels. The Tiwi Islands are a popular tourist destination offering cruises, fishing, sailing and water tours among other cultural activities.
Underwater maritime heritage (see Section 3.2.4.8)	There are no world heritage properties, national heritage places or Commonwealth heritage places within the OA. No shipwrecks are registered within the OA. There is one sonar anomaly that could be a possible small vessel shipwreck within the OA (Section 3.2.4.8), however the location of this anomaly will not be impacted by planned activities.	There are no world heritage properties, national heritage places or Commonwealth heritage places within the EMBA. Multiple known shipwrecks, sunken aircraft, and historic (more than 75 years old) aircraft and shipwrecks and other sites occur within the EMBA (Figure 3-17).

[8] The Pearl Oyster Fishery is not active within the OA or EMBA. Although no fishing activity occurs, the fishery licence does intersect the OA. Therefore, Santos will consult with the fishery as a Relevant Person. This fishery is not included in Figure 3-13 for the reasons stated.

3.2.4.1 Commercial fisheries

The NWMR and NMR support Commonwealth, NT- and WA-managed commercial fisheries. The Timor and Arafura seas support various shark, demersal and pelagic finfish and crustacean species of commercial importance. The fisheries overlapping the OA and EMBA are shown in Figure 3-13, Figure 3-14 and Figure 3-15. Table 3-12 lists and describes the commercial fisheries and Santos' understanding of fishing effort based on publicly available information and consultation with Relevant Persons.

Consultation with the Australian Fisheries Management Authority (AFMA), NT Department of Industry, Tourism and Trade (NT Fisheries) and appropriate fisheries associations and licence holders is discussed in Section 3.2.5.10. Records of consultations are provided in Table 4-13.

Table 3-12: Commonwealth and state fisheries that overlap the OA and/or EMBA

Commercial fishery	OA	EMBA	Description	Likelihood of interaction with fishers
Commonwealth-managed				
Northern Prawn Fishery	✓	✓	**Area**: extends from Joseph Bonaparte Gulf across the top end to the Gulf of Carpentaria. Most of the Northern Prawn Fishery effort lies in the Gulf of Carpentaria, Joseph Bonaparte Gulf and along the Arnhem Land coast (DoA, 2014). **Gear**: trawl. **Key target species**: The key target species are banana prawns, tiger prawns and endeavour prawns. There are 2 fishing seasons—the season end date depends on catch rates: • Season 1 (mainly banana prawns caught): 1 April to 15 June • Season 2 (mainly tiger prawns caught): 1 August to 30 November. Fishing for scampi also occurs in deeper waters, with fishing effort spread across 2–3 months of the year (December to February). **Effort** (2020): 52 active vessels; around 4,767 t (Patterson et. al., 2021).	The areas of medium and high fishing effort are 113 km and 122 km respectively from the OA. Based on industry consultation, prawn fishing is not expected in water more than approximately 130 m deep, therefore interaction with this fishery is unlikely. Low level fishing effort occurs for scampi in deeper waters (>250 m) during December and January within the licence area. The outermost northern area of the OA has water depths of >250 m. Therefore, interaction with this fishery is possible during January and December but unlikely.
North-West Slope Trawl Fishery	✗	✓	**Area**: Operates off north-western Australia from 114°E to 125°E, roughly between the 200 m isobath and the outer boundary of the Australian Fishing Zone. A large area of the Australia–Indonesia MoU Box falls within the North West Shelf throughflow. **Gear**: demersal trawl. **Key target species**: scampi. **Effort** (2020): Six active vessels; around 111.5 t (Patterson et. al., 2021).	No interaction, fishery does not overlap the OA. Effort known within the EMBA.
Southern Bluefin Tuna Fishery	✓	✓	**Area**: The Southern Bluefin Tuna Fishery spans the Australian Fishing Zone. However, it is only active in waters off south and south eastern Australia. **Gear**: purse seine and pelagic long line. **Key target species**: southern bluefin tuna. **Effort** (2020): 30 active vessels; around 5,429 t (Patterson et. al., 2021).	No active commercial fishing effort reported in the OA or EMBA, therefore interaction with this fishery is unlikely.
Western Skipjack Tuna Fishery	✓	✓	**Area**: The Western Skipjack Tuna Fishery spans the Australian EEZ and adjacent high seas, from Cape York to the Victoria–South Australia border, including waters around Tasmania and the high seas of the Pacific Ocean. **Gear**: purse seine **Key target species**: skipjack tuna **Effort** (2020): None. There has been no fishing effort since the 2008–2009 season, and in that season, activity was concentrated off South Australia (Patterson et. al., 2021).	No active commercial fishing effort reported in the OA or EMBA, therefore interaction with this fishery is unlikely.
Western Tuna and Billfish Fishery	✓	✓	**Area**: Operates in Australia's EEZ and high seas of the Indian Ocean. In recent years, fishing effort has concentrated off south-west WA, with occasional activity off South Australia. **Gear**: pelagic longline. **Key target species**: bigeye tuna, yellowfin tuna, striped marlin, swordfish. **Effort** (2020): 3 active vessels; around 161 t (Patterson et. al., 2021).	No active commercial fishing effort reported in the OA or EMBA, therefore interaction with this fishery is unlikely.
NT-managed				
Aquarium Fishery	✓	✓	**Area**: Includes freshwater, estuarine and marine habitats to the outer boundary of the Australian Fishing Zone. Most marine species are collected within 100 km of Nhulunbuy and Darwin. A specimen shell collection enterprise occurs around Ashmore Reef and Cartier Island (outside the EMBA). **Gear**: handheld, nets and pots (dive-based). **Key target species**: fish, invertebrates and plants for aquariums. **Effort**: unknown – no restriction on number of licences (NT Government, 2023).	No active commercial fishing effort reported in the OA. Therefore, interaction with this fishery is unlikely. Effort could occasionally occur within the EMBA near Evans Shoal (~67 km west of the OA).

Commercial fishery	OA	EMBA	Description	Likelihood of interaction with fishers
Spanish Mackerel Fishery	✓	✓	**Area**: Commercial fishing for Spanish mackerel is allowed from the high water mark to the outer boundary of the Australian Fishing Zone, which is 200 Nm offshore. Most fishing effort occurs near reefs, headlands and shoals and includes waters near Bathurst Island, New Year Island, northern and western Groote Eylandt, the Gove Peninsula, the Wessel Islands, the Sir Edward Pellew Group and suitable fishing grounds on the western and eastern mainland coasts. Fishing generally takes place around reefs, headlands and shoals. **Gear**: trolling, handline. **Key target species**: Spanish mackerel. **Effort**: 15 licences allowed (NT Government, 2023).	No active commercial fishing effort reported in the OA. Therefore, interaction with this fishery is unlikely. Effort is known within the EMBA.
Timor Reef Fishery	✓	✓	**Area**: The Timor Box extends north-west of Darwin to the WA/NT border and to the outer boundary of the Australian Fishing Zone. The fishery has an area of approximately 15,000 km^2 (NT Government, 2022). Fishing occurs primarily in waters 100–200 m deep (OA water depths are 227–269 m). Previous consultation indicates that the main target species is goldband snapper, with other tropical snappers (e.g. crimson snapper, saddletail snapper) also making up part of the catch; main fishing method is trap fishing; fishery is most productive between October and May, with less activity during the dry season months of June–August due to strong northerly winds. Due to the water depth and based on a review of available historical catch data, fishing activity has been reported within the OA. **Gear**: line and trap. **Key target species**: snapper, red emperor, seabream and cods. **Effort**: 15 licences allowed; 2 active licences (NT Government, 2023).	Effort possible but not expected within the OA due to water depth and expected in the EMBA. Therefore, interaction with this fishery is possible.
Offshore Net and Line Fishery	✓	✓	**Area**: Operates in NT waters from the low water mark to the boundary of the Australian Fishing Zone. Most fishing is done in the coastal zone within 12 Nm of the coast, and immediately offshore in the Gulf of Carpentaria. The fishery has an area of approximately 522,000 km^2. **Gear**: longlines or pelagic nets (there are restrictions on where certain gear can be used). **Key target species**: blacktip sharks, grey mackerel. **Effort**: Unknown – no restriction on number of licences (NT Government, 2023).	Interaction with this fishery in the OA is possible but highly unlikely due to the concentration of fishing effort in near coastal areas and distribution of the targeted species.
Pearl Oyster Fishery	✗	✓	**Area**: The fishery extends from the high-water mark in NT waters to the outer boundary of the Australian Fishing Zone, 200 nautical miles offshore in Commonwealth waters. All current activity occurs in NT waters within 12 nautical miles of the mainland. There are five active fishing licence holders currently operating in the fishery which can be active throughout the year. **Gear:** farming by hand only. **Effort:** 5 licences allowed.	No active commercial fishing effort reported within the OA and EMBA. Therefore, interaction with this fishery is unlikely.
Demersal Fishery	✗	✓	**Area**: Demersal fishing is allowed from the NT coast between the 15 nautical miles to the outer boundary of the Australian Fishing Zone, excluding the area of the Timor Reef Fishery. **Gear**: lines, fish traps and semi-demersal trawl nets. **Key target species**: snapper (various species). **Effort**: Unknown – 18 licences currently issued (NT Government, 2023).	Effort may occur within the EMBA as fishing effort is concentrated in the waters of Arafura, Joseph Bonaparte and Gulf of Carpentaria.
Coastal Line Fishery	✗	✓	**Area**: Fishery is allowed from the NT coast between the high water mark to 15 nautical miles seaward of the coast. **Gear**: lines, hooks, cast nets, scoop nets or gaffs. **Key target species**: black jewfish and golden snapper **Effort**: 52 licences currently issued. (NT Government, 2023).	No fishery overlaps with the OA. Effort not expected within the EMBA.

Commercial fishery	OA	EMBA	Description	Likelihood of interaction with fishers
WA-managed				
Mackerel Managed Fishery	✗	✓	**Area**: Commercially fished between Geraldton and the WA/NT border. **Gear**: surface and midwater trolled lines. **Key target species**: Spanish mackerel. **Effort** (2021): 16 active vessels; total catch: 238 t (Newman et al., 2023).	No fishery overlaps with the OA. Effort expected within the EMBA.
Northern Demersal Scalefish Managed Fishery	✗	✓	**Area**: Operates off WA's coast in waters east of 120°E longitude. **Gear**: handline, dropline and fish traps, although the fishery has essentially operated as a trap-based fishery since 2002. **Key target species**: goldband snapper and red emperor. **Effort** (2021): active vessels: (unknown); total catch: 1,544 t (Newman et al., 2023).	No fishery overlaps with the OA. Effort expected within the EMBA.
South West Coast Salmon Fishery	✗	✓	**Area**: Perth metropolitan area extending to Cape Beaufort (WA/NT border). No fishing takes place north of the Perth metropolitan area. **Gear**: beach seine nets. **Key target species**: Western Australian salmon. **Effort**: 6 licences (DPIF, 2019); No catch data was provided for the 2021 to 2022 reporting period (Newman et al., 2023).	No fishery overlaps with the OA. No fishing takes place north of the Perth metropolitan area, despite the managed fishery boundary extending to Cape Beaufort (WA/NT border).
Abalone Fishery	✗	✓	**Area**: Operates in all WA waters (between the NT and South Australian borders). **Gear**: unknown. **Key target species**: abalone. **Effort** (2020): 0 diver days; total catch 0 t. Closed since 2012 due to environmentally induced mortality (Newman et al., 2021).	N/A
Kimberley Crab Fishery	✗	✓	**Area**: Operates off the north-west coast of WA in WA waters. Fishing effort is concentrated in nearshore waters. **Gear**: crab traps. **Key target species**: green and brown mud crab. **Effort** (2021): effort occurring between April and September with a catch of 0.8 t (Newman et al., 2023).	No fishery overlaps with the OA. The EMBA intersects the outer limits of the fishing licence boundary, however fishing effort is concentrated in nearshore waters. Interaction with this fishery is highly unlikely.
Kimberley Prawn Fishery	✗	✓	**Area**: Operates off the north-west coast of WA in WA waters east of 123°45'E longitude and west of 126°58'E longitude. **Gear**: unknown. **Key target species**: primarily banana prawns, with brown tiger and blue endeavour prawns. **Effort** (2021): 203.9 t (Newman et al., 2023)	No fishery overlaps with the OA and the EMBA intersects the outer limits of the fishing licence boundary. Noting only 3% of the total fishing licence area was used (Newman et al., 2023). The concentration of fishing effort in near coastal areas and distribution of the targeted species means that interaction with this fishery is highly unlikely.
Marine Aquarium Fishery	✗	✓	**Area**: Operates in all WA waters (between the NT and South Australian borders). Fishing effort occurs south of Broome with higher effort around the Capes region of south-west WA, Perth, Geraldton, Exmouth, Dampier and Broome. **Gear**: unknown. **Key target species**: coral, live rock, algae, seagrass and invertebrates. **Effort** (2021): 12 licences; total catch: 92,227 fishes, 27.97 t of coral, live rock & living sand and 42 L of plants and live feed. (Newman et al., 2023).	No fishery overlaps with the OA and the EMBA intersects the outer limits of the fishing licence boundary, which extends the entire WA coastline. Interaction with this fishery is highly unlikely.
Specimen Shell Fishery	✗	✓	**Area**: Operates in all WA waters (between the NT and South Australian borders); however concentrated effort is around Broome, Exmouth, Shark Bay, Geraldton, Perth, Mandurah, the Capes area, Albany and Esperance **Gear**: unknown. **Key target species**: cowries, cones, murexes and volutes. **Effort** (2021): 30 licences; total catch: 5,443 shells (Newman et al., 2023).	No fishery overlaps with the OA and the EMBA intersects the outer limits of the fishing licence boundary, which extends the entire WA coastline. Interaction with this fishery is highly unlikely.
West Coast Deep Sea Crustacean Fishery	✗	✓	**Area**: Operates primarily in the Gascoyne bioregion in WA. **Gear**: unknown. **Key target species**: champagne, giant and crystal crab. **Effort** (2021): 155.5 t (Newman et al., 2023).	No fishery overlaps with the OA and the EMBA intersects the outer limits of the fishing licence boundary. The concentration of fishing is located in the Gascoyne bioregion. Interaction with this fishery is highly unlikely.

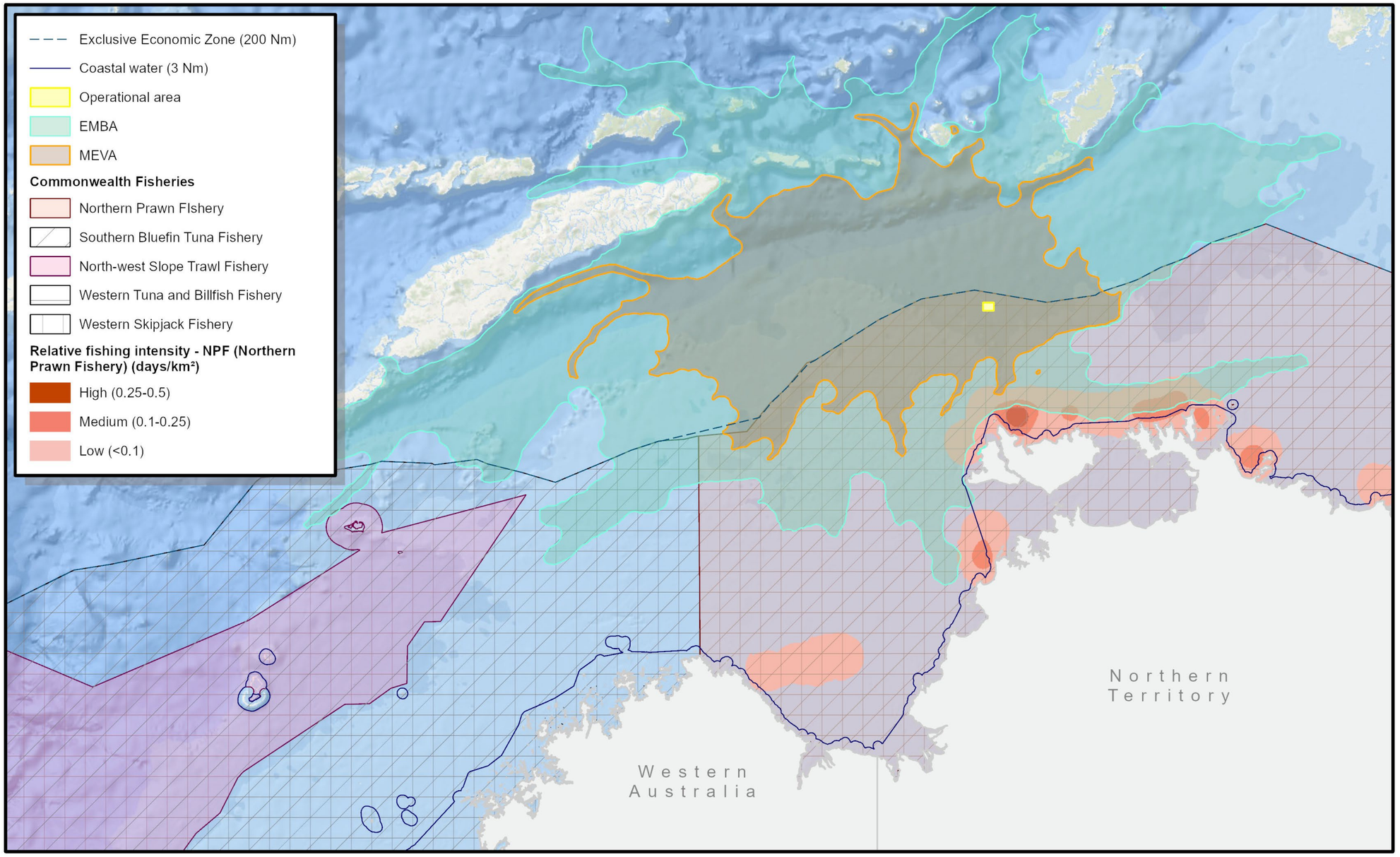


Figure 3-13: Commonwealth-managed fisheries overlapping the OA and/or EMBA

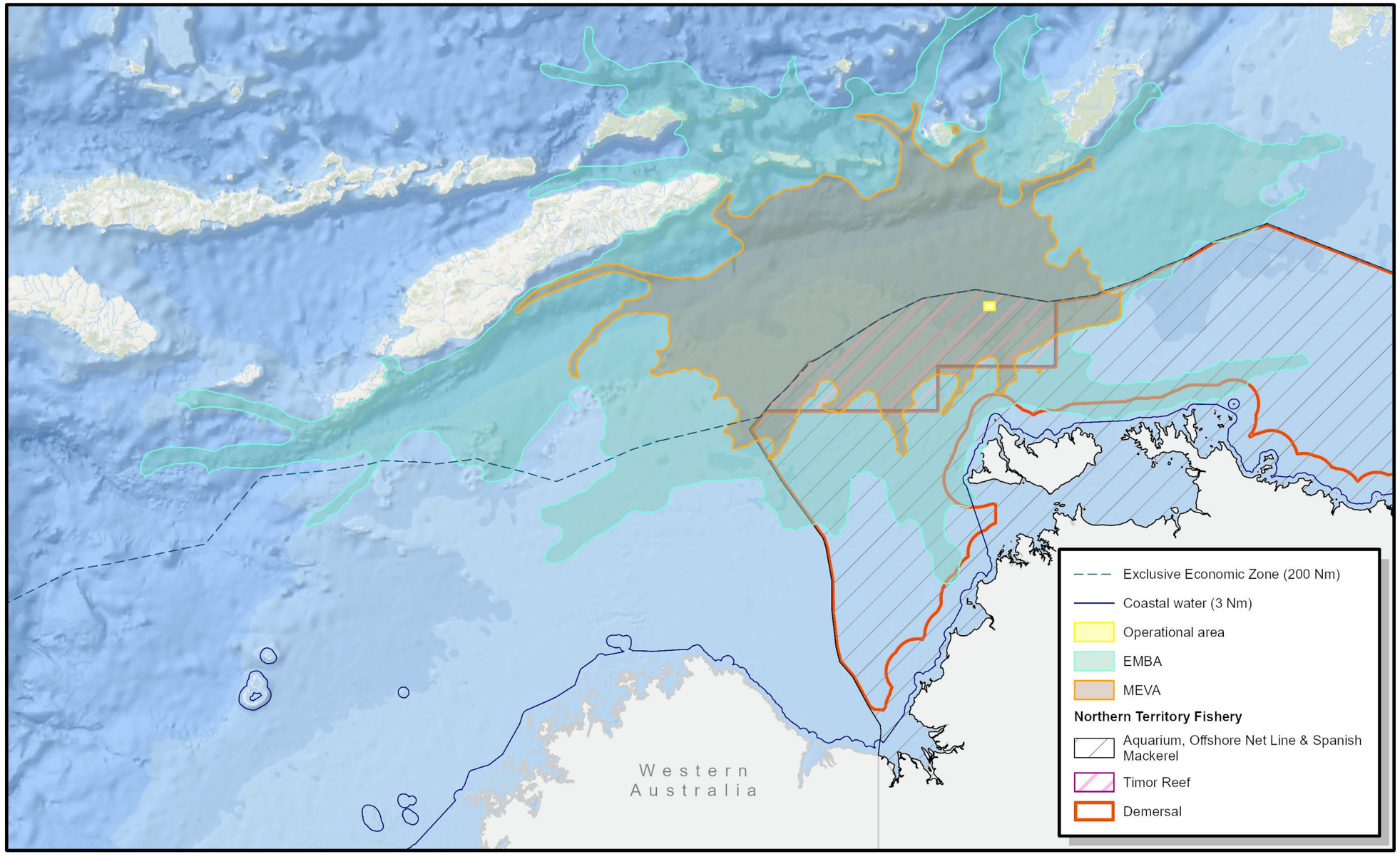


Figure 3-14: Northern Territory-managed fisheries overlapping the OA and/or EMBA

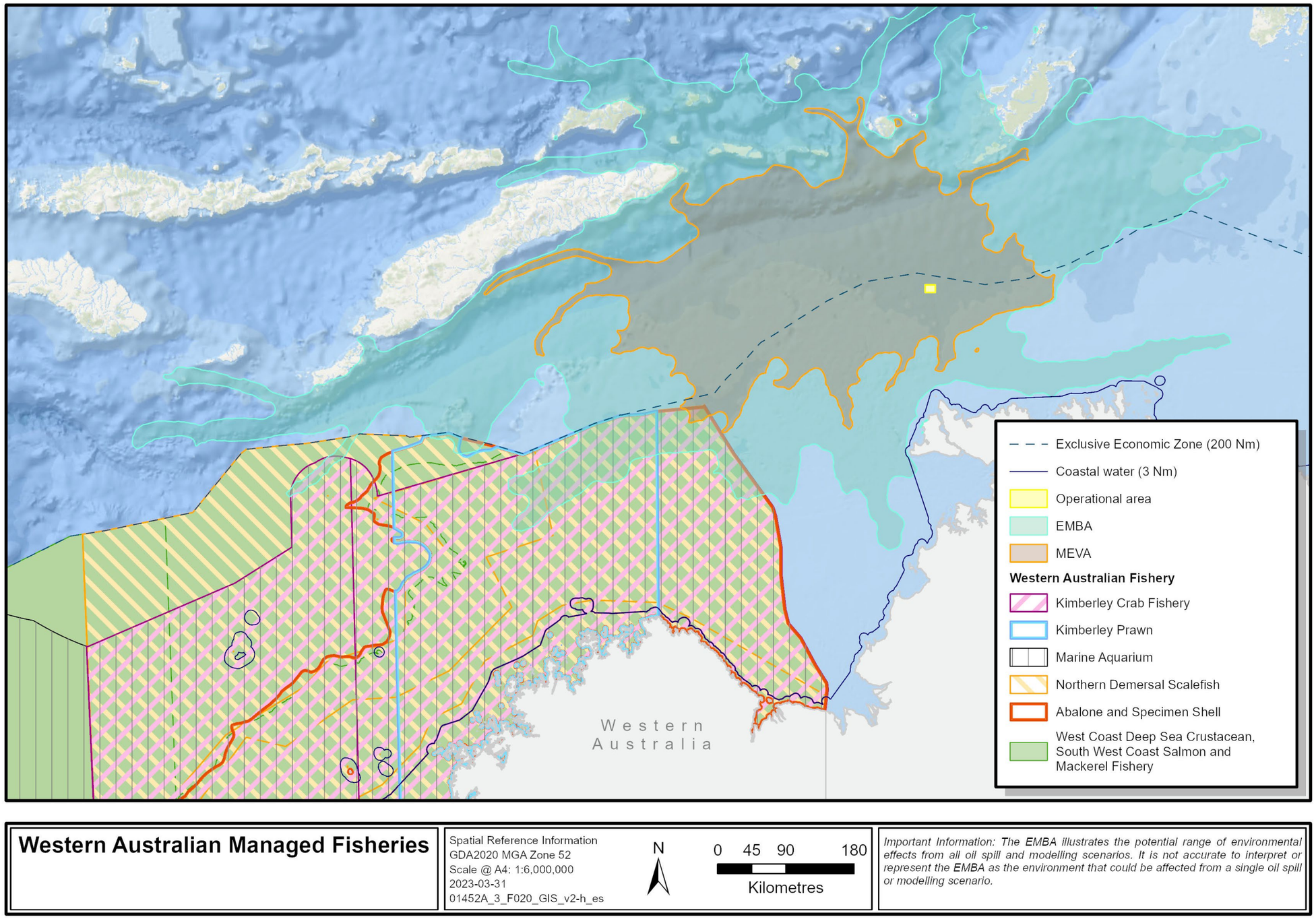


Figure 3-15: Western Australian-managed fisheries overlapping the EMBA

3.2.4.2 Indonesian and Timorese commercial and subsistence fishing

The OA is located in remote offshore waters with no geomorphic features such as shoals, banks, or reefs. Therefore, subsistence and commercial Indonesian and Timorese fishing is unlikely to occur within this area. Within Commonwealth waters, there are shoals within the EMBA, so these subsistence fishers may fish in the EMBA or transit the EMBA to reach a fishing location outside of the EMBA such as Ashmore Reef, approximately 800 km south-west of the OA. Fishing occurs from April to December, with most activity occurring in September and October. The Big Bank Shoals are in the Indonesian EEZ, and Indonesian commercial vessels may fish in and around these shoals (Heyward et al., 1997).

An MoU between the Australian and Indonesian governments, officially known as the Australia–Indonesia Memorandum of Understanding on the Operations of Indonesian Traditional Fishermen in Areas of the Australian Fishing Zone and Continental Shelf – 1974, exists to:

> 'provide the framework for fisheries and marine cooperation between Australia and Indonesia, and facilitates information exchange on research, management and technological developments, complementary management of shared stocks, training and technical exchanges, aquaculture development, trade promotion and cooperation to deter illegal fishing.' (Department of Agriculture, Water and the Environment [DAWE], 2020b)

The MoU enables subsistence fishing to occur within sections of the Australian EEZ (outside of the EMBA).

The OA is within the Australian EEZ and Indonesian and Timor-Leste fishing is not permitted within the area. The EMBA intersects the jurisdiction established in an Agreement between the Government of the Commonwealth of Australia and the Government of the Republic of Indonesia establishing Certain Seabed Boundaries (1971) and the Seabed Boundaries Agreement between the Commonwealth of Australia and the Republic of Indonesia on Seabed Boundaries in the Area of the Timor and Arafura Seas (1972). Each of these Agreements, together with the MOU, was affirmed by the Treaty between the Government of Australia and the Government of the Republic of Indonesia establishing an Exclusive Economic Zone Boundary and Certain Seabed Boundaries (Perth, 14 March 1997) (Perth Treaty). This area is commonly referred to as the Perth Treaty Area. When this treaty is ratified, Australia will have jurisdiction over the seabed and Indonesia will have jurisdiction over the water column within the Perth Treaty Area. The treaty permits Indonesian fishing by both traditional and modern vessels. Although not yet ratified, Santos understands that the Perth Treaty is generally observed.

3.2.4.3 Energy industry

Approximately 898 wells have been drilled by the energy industry within the EMBA between 1967 and 2022 (**https://www.petrosys.com.au/products/gpinfo/**). There are several energy companies that currently hold petroleum permits near the OA, however, no established operations are located within, or in the immediate surrounds of the OA. The closest operational offshore production facilities and in-field subsea infrastructure are associated with the Santos-operated Bayu-Undan platform, located approximately 410 km to the south-west of the OA.

Petroleum retention lease area and exploration permit leases, or greenhouse gas emissions assessment permits within the EMBA (not including Santos' interests) are currently held by various operators (and subsidiaries), including Bengal Energy Ltd, Carnarvon Energy Ltd, Woodside Energy Ltd, Shell Development (Australia) Pty Ltd, Eni Australia Limited, INPEX Icthys Pty Ltd, Finder No. 1 Pty Ltd, Jadestone Pty Ltd, Melbana Energy Pty Ltd, PTTEP Australia, Vulcan Exploration Pty Ltd and Timor Sea Oil & Gas Australia Pty Ltd.

3.2.4.4 Telecommunications cables

The North-West Cable System (NWCS) is located approximately 212 km south of the OA. Extending 2,100 km from Darwin to Port Hedland, the NWCS connects Australia's remote northern and western regions, including offshore energy industry facilities, with onshore locations.

3.2.4.5 Defence activities

No designated military/defence exercise areas within or near the OA. However, the EMBA intersects a practice area of north Australian exercise area, a maritime military zone administered by the Department of Defence (Figure 3-16), which comprises practice and training areas used for offshore naval exercises and onshore weapons-firing training.

The Australian Border Force also undertakes civil and maritime surveillance (and enforcement) in Australian offshore maritime waters, which includes the Australian EEZ. During their surveillance, Australian Border Force vessels may transit through the OA and EMBA.

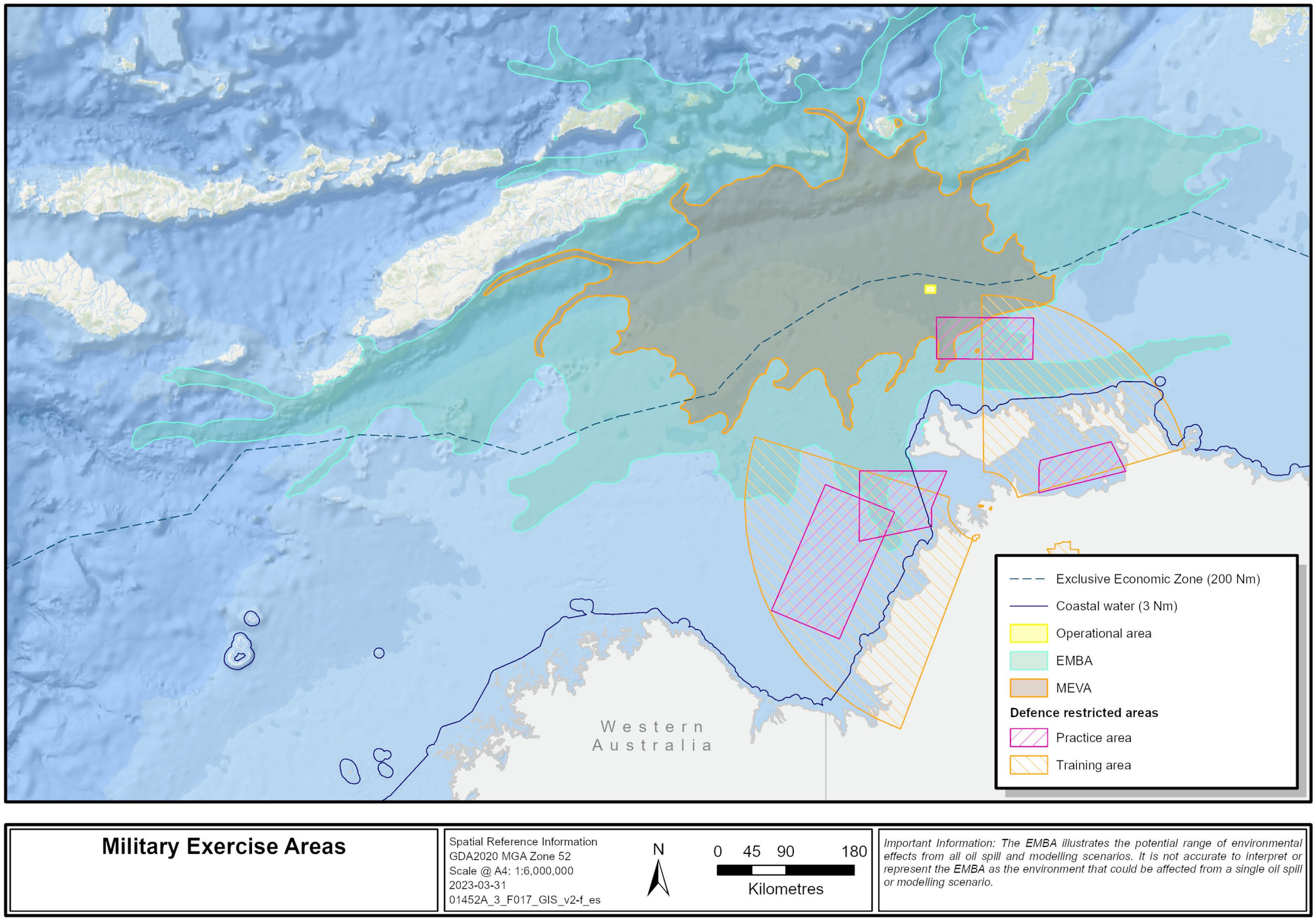


Figure 3-16: Defence training and exercise areas within the EMBA

3.2.4.6 Shipping

AMSA has established a network of shipping fairways off the north-west coast of Australia to manage traffic patterns. The shipping fairways are designed to keep shipping traffic away from offshore infrastructure to reduce the risk of a vessel collision (AMSA, 2013).

The use of the fairways is strongly recommended and the International Regulations for Preventing Collisions at Sea 1972 apply to all vessels navigating within or outside the shipping fairways. Under the *Commonwealth Navigation Act 2012* (Cth), certain vessels operating in Australian waters are required to report their location daily to AMSA's Joint Rescue Coordination Centre (JRCC) in Canberra. This Australian Ship Reporting System is an integral part of the Australian Maritime Search and Rescue system.

The OA and EMBA does not overlap any Port.

Darwin Port is a major shipping port in Australia located approximately 300 km south-south east of the OA. In 2021–2022, there were 1,500 vessel calls to port (Landbridge Darwin Port, 2023).

Darwin Port is a major port for vessels servicing operations offshore from north-west Australia. The primary shipping channels within the EMBA are between Darwin and Southeast Asian ports. Average vessel displacements and speeds for shipping vessels transiting the EMBA and OA include:

- bulk carriers averaging 55,300 t with speeds of 14 knots
- livestock carriers averaging 2,800 t with speeds of 12 knots
- general cargo vessels averaging 4,900 t with speeds of approximately 12 knots.

Although Darwin Port is the primary active port in the region, there is a port, Port Melville, located at the Tiwi Islands, which is approximately 150 km south-south east of the OA and 125 km north of Darwin and described in Santos' SURF Values & Sensitivities of the Marine Environment (BAS-210 0132, Appendix C).

3.2.4.7 Recreation and tourism

In NT there were 781,000 visitors for the purposes of tourism during the year ending September 2022 with a $1,332 million spend (NT Tourism, 2022). The OA is located in offshore waters that are not likely to be accessed for tourism activities (e.g. recreational fishing and boating, charter boat operations), as these tend to be centred around nearshore waters, islands and coastal areas.

In the NT, 95% of recreational fishing occurs in in areas <5 km from the coastline (West et al., 2022). The peak fishing effort between October to December and April to June (West et al., 2022). Several shoals and banks within the EMBA may be visited by small numbers of recreational fishers/charter vessels targeting fish inhabiting these shallower offshore features.

Scuba diving, snorkelling, and charter vessels are also significant tourist attraction, with operators visiting the numerous shipwrecks, coral reefs and artificial reefs and embarking on day or multiday trips out to offshore islands and shoals (such as Evans shoal ~67 km west of the OA) (INPEX Browse, 2010).

The Tiwi Islands are a popular tourist destination offering cruises, fishing, sailing and water tours among other cultural activities. Access and fishing are not permitted at the locations on the west coast of Bathurst Island that are intersected by the EMBA (Tiwi Land Council, 2023b). Tourism and recreational activities are likely to be more concentrated within coastal waters outside the EMBA, but activities such as deep-water fishing and diving around offshore shoals and reefs may potentially take place in the EMBA.

Indonesian and Timor-Leste-based marine tourism companies have advised that they also offer diving to areas predominantly close to shore. The majority occur off the northern coastlines, but some of these activities may occur in the EMBA.

3.2.4.8 Underwater maritime heritage

There are no registered underwater cultural heritage sites within the OA. Multiple known shipwrecks, sunken aircraft, and historic (more than 75 years old) aircraft and shipwrecks and other sites occur within the EMBA (see Figure 3-17).

In the Timor Sea are 10 unlocated historic aircraft wrecks from the Second World War (associated with the Japanese and Australian air forces) and one unlocated modern Indonesian fishing vessel that sank in 1997 (Cosmos Archaeology, 2023). The historic aircraft wrecks are subject to automatic protection under the UCH Act. These unlocated wrecks could fall within the boundaries of the OA or EMBA.

Cosmos Archaeology analysed SSS and MBES geophysical survey data collected over the OA in 2018 to identify potential shipwrecks or aircraft wrecks. The survey data did not provide clear evidence of any shipwrecks or aircraft wrecks. However, within the OA, 18 sonar anomalies could be related to potential maritime heritage sites such as debris fields, isolated debris, or discard (Cosmos Archaeology, 2023). Of these anomalies, only one appears to be related to the remains of a small shipwreck located more than 500 m from the proposed subsea infrastructure location (Cosmos Archaeology, 2023).

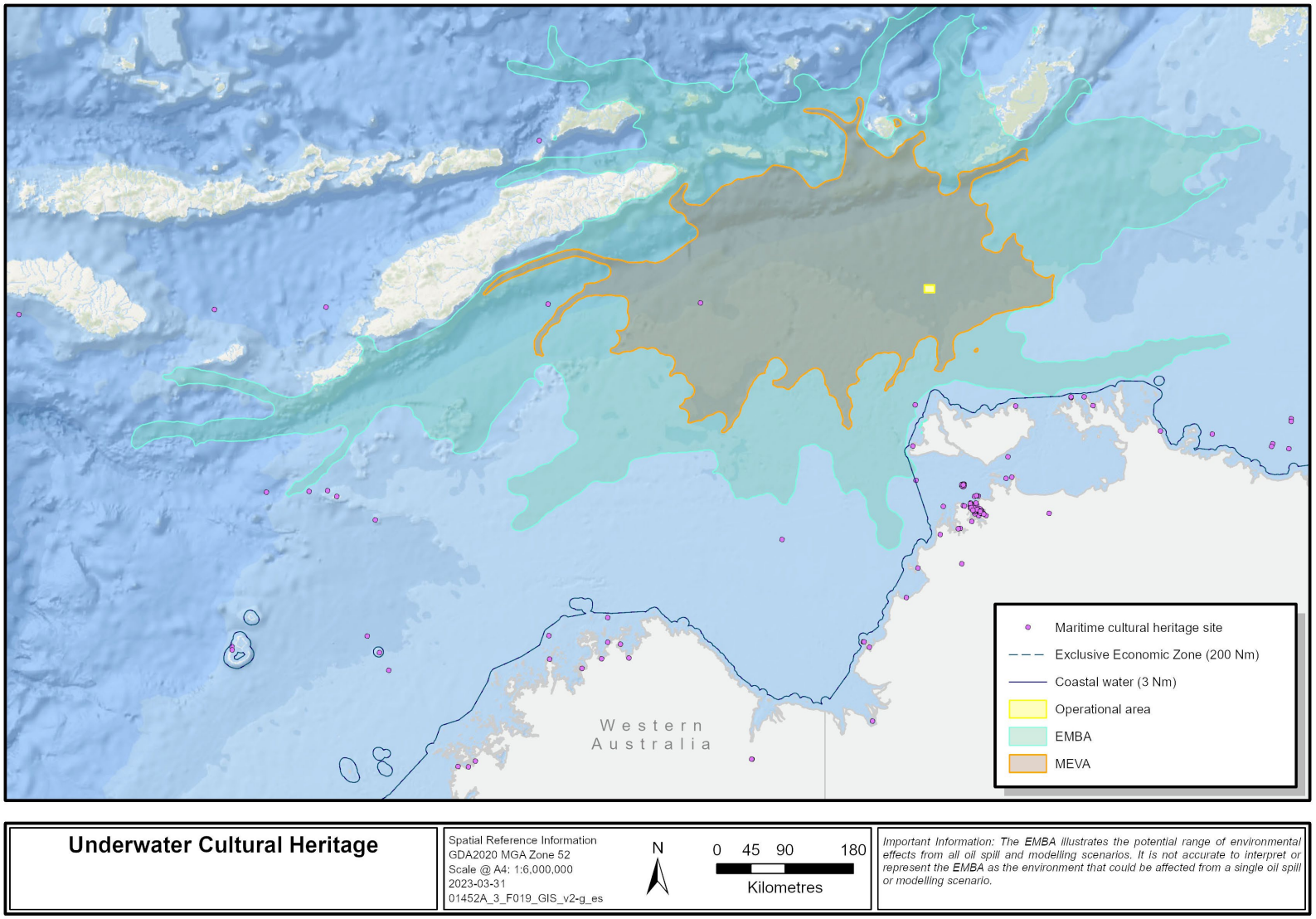


Figure 3-17: Underwater maritime heritage overlapping or proximal to the EMBA

3.2.5 Cultural features

3.2.5.1 Introduction

First Nations people have occupied the Australian continent for at least 65,000 years, making them the oldest continuous culture in the world. First Nations Australians' *connection to land is essential to the continued cultural survival of Australia's First Peoples as well as their economic and social development* (AIATSIS, 'Land Rights', Reuters).

Santos acknowledges the tradition of the First Nations people of Australia includes a cultural and spiritual connection to their land and waters, including sea country. These connections are rooted in their traditional communal beliefs and practices. First Nations people view their land and waters as integral to their identity, culture, and spirituality and they have a deep respect for the natural world. First Nations persons and groups that identify as saltwater people/groups have a complex relationship with sea country, based, for the most part, on inherited rights, including totemic affiliation, and ceremonial duties. Santos understands that First Nations groups of Northern Australia are generally aware of the nature and geographic extent of their areas of responsibilities over sea country.

The cultural heritage of First Nations people is defined by Indigenous tradition through traditional laws and customs amongst themselves.

It includes a vast array of cultural artifacts, practices and beliefs. The protected heritage of First Nations peoples is also of cultural value to Australia and the global community. The cultural value of First Nations protected heritage to Australia is evidenced and given force by a range of factors, including the laws, regulations and institutions established across Australia that are designed specifically to protect First Nations rights and interests in relation to sacred sites and other aspects of First Nations cultural heritage, including the *Native Title Act 1993* (Cth) (NT Act), *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (Cth) (ATSIHP Act), UCH Act, *Aboriginal Land Rights (Northern Territory) Act 1976* (Cth) (ALR Act) and *Northern Territory Aboriginal Sacred Sites Act 1989* (NT) (NTASS Act) (see Section 3.2.5.2 to 3.2.5.6).

There are no native title claims or determinations registered or recorded under the NTASS Act or sites protected under the ATSIHP Act, UCH Act or ALR Act, Aboriginal land rights claimed or granted under the ALR Act or Indigenous Protected Areas (IPAs) within the OA.

One registered sacred site and 3 recorded sacred sites are located on the western coast of Bathurst Island that may potentially intersect the outer extent of the EMBA. All sacred sites in the NT are protected in accordance with the NTASS Act.

Santos has considered the potential for presence of First Nations cultural artifacts to occur within the OA. Information interpreted from McCarthy et al 2022 indicates that the OA has always been submerged during the period of First Nations occupation of the Australian continent (~65,000 years). Therefore, Santos does not consider it credible that First Nations cultural artifacts are present in the OA.

3.2.5.2 Native title

Native title was first recognised in Australia in *Mabo v Queensland (No 2)* (1992) 175 CLR 1 (*Mabo*). Consequent to that decision, the *Native Title Act 1993* (Cth) was enacted to provide a statutory mechanism for the recognition of claims for, and protection of, native title.

Native title claims are applications made to the Federal Court under the NT Act for a determination, or decision about native title in a particular area. A claimant application is made by a native title claim group which asserts it holds native title rights and interests in an area of land and/or water, according to its traditional laws and customs. By making a claimant application, the native title claim group seeks a decision that native title exists, so its physical and spiritual rights and interests are

recognised by the common law of Australia. This is called a native title determination. A determination is a decision by a recognised body, such as the Federal Court or High Court of Australia, that native title either does or does not exist in relation to a particular area.

A native title claim group must demonstrate that the acknowledgement and observance of traditional laws and customs have continued substantially uninterrupted since sovereignty (capable of being recognised by the common law of Australia) (section 223(1) NT Act). Native title rights and interests are determined as a question of fact. For example, in *Western Australia v Ward* (2000) 99 FCR 316, [243], the Full Federal Court stated that:

Acknowledgment and observance may be established by evidence that traditional practices and ceremonies are maintained by the community, insofar as that is possible, off the land, and that ritual knowledge including knowledge of the Dreamings which underlie the traditional laws and customs, continue to be maintained and passed down from generation to generation. Evidence of present members of the community, which demonstrates knowledge of the boundaries to their traditional lands, in itself provides evidence of continuing connection through adherence to their traditional laws and customs.

A requirement to establishing a positive determination of native title in court is proving that there is an organised group that occupies the claimed land and waters at the time of British annexation. The requirement of an 'organised society' is set out in *Mabo*.

From this, it is considered that it is a group of native titleholders that hold communal native title and that native title claims are understood to represent the area over which First Nations groups are claiming their rights and interests.

A native title determination is where native title has been determined to exist, which may include only part of a native title claim, and represents the lands and waters over which the native title group has recognised rights and interests. Where a Court has determined that native title exists, those native title rights and interests will be held (often but not always) in trust by a Registered Native Title Body Corporate designated by the Native Title holders (section 57 NT Act).

Native title is, in any particular case, a collection of rights and interests the content of which varies according to the traditional laws and customs from which they are, in each particular case, derived. For example, these rights may include the right to have access, to camp, hunt, fish, use water, hold meetings, perform ceremony and/or protect cultural sites (see for example, *Akiba v The Commonwealth* (2013) 250 CLR 209).

For the Activity in this EP, there are no native title claims or determinations that overlap with the EMBA (refer to Figure 3-18). Notwithstanding the absence of native title claims or determinations that overlap the EMBA, the areas of responsibility for regional native title representative bodies overlap the EMBA as shown in Figure 3-19.

Santos was provided with information by First Nations people during consultation meetings for the Drilling EP and by NOPSEMA in the course of preparing the Drilling EP. NOPSEMA provided Santos with 4 separate letters from Tiwi clan members to NOPSEMA in April 2022 requesting the statement of reasons for NOPSEMA's decision to accept Revision 3 of the Drilling EP (2022 Statement of Reasons Requests[9]), and asked Santos to consider the relevance of the information to the EMBA under the Drilling EP. As the Drilling activities occur in a similar geographical area (resulting in a partially overlapping OA and EMBA with the SURF Activity), this information has been considered within Sections 3.2.5.8 to 3.2.5.10 of this EP.

[9] 2022 Statement of Reasons Requests asked for copies of statement of reasons to be sent to EDO email addresses

3.2.5.3 Indigenous land use agreements

An Indigenous land use agreement (ILUA) is a voluntary agreement between native title parties and other people or bodies about the use and management of areas of land and/or waters. An ILUA can be made over areas where:

- native title has been determined to exist in at least part of the area
- a native title claim has been made
- no native title claim has been made.

While registered, ILUAs bind all native title holders to the terms of the agreement. ILUAs also operate as a contract between the parties. A register of ILUAs is maintained by the Native Title Registrar. The register of ILUAs does not disclose the existence of any ILUA which overlaps with the EMBA (refer to Figure 3-18).

3.2.5.4 Indigenous protected areas

Indigenous protected areas (IPAs) are areas of land and sea managed by First Nations groups as protected areas for biodiversity conservation through voluntary agreements with the Australian Government. IPAs are an essential component of Australia's National Reserve System, which is the network of formally recognised terrestrial parks, reserves and protected areas across Australia's landmass. There are currently 82 dedicated IPAs over 87 million hectares of land. There is also around five million hectares of Australia's sea areas in dedicated IPAs. Managing IPAs helps First Nations communities protect the cultural features of their country for future generations.

For the Activity in this EP, there are no IPAs that overlap with the EMBA. Refer to Figure 3-18.

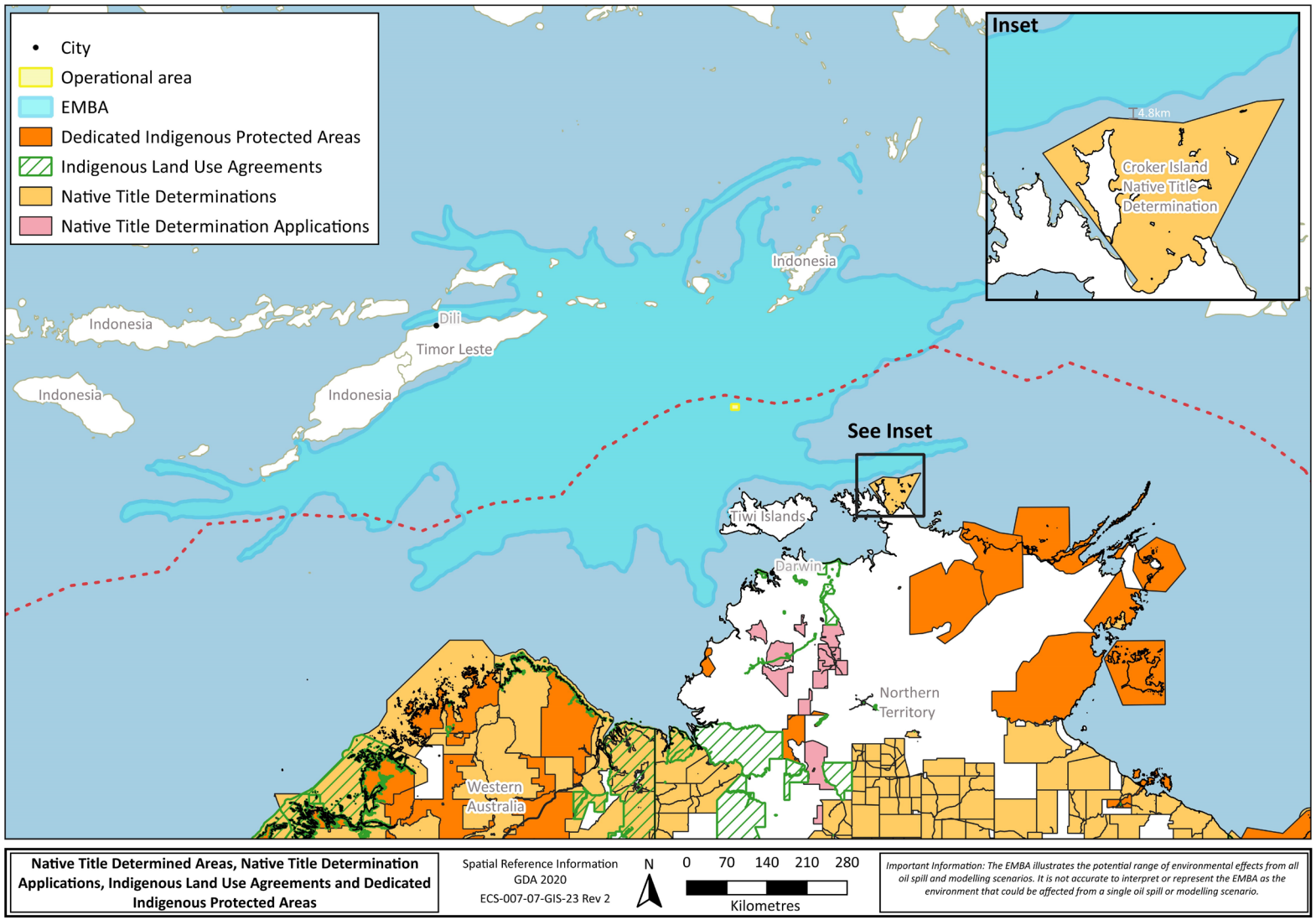


Figure 3-18: Native Title Determined Areas and Applications, ILUAs and IPAs

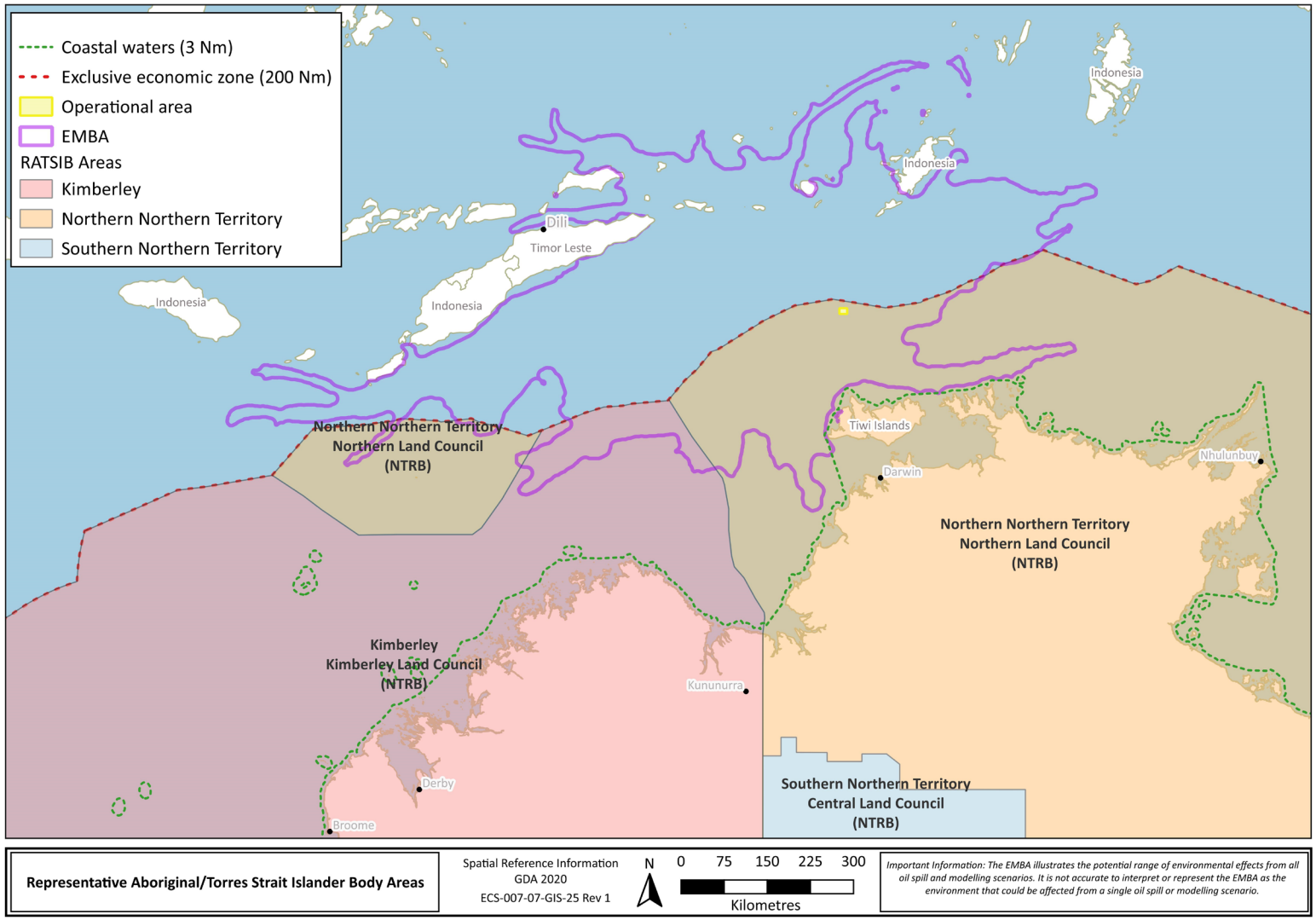


Figure 3-19: Representative Aboriginal/Torres Strait Islander Body Areas

3.2.5.5 Sacred sites

Through consultation, Santos became aware of the presence of one sacred site. One registered sacred site and 3 recorded sacred sites are located on the western coast of Bathurst Island that may potentially intersect the outer extent of the EMBA. All sacred sites in the NT are protected in accordance with the NTASS Act. Sacred sites may be registered in sea country, with access not permitted within 100 metres of any such sacred site, though some sacred sites may have more restrictive access.

Sacred sites may also be protected under the ATSIHP Act, the UCH Act, the ALR Act or the *Environment Protection and Biodiversity Conservation Act 1999* (Cth).

3.2.5.6 Land rights

The ALR Act governs Aboriginal land (not native title claims) in the NT. Land that has been granted or recommended for grant under the ALR Act is determined to be held communally by the "traditional Aboriginal owners" of that land. the ALR Act has enabled the establishment of Aboriginal Land Trusts to hold title to Aboriginal land granted in the NT under that Act.

Aboriginal land rights governed under the ALR Act do not extend past the low water mark of tidal waters overlaying the NT coastline. In coastal areas, grants of Aboriginal land under the ALR Act are made to the low water mark. *Northern Territory v Arnhem Land Aboriginal Land Trust* (2008) 236 CLR 24 confirmed that Traditional Owners of First Nations-owned NT coastline have exclusive access rights to the tidal waters overlying their land.

For the Activity in this EP, there is no Aboriginal land either claimed or granted under the ALR Act, or sea closures put into effect in accordance with that Act, that overlap with the EMBA.

3.2.5.7 Australian marine parks

Santos acknowledges that the EMBA for this EP overlaps with features of the North MPNMP and the North-West MPNMP, which identify natural, cultural and spiritual values associated with AMP's, specifically the Oceanic Shoals AMP and the Arafura AMP.

Santos acknowledges that Commonwealth and State Marine Park Management Plans have sought to recognise cultural interests of First Nations groups. Australian Marine Parks has described this framework as taking 'values into account' when making decisions and taking action in relation to marine parks. Australian Marine Parks summarises these values into natural, cultural, heritage and socioeconomic categories. Additionally, the Commonwealth and State Marine Park Management Plans state that there could be First Nations groups or native title representative groups who may have responsibility for sea country within marine park areas.

3.2.5.8 Cultural fishing and hunting activities

First Nations fishing activity in NT waters predominately occurs within inshore tidal waters. Approximately 80% of NT's coastline is recognised as being under Aboriginal land and sea ownership under the NT *Aboriginal Land Rights Act 1976* (NT Government, 2022). Almost all traditional fishing effort (~93%) is concentrated within coastal waters (up to 3 Nm) off the NT coastline and Tiwi Islands (NT Government, 2017). Traditional fishing effort is greatest near the larger communities of Wurrumiyanga on Bathurst Island, and Pirlangimpi and Milikapiti on Melville Island (these communities are located outside the EMBA) for the Tiwi Island people (DPIF, 2014). Sensitivity mapping carried out for the Tiwi Islands (ConocoPhillips, 2019) indicated that traditional subsistence activities occur within the coastal waters of the Tiwi Islands and includes fishing, customary hunting (turtles and dugongs) and gathering (turtle eggs and seagull eggs). Green turtles are the main species harvested in the water, while eggs of all turtle species are taken periodically

(Tiwi Land Council, 2022). Traditional fishing and gathering activities may occur on the western shoreline of Bathurst Island (outer extent of the EMBA).

Information provided during Tiwi Clan meetings during consultation for the Drilling EP indicated that some Tiwi people have a particular interest in turtles as a traditional food source. The 2022 Statement of Reasons requests for the Drilling EP provided Santos with information about Tiwi people:

- going to Seagull Island to collect turtle eggs and seagull eggs;
- collecting black lip oysters from Wulanju Island near Pirlangimpi Bay; and
- hunting on and around Tiwi Islands for a range of other food sources including fish (mullet, mackerel, barramundi, trevally), mud mussels, mud crabs, long bums shellfish, yams, mullet, chilli worms, mangrove worms, turtles, stingray, and dugong.

Fishing and hunting activities on and immediately adjacent to the Tiwi Islands are for the most part outside of the EMBA. A small area of potential overlap with the outer extent of the EMBA was identified on the west side of Bathurst Island.

Santos was also provided with information during the preparation of the Drilling EP from Croker Island clients of the Environmental Defenders Office (EDO) that members of the community in Minjilang rely on fish, turtles, dugong, oysters and other marine food sources. The information provided to Santos did not include details about the locations of traditional fishing and hunting activities.

3.2.5.9 Culturally significant marine species

In consultations with Tiwi Clans for the Drilling EP, Tiwi people emphasised that marine turtles are regarded by Tiwi people as totemic and culturally significant species. Therefore environmental protection measures for marine turtles are important to Tiwi people.

The 2022 Statement of Reasons requests indicated that Tiwi people also consider fish, dugong and whales to hold cultural significance as totemic species (in addition to marine turtles).

The Northern Land Council (NLC) in a submission as part of the consultation for the Drilling EP also indicated a number of marine species that are significant to Aboriginal Dreaming including birds, crocodiles, crows, whales, manta rays, crabs, dugong, sea turtle, gropers, sea-eagles, octopus and other turtles. The 2022 Statement of Reasons requests provided to Santos by NOPSEMA also indicated other terrestrial species, such as the brown fowl, as having cultural significance to Tiwi people.

Terrestrial species of cultural significance that inhabit the Tiwi Islands are outside the EMBA and therefore are not considered further in this EP.

3.2.5.10 Sea country

First Nations people view their land and waters as integral to their identity, culture, and spirituality and they have a deep respect for the natural world. The cultural heritage of First Nations peoples includes a vast array of cultural artifacts, practices and beliefs.

Santos acknowledges the cultural features of the First Nations people includes their intangible spiritual and cultural heritage stories, song lines and connections to their lands and waters, including sea country, and that these connections are rooted in their traditional communal beliefs and practices.

The Australian Marine Parks North-west Marine Parks Network Management Plan (DNP, 2018b) states:

Sea country refers to the areas of the sea that Aboriginal people are particularly affiliated with through their traditional lore and customs. Sea country is valued for Indigenous cultural identity, health and wellbeing. Across Australia, Indigenous people have been sustainably using and managing their sea country for tens of thousands of years.

Santos acknowledges regulatory guidance that under Regulation 4 'environment' is defined as including ecosystems and their constituent parts including people and communities, and this further includes the cultural features of those people and communities (Reg 4 (definition of 'environment') (e)). On that basis, Santos considers that First Nations people and communities are part of the ecosystem that may be affected by the activity (Reg 13(2)(a)).

As part of consultation in the course of preparing the Drilling EP some First Nations Relevant Persons expressed cultural connections with sea country in terms of spiritual beings. Information about First Nations cultural beliefs and connection with their sea country, within and adjacent to the environment that may be affected by the Drilling Activity, was provided during First Nations consultation meetings for the Drilling EP and from other information provided by NOPSEMA to Santos (2022 Statement of Reasons requests).

Additional information on cultural features which was obtained in during the course of consultations associated with the Barossa Gas Project are provided in this section, given the SURF OA and EMBA are in geographically similar locations and overlap with the Drilling EP OA area and EMBA. This additional information is therefore considered potentially relevant for informing the SURF EP of the cultural features and values held by Tiwi Islands and Croker Island people.

During Tiwi Clan consultation meetings for the Drilling EP, Tiwi people spoke about the importance of their spiritual dreaming which protects the Tiwi Islands from man-made and natural disasters. Santos recognises that some First Nations Relevant Persons fear sickness or other adverse effects from the actions of spiritual beings in response to impacts on the environment of sea country itself.

The 2022 Statement of Reasons requests, claimed that four individual Tiwi Islanders have a spiritual and cultural connection with the land and the sea, and more specifically with the location of the Drilling Activity (Operational Area) and the area that may be affected (EMBA), describing it as "their water" and "the home of their Ampiji". The four individual Tiwi Islanders also claim that their bodies are part of the land and the sea, and they describe their deep connection with the sea through cultural totems (see Section 3.2.5.9) and skin names. Santos was also advised by some of these individuals that their sea country extends from Cape Van Diemen to the East all along Snake Bay and around to South West side of the Tiwi Islands, and that the Eastern Side of Snake Bay is home to cultural stories and legends. The area from Cape Van Diemen to the East all along Snake Bay and around to the South West side of the Tiwi Islands is outside the drilling EMBA. Santos acknowledges the spiritual beliefs of these individual Tiwi Islanders and also observes that these beliefs are not shared by all Tiwi Islanders.

During Croker Island consultation meetings in Darwin, Croker Islanders conveyed their affiliation to their land and sea. They advised that their culture is at the coast and includes everything in the water including the marine life.

Croker Island clients of the EDO provided information to Santos during consultation for the Drilling EP about their connections with their sea country. They advised that their sea country is to the north of Cape Croker out to the deep water, and is called Inigarrka, and is considered the most sacred place in the ocean. They advised that they are not permitted to travel in that sea country for fishing or any other purposes because it is so sacred that it should never be disturbed. These individuals also advised that their sea country to the north of Inigarrka crossed into the Drilling EP EMBA. They also advised that important songlines go from land to the sea, and that in particular, there are important songlines that go out into sea country from Inigarrka. They also described a rainbow serpent, called Ambidj/ Umbidj, who protects the ocean and protects Minjilang. They advised that her (Amidj/Umbidj) sea is to the north of Inigarrka and she travels far north and all the way to the

Tiwi Islands as well, according to Minjilang Dreaming, Minjilang is the birthplace of the rainbow serpent, Umbidj, and the sea country is very sacred and important because of that.

Santos commissioned an independent expert assessment by Dr Brendan Corrigan for the purpose of identifying UCH places along the route of the Barossa Gas Export Pipeline (GEP) west and northwest of the Tiwi Islands ("Corrigan Report"). The cultural heritage assessment by Dr Corrigan is relevant to the description of the environment and the values and sensitivities of that environment (Reg 13(2))that may be affected by the activities described in this EP.

Dr Corrigan is of the view that the cultural heritage of First Nations people is defined by Indigenous tradition through traditional laws and customs amongst themselves. Dr Corrigan reviewed extensive ethnographic studies of the Tiwi people in order to gain an historical understanding of their society, culture and hierarchy. As part of the fieldwork, Dr Corrigan considered the views presented by the EDO reports prepared by Mr Lewis and Dr O'Leary and the affidavits of EDO clients in the Tipakalippa case (which concerned the prior accepted Drilling EP) and conducted extensive interviews amongst the communities.

Dr Corrigan documented a range of views on Tiwi clans connection with sea country and considered claims for several items to be protected in accordance with Tiwi law and custom. This included:

- the travels of the Crocodile Man
- the location of mother Ampitji
- the travels of Ampitji
- the necessity to look after country in a manner that seeks to ensure no industrial accidents occur which might affect sea country and marine resources (including spiritual connections to the same)
- the Imunka force present in the seas
- the location of a place under the sea where spirits go to upon people's death and then being moved on from the world of the living through Pukamani ceremony.

Tiwi Islanders interviewed by Dr Corrigan about the location of the above items expressed a variety of views. Whilst the outer limit of the SURF EP EMBA has the potential to overlap with some of these items, the SURF OA is in excess of 100 km from these items.

Dr Corrigan noted that there were differing views on the cultural significance of each of these items and that in many cases the location was insufficiently defined to require protection.

A key theme of the information provided by Tiwi Island and Croker Island clients of the EDO (as part of the Drilling EP consultation and to Dr Corrigan in preparing his report), is that a spirit being (or spirit beings) called Ampitji (sometimes known as a rainbow serpent) routinely traverses all of the sea in the vicinity of the islands and that Ampitji might become disturbed by the activities associated with the activities associated with the Barossa Gas Project and cause spiritual and physical harm to the Tiwi Islanders, Croker Islanders and others. In some instances, people who believe this also believe that preventative measures, such as having relevant Tiwi people 'introduce the [activities] to the rainbow serpent' would ameliorate any risk. Others have put the view that Ampitji remains fairly local to known geographic sites on the Tiwi islands and does not travel in the seas around the Tiwi Islands. Dr Corrigan concluded that the geographic extent of Tiwi sea country was a fairly limited distance from shore due to the limited seafaring capacity of the Tiwi people.

Dr Corrigan concluded that, in accordance with Indigenous tradition, there were no specific underwater cultural heritage places along the GEP route that may be affected by the activities under the GEP Environment Plan: that there are no known sacred sites or some other specific places which are known to be specific locations where something happened that are part of well-known sets of ancestral creation stories amongst the Tiwi people. Whilst this conclusion was made in relation to activities which will be covered in a separate GEP EP, they apply in this context because the GEP

extends to the site of the SURF activities. This means there are no intangible cultural heritage values and sensitivities attached to specific locations along the GEP route, including, relevantly within that part of the SURF OA and EMBA.

In its correspondence to Santos of 25 August 2023 in relation to the Drilling EP, NOPSEMA drew Santos' attention to two reports provided to NOPSEMA by the EDO on behalf of seven Tiwi Islander clients on 21 July 2023. These reports relate to the proposed GEP, which is the subject of a separate Environment Plan, for the Barossa Development (EDO GEP Reports), which NOPSEMA said may contain information relevant to the environment that may be affected by the Activity covered by this EP. The EDO GEP Reports claim to provide an assessment of the locations of potential impacts to Indigenous underwater cultural heritage sites along the Barossa GEP Route and claim to identify underwater cultural heritage along the Barossa GEP route. While the locations of these claimed sites of significance are partially within the SURF EMBA, the locations and significance of these claimed sites as put forward in the EDO GEP Reports is disputed by the Corrigan report.

The Corrigan report assessment included consideration of detailed expert reports on archaeology and sedimentology along the pipeline route conducted by Wessex Archaeology and Dr Posamentier; and the EDO GEP reports. The Corrigan Report concluded there are no specific underwater cultural heritage places along the Barossa GEP to which people, in accordance with Indigenous tradition, may have spiritual and cultural connections that may be affected by the GEP Environment Plan activities. As the northern section of the GEP extends into the operational area of the SURF and the SURF EP EMBA overlays the entire GEP route, this conclusion also applies to these areas of the SURF activity.

The Corrigan Report provided the following independent expert comments on the EDO Reports:

- The EDO Reports come to dramatic conclusions about cultural heritage elements in the vicinity of the GEP which overestimate the consistency of the views of the EDO clients with those held by the wider jural public of the Tiwi Islanders;
- Some Tiwi Islanders express views consistent with the EDO Reports, but the authors of those reports failed to consider and take account of other alternative expression;
- The narratives contained in the EDO Reports are not anything like the narratives described to Dr Corrigan in the interviews he undertook;
- The location of mother Ampitji is not agreed by all relevant parties;
- Dr O'Leary (the author of one of the EDO Reports) does not mention any qualification he holds for which he might rely upon to undertake detailed and nuanced ethnographic enquiries in the context of a controversial industrial project;
- Dr O'Leary incorrectly assumes an accuracy of the advice he received about the location of paleo sub-sea burial places;
- The EDO Reports do not correctly identify any specific underwater cultural heritage places along the Barossa GEP Route.

Dr Corrigan also identified a constant theme in his interviews with the Tiwi Islanders that Ampitji travel within the waterholes of the Tiwi Islands and surrounding the Tiwi Islands. Dr Corrigan accepts that the Ampitji exists in the sea country surrounding the Tiwi Islands. Dr Corrigan did not state that Ampitji exist anywhere else as part of his assessment, which included an area at the north end of the GEP which intersects the OA for the SURF EP.

While Santos recognises the importance of cultural and spiritual beliefs to Tiwi Islands and Croker Island First Nations people, Santos also observes that these beliefs as described above are expressed in a way that broadly describes their connection with sea country without reference to a specific place or location which is regarded by Tiwi Islands and Croker Island communities as being culturally significant.

4 Consultation

OPGGS(E)R 2009 Requirements
Regulation 9AB Publishing environment plan and associated information
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 11A Consultation with relevant authorities, persons and organisations, etc
11A(1) In the course of preparing an environment plan, or a revision of an environment plan, a titleholder must consult each of the following (a Relevant Person): g. each Department or agency of the Commonwealth to which the activities to be carried out under the environment plan, or the revision of the environment plan, may be relevant; h. each Department or agency of a State or the Northern Territory to which the activities to be carried out under the environment plan, or the revision of the environment plan, may be relevant; i. the Department of the responsible State Minister, or the responsible Northern Territory Minister; j. a person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the environment plan, or the revision of the environment plan; k. any other person or organisation that the titleholder considers relevant. 11A(2) For the purpose of the consultation, the titleholder must give each Relevant Person sufficient information to allow the Relevant Person to make an informed assessment of the possible consequences of the activity on the functions, interests or activities of the Relevant Person. 11A(3) The titleholder must allow a Relevant Person a reasonable period for the consultation. 11A(4)The titleholder must tell each Relevant Person the titleholder consults that: a. the Relevant Person may request that particular information the Relevant Person provides in the consultation not be published; b. information subject to such a request is not to be published under this Part.
Regulation 14(9) Implementation strategy for the environment plan
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 Other information in the environment plan
The environment plan must contain the following: b. a report on all consultations under regulation 11A of any Relevant Person by the titleholder, 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 titleholder's response, or proposed response, if any, to each objection or claim; and

OPGGS(E)R 2009 Requirements
iv. a copy of the full text of any response by a Relevant Person.

4.1 Consultation background

Santos (including through ConocoPhillips, as previous operator of the Barossa Gas Project), has continued to undertake consultation with Relevant Persons throughout various phases of the Barossa Gas Project to date, and specifically for the following key components:

- the OPP, which was accepted by NOPSEMA in March 2018
- the Barossa GEP Installation EP (BAA-210 0010), which was accepted by NOPSEMA in March 2020
- the Barossa Development Drilling and Completions EP (BAD-200 0003):
  - Revision 3, which was accepted by NOPSEMA in March 2022; and
  - Revision 4, which was submitted to NOPSEMA in July 2023.

NOPSEMA's decision to accept the Barossa Development Drilling and Completions EP (Revision 3) was set aside by the Federal Court in October 2022, following an application for judicial review. The Full Federal Court, on appeal, in making its findings, provided certain guidance on the requirements for consultation under the OPGGS(E)R.

Following the Appeal Judgment, in December 2022, NOPSEMA issued an interim Guideline entitled Consultation in the course of preparing an environment plan, subsequently finalised in May 2023, to assist titleholders to comply with their obligations to consult Relevant Persons (see Section 4.4).

Santos has undertaken regulation 11A consultation with Relevant Persons in relation to this EP to comply with applicable regulations, the Appeal Judgment and the latest NOPSEMA guidance issued in May 2023 to assist titleholders to comply with their obligations to consult Relevant Persons. Santos has also undertaken regulation 11A consultation with Relevant Persons in relation to the Drilling EP. As the Drilling activities occur in a similar geographical area (resulting in a partially overlapping OA and EMBA with the SURF Activity), information provided during Drilling EP consultation has been considered for SURF activity relevancy. This includes First Nations Relevant Persons feedback relating to concerns or potential impacts to cultural features. Where relevant, these concerns and issues have been addressed in the impact and risk assessment (Sections 6 and 7). Section 3.2.5 has also incorporated information collected regarding cultural features and values from First Nations Relevant Persons consultation. Refer to the Section 4.7 of the Drilling EP for records of consultation. Section 3.2.5 describes Santos' Regulation 11A consultation with Relevant Persons.

The consultation methodology for this EP is outlined in Section 4.5.

Section 8 includes Santos' post acceptance consultation implementation strategy for the Activity covered by this EP in accordance with regulation 14(9) of the OPGGS(E)R.

4.2 Regulatory requirements

Table 4-1 outlines the applicable regulatory requirements for consultation with Relevant Persons for this EP.

Table 4-1: Applicable regulatory requirements

Regulation	Relevant Extract of Regulation
Section 280(2) of the OPGGS Act	(2) A person (the **first person**) carrying on activities in an offshore area under the permit, lease, licence, authority or consent must carry on those activities in a manner that does not interfere with: a. navigation; or b. fishing; or c. the conservation of the resources of the sea and seabed; or d. any activities of another person being lawfully carried on by way of: i. exploration for, recovery of or conveyance of a mineral (whether petroleum or not); or ii. construction or operation of a pipeline; or iii. offshore infrastructure activities (within the meaning of the *Offshore Electricity Infrastructure Act 2021*); or e. the enjoyment of native title rights and interests (within the meaning of the *Native Title Act 1993*); to a greater extent than is necessary for the reasonable exercise of the rights and performance of the duties of the first person.
Regulation 4 of the OPGGS(E)R	**environment** means: a. ecosystems and their constituent parts, including people and communities; and b. natural and physical resources; and c. the qualities and characteristics of locations, places and areas; and d. the heritage value of places; e. and includes the social, economic and cultural features of the matters mentioned in paragraphs (a), (b), (c) and (d).
Regulation 9(8) of the OPGGS(E)R	(8) All sensitive information (if any) in an environment plan, and the full text of any response by a Relevant Person to consultation under regulation 11A in the course of preparation of the plan, must be contained in the sensitive information part of the plan and not anywhere else in the plan.
Regulation 10(A) of the OPGGS(E)R	For regulation 10, the criteria for acceptance of an environment plan are that the plan: … g. demonstrates that: i. the titleholder has carried out the consultations required by Division 2.2A; and ii. the measures (if any) that the titleholder has adopted, or proposes to adopt, because of the consultations are appropriate;

Regulation	Relevant Extract of Regulation
Regulation 11A(1) of the OPGGS(E)R	(1) In the course of preparing an environment plan, or a revision of an environment plan, a titleholder must consult each of the following (a **Relevant Person**): a. each Department or agency of the Commonwealth to which the activities to be carried out under the environment plan, or the revision of the environment plan, may be relevant; b. each Department or agency of a State or the Northern Territory to which the activities to be carried out under the environment plan, or the revision of the environment plan, may be relevant; c. the Department of the responsible State Minister, or the responsible Northern Territory Minister; d. a person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the environment plan, or the revision of the environment plan; e. any other person or organisation that the titleholder considers relevant.
Regulation 11A(2) of the OPGGS(E)R	(2) For the purpose of the consultation, the titleholder must give each Relevant Person sufficient information to allow the Relevant Person to make an informed assessment of the possible consequences of the activity on the functions, interests or activities of the Relevant Person.
Regulation 11A(3) of the OPGGS(E)R	(3) The titleholder must allow a Relevant Person a reasonable period for the consultation.
Regulation 11A(4) of the OPGGS(E)R	4) The titleholder must tell each Relevant Person the titleholder consults that: a. the Relevant Person may request that particular information the Relevant Person provides in the consultation not be published; and b. information subject to such a request is not to be published under this Part.
Regulation 13(2)-(3) of the OPGGS(E)R	Description of the environment (2) The environment plan must: a. describe the existing environment that may be affected by the activity; and b. include details of the particular relevant values and sensitivities (if any) of that environment. Note: The definition of **environment** in regulation 4 includes its social, economic and cultural features. (3) Without limiting paragraph (2)(b), particular relevant values and sensitivities may include any of 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. the presence of a listed threatened species or listed threatened ecological community within the meaning of that Act; e. the presence of a listed migratory species within the meaning of that Act;

Regulation	Relevant Extract of Regulation
	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.
Regulation 14(9) of the OPGGS(E)R	(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(b) of the OPGGS(E)R	The environment plan must contain: … b. a report on all consultations under regulation 11A of any Relevant Person by the titleholder, 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 titleholder'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;

4.3 Government and industry guidance

Santos has considered the following NOPSEMA guidance in developing its consultation activities and approach:

- *GL2086 – Consultation in the course of preparing an environment plan* (EP Consultation Guideline) (NOPSEMA, 2023)
- *GN1847 – Responding to public comment on Environment Plans (NOPSEMA 2022)*
- *GL1887 – Consultation with Commonwealth agencies with responsibilities in the marine area* (NOPSEMA, 2023a)
- *GL1721 – Environment plan decision making* (NOPSEMA, 2022b)
- *GN1344 – Environment plan content requirement* (NOPSEMA, 2022a)
- *GN1488 – Oil Pollution Risk Management* (NOPSEMA, 2021)
- *Supporting cooperative coexistence of seismic surveys and commercial fisheries in Australia's Commonwealth marine area* (Australian Government, 2022) jointly released by NOPSEMA, the Commonwealth Department of Agriculture, Fisheries and Forestry (DAFF), the Commonwealth Department of Industry, Science and Resources (DISR), and AFMA.
- *Petroleum activities and Australian Marine Parks: A guidance note to support environmental protection and effective consultation* (Australian Government 2023) jointly released by NOPSEMA and Parks Australia.

Santos has also considered other government and industry guidance, including:

- International Standards Organisation
  - ISO14001:2015 Environmental Management Systems
- AFMA
  - Petroleum industry consultation with the commercial fishing industry
- Australian Heritage Commission
  - Ask First - A guide to respecting Indigenous heritage places and values
- Commonwealth Department of Agriculture, Fisheries and Forestry
  - Fisheries and the Environment – OPGGS Act
  - Offshore Installations–Biosecurity Guide (DAWE, 2020c)
- DCCEEW
  - Interim Engaging with First Nations People and Communities on Assessments and Approvals under the Environment Protection and Biodiversity Conservation Act 1999 (DCCEEW, 2023c)
- Commonwealth Ministerial Council on Mineral and Petroleum Resources
  - Principles for Engagement with Communities and Stakeholders
- International Association for Public Participation
  - Quality Assurance Standard for Community and Stakeholder Engagement
- WA Department of Primary Industries and Regional Development
  - Guidance statement for oil and gas industry consultation with the Department of Fisheries
- WA Department of Transport

  - Offshore Petroleum Industry Guidance Note - Marine Oil Pollution: Response and Consultation Arrangements
- Western Australian Fishing Industry Council
  - Consultation approach for unplanned events

4.4 Applicable case law and guidance

In addition to considering the regulatory requirements and guidance set out above, in developing this EP Santos has considered the guidance of the Full Federal Court in the Appeal Judgment.

The EP Consultation Guideline referred to above provides a summary of the Full Federal Court's interpretation of “functions”, “activities” and “interests” referenced in regulation 11A(1)(d), adopted by NOPSEMA to assist in informing who may be a Relevant Person and how Relevant Persons may be identified, as defined in Table 4-2.

Table 4-2: Interpretation of functions, activities and interests

Term	Interpretation
Functions	Refers to “a power or duty to do something”
Activities	To be read broadly and is broader than the definition of “activity” in Regulation 4 of the OPGGS(E)R and is likely directed to what the Relevant Person is already doing
Interests	To be construed as conforming with the accepted concept of “interest” in other areas of public administrative law. Includes “any interest possessed by an individual whether or not the interest amounts to a legal right or is a proprietary or financial interest or relates to reputation”

Santos has also had regard to the purpose of consultation as outlined in the Appeal Judgment and EP Consultation Guideline, the emphasis that superficial or tokenistic consultation is not sufficient and that:

- consultation must be appropriate and adapted to the nature of each Relevant Person;
- for each Relevant Person, the appropriate manner and method of consultation (including the nature of information, time periods for consultation and mode of communication) may differ; and
- there is good reason to adopt pragmatic and practical approaches to consultation conducted in accordance with regulation 11A.

4.5 Santos’ consultation methodology

4.5.1 Overview

Santos consults to ensure that any activity it is proposing under an EP is carried out in a manner:

- consistent with the principles of ecologically sustainable development set out in section 3A of the EPBC Act;
- by which the environmental impacts and risks of the activity will be reduced to as low as reasonably practicable (ALARP); and
- by which the environmental impacts and risks of the activity will be of an acceptable level.

The consultation process is designed to assist Santos to further ascertain, understand and assess values and sensitivities of the environment that may be affected by a proposed activity, and the potential environmental impacts and risks, through information obtained during consultations. Santos may then refine or change its proposed control measures to address potential environmental impacts

and risks of the activity based on that information or any claims or objections raised through consultation.

Santos' consultation methodology and process adopted in developing this EP comprised the following key steps:

- identifying potential Relevant Person categories
- identifying Relevant Persons
- providing opportunities for Relevant Persons to identify themselves if they wished to be consulted (e.g. through advertising)
- consultation planning and preliminary consultation activities
- consulting Relevant Persons
- assessing the merits of objections or claims made by Relevant Persons about the adverse impact of each activity to which the EP relates
- providing responses to queries, requests and feedback.

As described below, Santos considered the spatial extent of the environment that may be affected by the Activity and the particular aspects of the relevant environment as part of its process for identifying Relevant Persons.

4.5.2 Identifying Relevant Persons

This section outlines the methodology and steps that Santos has used to identify Relevant Persons. The identification of Relevant Persons was an iterative process. Table 4-3 summarises the preliminary steps adopted by Santos to identify Relevant Persons.

Table 4-3: Preliminary identification methodology

Process steps
1. Identify the impacts of the planned activities and the risks and impacts of unplanned events.
2. Consider the spatial extent of the environment that may be affected by the Activity impacts and risks.
3. Consider and identify aspects of the environment within the environment that may be affected, having regard to: (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).
4. Identify Relevant Person categories, having regard to: (a) aspects of the environment identified at Item 3 (b) the departments or agencies of Commonwealth, State and Territory governments that could therefore be relevant (c) the kinds of functions, interests or activities of people or organisations that could therefore be affected (d) submissions received in response to Santos' advertisements asking Relevant Persons to identify themselves if they wished to be consulted. (e) any other person or organisation that the titleholder considers relevant. Update during consultation based on new information, if appropriate.
5. Identify Relevant Persons within Relevant Person categories, having regard to items 1-4 above.

Santos considered the nature of the Activity (and key component activities) (described in Section 2), the location of the Activity and the OA (described and depicted in Section 2), the impacts of planned activities (described in Section 6) and the risks and impacts of unplanned events (described in Section 7).

Santos also considered the spatial extent of the environment that may be affected by the Activity impacts and risks (described in Section 3 and Appendix C).

Table 4-4 outlines the environmental aspects (described in detail in Section 3). Santos considered these aspects for the purpose of identifying Relevant Person categories.

Table 4-4: Environmental aspects considered for Relevant Person category identification

Aspects of the environment	EP Reference
Physical environment	Section 3.2.1
Provincial bioregions	Section 3.2.1.1
Benthic habitats	Section 3.2.1.3
Australian marine parks and state marine parks, management areas, reserves	Section 3.2.2.1
Wetlands of international and national importance	Section 3.2.2.2
Key ecological features	Section 3.2.2.3
Biologically important areas and critical habitat	Section 3.2.3.1
Conservation advice, recovery plans and management plans	Section 3.2.3.2
Commercial fisheries	Section 3.2.4.1
Indonesian and Timorese commercial and subsistence fishing	Section 3.2.4.2
Energy industry	Section 3.2.4.3
Telecommunications cables	Section 3.2.4.4
Defence activities	Section 3.2.4.5
Shipping	Section 3.2.4.6
Recreation and tourism	Section 3.2.4.7
Underwater maritime heritage	Section 3.2.4.8
Cultural features	Section 3.2.5

The consideration of the environmental aspects resulted in identification of the following Relevant Person categories:

- Regulation 11A(1)(a) of the OPGGS(E)R
  - Commonwealth Departments/Agencies
- Regulation 11A(1)(b) and (c) of the OPGGS(E)R
  - State and Territory Departments/Agencies
- Regulation 11A(1)(d) of the OPGGS(E)R
  - Local Government Authorities
  - First Nations peoples and groups
  - Environmental conservation organisations

- Commercial fishing (Commonwealth, NT, WA, International)
- Recreational fishers
- Industry associations
- Energy industry titleholders / operators
- Infrastructure operators
- Marine and coastal tourism operators

- Regulation 11A(1)(e)
  - People or organisations who Santos had previously recognised as relevant under this category.

Table 4-5 outlines actions that Santos implements to identify Relevant Persons within each category.

Table 4-5: Actions for identifying Relevant Persons by category

Relevant Person Category	Actions to identify Relevant Persons
All Relevant Person categories	• Review of relevant regional historical consultation to create a consolidated list of Relevant Persons, having regard to previously identified functions, interests and/or activities. • Review of lists of Relevant Persons in publicly available EPs, submitted by other Operators that may be relevant, having regard to the region, activities or risks/impacts under this EP. • Conducting key-word searches using online search engines and reviewing media coverage and organisation websites to identify persons and organisations with reasonably ascertainable functions, interests and activities that may be affected by the activities under this EP. • Conducting a large-scale, targeted media and advertising campaign to promote wide awareness of the Activity and to seek that Relevant Persons come forward. • Review of information provided by or claims made by or on behalf of organisations who claimed to be Relevant Persons.
Regulation 11A(1)(a) of the OPGGS(E)R	
Commonwealth Departments/Agencies	• Review of government agency websites and directories to understand agency roles, functions and responsibilities. • Review of NOPSEMA and government agency guidance on consultation expectations.
Regulation 11A(1)(b) and (c) of the OPGGS(E)R	
State and Territory Departments/Agencies	• Review of government agency websites and directories to understand agency roles, functions and responsibilities. • Review of NOPSEMA and government agency guidance on consultation expectations.
Regulation 11A(1)(d) of the OPGGS(E)R	
Academic and Research Organisations	• Desktop review of publicly available and reasonably ascertainable published research (including conducting searches of research databases) having regard to the region, activities or risks/impacts under this EP.

Relevant Person Category	Actions to identify Relevant Persons
Commercial Fishing	• Review of Commonwealth, NT and WA Government commercial fishing catch and effort data. • Review of fisheries entitled to fish in the EMBA.
Environmental Conservation Organisations	• Conducting key-word searches of publicly available online search engines, review media coverage and review organisation websites to identify organisations with reasonably ascertainable functions, interests or activities that may be affected, having regard to the region, activities or risks/impacts under this EP. • Review of other publicly available information, e.g. websites of conservation organisations whose functions, interests or activities within the EMBA may be affected.
First Nations Peoples and groups	• Review of the Judgment and the Appeal Judgment. • Review of publicly available studies, reports and/or other information sources and reports that may assist in identifying or mapping relevant cultural interests in the EMBA. • Review of EMBA overlap with Native Title determined areas and claims, ILUAs, sacred sites, land rights and IPAs to identify areas over which a First Nations group may have functions, interests or activities that may be affected. • Review of Representative Aboriginal/Torres Strait Island Bodies (RATSIBs) on Native Title website. • Review of prescribed bodies corporate on Native Title website. • Conducting searches of public cultural heritage databases relevant to the EMBA. • Review of marine park management plans relevant to the EMBA. • Engagement with government departments/agencies with relevant knowledge or relevant responsibilities. • Engagement with representative bodies under the NT Act and the ALR Act.
Infrastructure Operators	• Review of EMBA overlap with offshore and onshore infrastructure, such as submarine telecommunications cables or ports.
Industry Associations	• Review of industry association representation of Relevant Persons.
Local Government Authorities	• Review of EMBA overlap with boundaries of Local Government Areas.
Energy Industry	• Review of EMBA overlap with petroleum, greenhouse gas and any other NOPTA issued titles.
Recreational Fishers	• Review of EMBA overlap with areas of interest to recreational fishing. • Review of website information of relevant agencies/organisations that represent recreational fishing interests. • Review of records of previous liaison with such representative agencies/organisations that may indicate persons or organisations with functions, interests or activities that may be affected by the activities under this EP.

Relevant Person Category	Actions to identify Relevant Persons
Marine and Coastal Tourism Operators	• Review of EMBA overlap with areas of interest to marine and coastal tourism operators . • Review of website information of relevant operators/organisations that represent marine and coastal tourism operators interests. • Review of records of previous liaison with such representative agencies/organisations that may indicate persons or organisations with functions, interests and activities that may be affected by the activities under this EP.
Regulation 11A(1)(e) of the OPGGS(E)R	
People or organisations who Santos had previously recognised as relevant under this category	• Review of relevant persons consultation summary and documents for this EP.

In addition to the steps outlined above, Santos undertook a public awareness and media and advertising campaign. This was designed to:

- raise public awareness of the Barossa Gas Project generally, the activities proposed under this EP and Santos' regulation 11A consultation in respect of this EP
- seek Relevant Persons and encourage them to come forward.

Copies of the advertisements run by Santos are included at Appendix F. Table 4-6 outlines the steps involved in the public awareness campaign.

Table 4-6: Public awareness campaign

Step	Description	Purpose
Website Hub	Dedicated Barossa Gas Project Hub created for Santos' website. Website content developed and made available at **https://www.santos.com/barossa/**. This was publicly available from 25 March 2023 with information on the proposed activities under the Barossa SURF EP added to the website on 22 April 2023.	To provide information regarding: • the Barossa Gas Project generally (including an animated overview of the Project) • the Activity • the environment that may be affected by the Activity (including depictions of the modelled EMBA and explaining how the EMBA is determined) • the potential environmental impacts and risks and proposed control measures • the environmental approval process • the purpose of consultation, who may be a Relevant Person and how to self-nominate as a potential Relevant Person • Santos' obligations during consultation in the course of preparing an environment plan • how to provide feedback. To link to the other information documents including: • Barossa Subsea Infrastructure Installation EP Information Booklet (Information Booklet) • online self-nomination form as a potential Relevant Person

Step	Description	Purpose
		(https://www.santos.com/barossa/subsea-infrastructure-installation/) • FAQ document, which was modified and updated during the consultation process.
Media and advertising campaign	Large-scale, targeted advertising campaign involving widespread print, radio and social media advertising. This included national print and radio advertisements, with a specific focus on the NT and WA, and social media advertisements throughout Australia, Timor-Leste and Indonesia.	To promote wide awareness of the Activity and seek out Relevant Persons. The advertisements encouraged interested parties to visit the website hub for more detailed information about the Activity. See Table 4-8 and Table 4-9
Drop-in consultation sessions	Five drop-in sessions held at the Darwin Convention Centre. Sessions advertised in the NT News, on NT radio and social media (see Table 4-10).	To make available: • information booklets • iPads pre-loaded with video content including a project overview video • project maps • Santos representatives to answer questions and receive feedback.
Pop-up stalls	Two pop-up stalls held in the Darwin Mall.	To make available: • information booklets • iPads pre-loaded with video content including a project overview video • project maps • Santos representatives to answer questions and receive feedback.
Arts in the Grass involvement	Santos representatives attended two Arts in the Grass events organised by Larrakia Nation at Mindil Beach for people living rough in Darwin.	To make available: • fact sheets • project maps • Santos representatives to answer questions and receive feedback.
Darwin Show	Santos representatives attended the Darwin Show.	To make available: • information booklets • project maps • Santos representatives to answer questions and receive feedback.

In some cases, these steps and initiatives also provided consultation opportunities.

Table 4-6 details Santos conducted a large-scale, targeted advertising campaign to promote wide awareness of the Activity, to seek out Relevant Persons, and to promote opportunities to provide feedback.

This involved phases as follows, depicted in Table 4-7.

Table 4-7: Targeted advertising campaign

Step	Description	Purpose
Identifying Relevant Persons	To raise broad awareness of the Activity and identify Relevant Persons.	Widespread 31-day print, radio and social media advertising from 22 April 2023 to 22 May 2023. This advertising included advertisements in national and regional newspapers, including the Australian, Australian Financial Review, West Australian, Northern Territory News and National Indigenous Times, as well as radio advertising. There was also geotargeted social media advertisements to reach Indonesia and Timor-Leste. See Table 4-8.
Seeking feedback from Relevant Persons	To seek feedback from Relevant Persons and advertise avenues for providing feedback.	Widespread 51-day print, radio and social media advertising from 12 June 2023 to 4 August 2023. In this phase, Santos also placed advertisements on Top End Aboriginal Bush Broadcasting Association to reach 29 remote communities. See Table 4-9.
Seeking feedback from Relevant Persons in Darwin	To advertise and promote consultation opportunities within Darwin.	Encouraging accessible consultation and engagement opportunities through hosting Darwin drop-in sessions held at the Darwin Convention Centre, at which information was made available and feedback sought. Also provided opportunities for Santos to identify additional Relevant Persons. See Table 4-10.
Identifying and seeking feedback from international Relevant Persons	To raise broad awareness of the Activity, identify Relevant Persons and seek feedback from Relevant Persons located internationally	Geotargeted social media advertising to Indonesia and Timor-Leste in English and national languages of Bahasa and Tetum. See Table 4-11.

Table 4-8: Phase 1 – Advertising seeking Relevant Persons

Date	Advertising type	Description	Reach
20 April 2023 – 22 May 2023	Social media ad	Facebook, Instagram and Messenger	Geotargeted NT and WA
22 April 2023	Press ad – The Australian	Full page, page 24	National coverage with reach of 635,000
22 April 2023 – 22 May 2023	Social media ad	Facebook, Instagram and Messenger	Geotargeted Australia
22 April 2023	Press ad – Australian Financial Review	Full page, page 7	National coverage with reach of 180,000
22 April 2023	Press ad – The West Australian	Full page, page 10	Target WA with reach of 491,000
24 April 2023	Public Notice – The West Australian	Full page, page 14	Target WA with reach of 415,000
24 April 2023	Press ad – NT News	Full page, page 6	Target NT with reach of 25,000

Date	Advertising type	Description	Reach
15 April 2023 – 21 April 2023	Radio advertising across metro stations in Sydney, Melbourne, Brisbane, Adelaide and Perth	923 spots/plays across period in Sydney, Melbourne, Brisbane, Adelaide and Perth	National coverage across major cities with reach of 2,211,000
15 April 2023 – 21 April 2023	Radio advertising across Darwin	213 spots/plays across period	Darwin Specific
25 April 2023	Press ad – National Indigenous Times	Full page, page 22	National coverage with reach of 1,100,000
26 April 2023	Public Notice – Australian Financial Review	Page 7	National coverage with reach of 226,000
29 April 2023	Public Notice – The Australian	Page 12	National coverage with reach of 635,000
29 April 2023	Public Notice – NT News	Page 6	National coverage with reach of 25,000
29 April 2023	Press ad – NT News	Full page, page 15	Target NT with reach of 25,000
1 May 2023	Public Notice – The West Australian	Page 7	Target WA with reach of 415,000
3 May 2023 – 22 May 2023	Social media ad	Facebook, Instagram and Messenger	Geotargeted Indonesia & Timor-Leste
3 May 2023	Public Notice – Australian Financial Review	Page 9	National coverage with reach of 226,000
6 May 2023	Public Notice – The Australian	Page 12	National coverage with reach of 635,000
6 May 2023	Public Notice – NT News	Page 13	National coverage with reach of 25,000
6 May 2023	Press ad – NT News	Full page, page 6	Target NT with reach of 25,000
8 May 2023	Public Notice – The West Australian	Page 7	Target WA with reach of 415,000
10 May 2023	Public Notice – Australian Financial Review	Page 4	National coverage with reach of 226,000
13 May 2023	Public Notice – The Australian	Page 10	National coverage with reach of 635,000
13 May 2023	Public Notice – NT News	Page 12	National coverage with reach of 25,000
15 May 2023	Public Notice – The West Australian	Page 7	Target WA with reach of 415,000
15 May 2023	Public Notice – Australian Financial Review	Page 10	National coverage with reach of 226,000
20 May 2023	Public Notice – The Australian	Page 7	National coverage with reach of 635,000
20 May 2023	Public Notice – NT News	Page 4	National coverage with reach of 25,000

Table 4-9: Phase 2 – Further advertising seeking Relevant Persons and seeking feedback

Date	Advertising type	Description	Reach
12 June 2023	Press ad – The West Australian	Half page, page 14	Target WA with reach of 415,000
13 June 2023	Press ad – The Australian	Half page, page 4	National coverage with reach of 389,000
14 June 2023	Press ad – Australian Financial Review	Half page, page 15	National coverage with reach of 258,000
14 June 2023	Press ad – NT News	Half page, page 13	Target NT with reach of 25,000
16 June 2023 – 14 July 2023	Radio advertising across metro stations	1,092 spots/plays across period in Sydney, Melbourne, Brisbane, Adelaide and Perth	National coverage across major cities with reach of 5,520,904
16 June 2023 – 14 July 2023	Radio advertising across Darwin	282 spots/plays across period	Darwin specific advertising
16 June 2023 – 14 July 2023	Radio advertising Top End Aboriginal Bush Broadcasting Association (TEABBA)	116 spots/plays across period	29 remote communities across top end of Australia, including Tiwi Islands
17 June 2023	Press ad – The West Australian	Half page, page 11	Target WA with reach of 491,000
17 June 2023	Press ad – The Australian	Half page, page 9	National coverage with reach of 635,000
19 June 2023	Press ad – Australian Financial Review	Half page, page 12	National coverage with reach of 258,000
20 June 2023 – 14 July 2023	Social media ad	Facebook, Instagram and Messenger	Geotargeted NT & WA, Timor-Leste and Indonesia
21 June 2023	Press ad – NT News	Half page, page 4	Target NT with reach of 25,000
24 June 2023	Press ad – The West Australian	Half page, page 16	Target WA with reach of 491,000
24 June 2023	Press ad – The Australian	Half page, page 29	National coverage with reach of 635,000
26 June 2023	Press ad – Australian Financial Review	Half page, page 4	National coverage with reach of 258,000
28 June 2023	Press ad – NT News	Half page, page 13	Target NT with reach of 25,000
1 July 2023	Press ad – The West Australian	Half page, page 14	Target WA with reach of 491,000
1 July 2023	Press ad – The Australian	Half page, page 6	National coverage with reach of 635,000
3 July 2023	Press ad – Australian Financial Review	Half page, page 4	National coverage with reach of 258,000

Date	Advertising type	Description	Reach
5 July 2023	Press ad – NT News	Half page, page 4	Target NT with reach of 25,000
8 July 2023	Press ad – The West Australian	Half page, page 11	Target WA with reach of 491,000
8 July 2023	Press ad – The Australian	Half page, page 29	National coverage with reach of 635,000
10 July 2023	Press ad – Australian Financial Review	Half page, page 6	National coverage with reach of 258,000
12 July 2023	Press ad – NT News	Half page, page 8	Target NT with reach of 25,000
18 July 2023 – 4 August 2023	Social media ad	Facebook, Instagram and Messenger	Geotargeted Australia Timor-Leste and Indonesia
19 July 2023	Press ad – NT News	Half page, page 13	Target NT with reach of 25,000
19 July 2023 – 4 August 2023	Radio advertising across metro stations	408 spots/plays across period in Sydney, Melbourne, Brisbane, Adelaide and Perth	National coverage across major cities with reach of 5,520,904
19 July 2023 – 4 August 2023	Radio advertising across Darwin	136 spots/plays across period	Darwin specific advertising
19 July 2023 – 4 August 2023	Radio advertising Top End Aboriginal Bush Broadcasting Association (TEABBA)	68 spots/plays across period	29 remote communities across top end of Australia, including Tiwi Islands
21 July 2023	Press ad – Australian Financial Review	Half page, page 9	National coverage with reach of 258,000
22 July 2023	Press ad – The West Australian	Half page, page 14	Target WA with reach of 491,000
22 July 2023	Press ad – The Australian	Half page, page 29	National coverage with reach of 635,000
24 July 2023	Press ad – Australian Financial Review	Half page, page 5	National coverage with reach of 258,000
25 July 2023	Press ad – National Indigenous Times	Half page, page 16	National coverage with reach of 1,100,000
26 July 2023	Press ad – NT News	Half page, page 13	Target NT with reach of 25,000
29 July 2023	Press ad – The West Australian	Half page, page 14	Target WA with reach of 491,000
29 July 2023	Press ad – The Australian	Half page, page 11	National coverage with reach of 635,000
31 July 2023	Press ad – Australian Financial Review	Half page, page 4	National coverage with reach of 258,000
2 August 2023	Press ad – NT News	Half page, page 4	Target NT with reach of 25,000

Table 4-10: Phase 3 – Advertising and promoting Darwin drop-in sessions

Date	Advertising type	Description	Reach
Darwin drop-in sessions – first round			
21 April 2023 – 3 May 2023	Social media ad	Facebook, Instagram and Messenger	Geotargeted Darwin
21 April 2023	Press ad – NT News	Half page, page 18	Target NT with reach of 22,000
27 April 2023	Press ad – NT News	Half page, page 6	Target NT with reach of 20,000
27 April 2023 – 3 May 2023	Radio advertising across Darwin	51 spots/plays across period	Darwin specific advertising
28 April 2023	Press ad – NT News	Half page, page 6	Target NT with reach of 22,000
1 May 2023	Press ad – NT News	Half page, page 7	Target NT with reach of 25,000
Darwin drop-in sessions – second round			
12 May 2023	Press ad – NT News	Half page, page 16	Target NT with reach of 22,000
15 May 2023	Press ad – NT News	Half page, page 5	Target NT with reach of 25,000
17 May 2023 – 12 June 2023	Social media ad	Facebook, Instagram and Messenger	Geotargeted Darwin
17 May 2023	Press ad – NT News	Half page, page 10	Target NT with reach of 25,000
22 May 2023	Press ad – NT News	Half page, page 9	Target NT with reach of 25,000
22 May 2023 – 7 June 2023	Radio advertising across Darwin	170 spots/plays across period	Darwin specific advertising
24 May 2023	Press ad – NT News	Half page, page 4	Target NT with reach of 25,000
29 May 2023	Press ad – NT News	Half page, page 5	Target NT with reach of 25,000
31 May 2023	Press ad – NT News	Half page, page 4	Target NT with reach of 25,000
5 June 2023	Press ad – NT News	Half page, page 11	Target NT with reach of 25,000
7 June 2023	Press ad – NT News	Half page, page 4	Target NT with reach of 25,000
Darwin drop-in sessions – third round			
6 July 2023	Press ad – NT News	Half page, page 12	Target NT with reach of 20,000
7 July 2023 – 17 July 2023	Radio advertising across Darwin	170 spots/plays across period	Darwin specific advertising

Date	Advertising type	Description	Reach
10 July 2023	Press ad – NT News	Half page, page 7	Target NT with reach of 25,000
10 July 2023 – 17 July 2023	Social media ad	Facebook, Instagram and Messenger	Geotargeted Darwin
13 July 2023	Press ad – NT News	Half page, page 11	Target NT with reach of 20,000
17 July 2023	Press ad – NT News	Half page, page 4	Target NT with reach of 25,000

4.5.2.1 Santos' approach to identifying international Relevant Persons

Further to the above, Santos took steps to seek out international persons or organisations with reasonably ascertainable *"functions, interests or activities"* that may be affected by the activities to be carried out under this EP (international Relevant Persons).

Santos' approach to identifying international Relevant Persons takes into account the nature and scale of the activity, and the likelihood and magnitude of impacts to international persons and organisations that may be affected by the Activity.

With regard to the location of the planned activities, there are no planned impacts generated at the Activity location that may affect the functions, interests or activities of international Relevant Persons (see Section 6). With regard to risk and impacts of unplanned events associated with the Activity, the likelihood of an unplanned spill event occurring and hydrocarbons reaching the locations where international persons or organisations may have functions, interests or activities is remote due to measures (refer Section 7.6.3) and implementation of spill response measures (refer to OPEP [BAS-210 0109]). It is important to note here that the modelled EMBA assumes none of the suite of mitigations described in the OPEP are implemented. This is particularly relevant to locations and receptors near the outer limits of the EMBA, where there is even lower likelihood of international persons or organisations functions, interests or activities being affected once spill response mitigation measures are taken into account.

Santos therefore sought to reasonably ascertain international Relevant Persons in a manner proportionate to the remote likelihood of any effect on the functions, interests or activities of international persons or organisations.

Santos considered that no further steps were reasonably required to identify international Relevant Persons due to the remote likelihood of any internationally held functions interests or activities that may be affected by the Activity. No international persons or organisations had self-nominated for SURF EP consultation during the domestic advertising campaign. The following international campaign involved geotargeted advertising on Facebook, Instagram and Messenger, in Indonesian, Tetum and English, to target locations including Indonesia and Timor-Leste (during May 2023 to August 2023), asking Relevant Persons to contact Santos in addition to the general widespread media and advertising campaign (see Table 4-11**)**. Those advertisements contained links to Santos' website for the SURF EP consultation which provided the Activity and consultation information (see Section 4.6.2) and a form for self-nomination as a potential Relevant Person. There were no further persons or organisations that self-nominated following the international advertising campaign.

Table 4-11: Targeted International Phase – Targeted international media / advertising

Date	Advertising type	Description	Reach
3 May 2023 – 22 May 2023	Social media ad	Facebook, Instagram and Messenger	Geotargeted Indonesia & Timor-Leste
22 May 2023 – 15 June 2023	Social media ad – Timor-Leste ad in Tetum	Facebook, Instagram and Messenger	Geotargeted Timor-Leste
23 May 2023 – 15 June 2023	Social media ad – Indonesian ad in Bahasa	Facebook, Instagram and Messenger	Geotargeted Indonesia
20 June 2023 – 14 July 2023	Social media ad	Facebook, Instagram and Messenger	Geotargeted NT & WA, Timor-Leste and Indonesia
18 July 2023 – 4 August 2023	Social media ad	Facebook, Instagram and Messenger	Geotargeted Australia Timor-Leste and Indonesia

In addition to its advertising campaign, Santos had previously consulted with DFAT, which has an interest in coordinating and facilitating communication between Australia and the Indonesian or Timor-Leste governments.

During consultation with DFAT for the Barossa Drilling and Completions Environment Plan (Revision 4), DFAT noted from Santos' oil spill modelling that Indonesia and Timor-Leste may be affected in the event of a hydrocarbon spill and confirmed that DFAT can provide assistance if it is determined there is a need to consult the Indonesian or Timor-Leste Governments, and that NOPSEMA can contact the relevant part of DFAT should this be necessary. The EMBA for the SURF EP also extends outside Australian waters.

As Santos has assessed there to be no Activity impacts or risks to internationally held functions, interest and activities, the only matter in respect of which consultation with Indonesian and Timor-Leste persons or organisations might be required is in relation to a hydrocarbon spill that reaches Indonesian or Timor-Leste waters. No particular Indonesian or Timor-Leste government person or organisation has been identified as having reasonably ascertainable functions, interests or activities that may be affected by the Activity. Santos understands that in the unlikely event of a hydrocarbon spill, communication about such matters is to occur at a State-to-State level.

Under the National Plan for maritime environmental emergencies (AMSA, 2020), Australia has entered into mutual aid arrangements and associated cooperation agreements with other countries impacted by maritime environmental emergencies. In this regard, Australia has entered into a bilateral agreement with Indonesia, and a Maritime Boundaries Treaty with Timor-Leste. Any relevant affected government authorities of Indonesia or Timor-Leste would be identified and notified through the domestic arrangements of that State at government-to-government level.

4.5.2.2 Further detail regarding Santos' approach to identifying First Nations Relevant Persons

While Santos' approach to identifying First Nations Relevant Persons is outlined above, further detail is provided below.

As with Santos' process for identifying Relevant Persons generally, Santos' process for identifying First Nations Relevant Persons was an iterative process, with multiple avenues of enquiry.

Santos' process involved identifying First Nations groups, clans and/or organisations along the NT/WA coastline in the vicinity of the EMBA and asking itself the following questions in order to positively identify First Nations Relevant Persons:

1. Do any First Nations groups, clans and/or organisations along the NT/WA coastline in the vicinity of the EMBA have any native title claims pending or determined (or any Indigenous Land Use Agreements) that extend offshore and cross into the EMBA?
2. Do any First Nations groups, clans and/or organisations along the NT/WA coastline in the vicinity of the EMBA have any responsibilities for sacred sites that extend offshore and cross into the EMBA (recognised and protected under the ALR Act, the NTASS Act, the ATSIHP Act, the UCH Act, or the EPBC Act).
3. Do any First Nations groups, clans and/or organisations along the NT/WA coastline in the vicinity of the EMBA have any land rights (apart from native title claims) pending or determined that extend offshore and cross into the EMBA?
4. Are there any Indigenous Protected Areas (IPAs) that extend offshore and cross into the EMBA?

If the answer to any of the above questions was Yes, this would have resulted in identification of the particular First Nations group, clan or organisation as a Relevant Person. However, in all cases, the answer to all four questions was No.

Santos recognises that not all relevant functions, interests or activities of First Nations persons or groups will be identified through the four steps above. To supplement the above process, Santos looked to the outcome of its other First Nations Relevant Persons identification steps (see Table 4-5) to further inform its identification of First Nations people or groups with reasonably ascertainable functions, interests or activities that may be affected by the activities to be carried out under this EP.

Santos' process for identifying Relevant Persons also involved including in its consultation materials an invitation for Relevant Persons (including the NLC and KLC) to notify Santos of other potential Relevant Persons for Santos to consider consulting about this EP. Santos was not directed to other First Nations groups or organisations in response to this invitation.

As outlined above, Santos' process further included a large-scale, targeted media and advertising campaign to promote wide awareness of the Activity and to seek to identify potential Relevant Persons. The media and advertising campaign had a strong regional focus, noting the remoteness of First Nations and other communities in Northern Australia, with social media and radio advertising seen as useful tools to raise awareness in First Nations communities about the proposed Activity and associated consultation opportunities.

As a result of all of Santos' collective enquiries Santos identified the First Nations persons and organisations listed in Table 4-12. Identification of the Tiwi Islands Clans was prompted by consideration of content in the Tipakalippa judgments, including:

- The conclusions of the Full Court of the Federal Court that:
  - Mr Tipakalippa and the Munupi clan had interests within the meaning of regulation 11A(1)(d) of the OPGGS(E)R;
  - "interests" within the regulatory framework includes cultural and spiritual interests of the kind described in the sea country material in Revision 3 of the Barossa Drilling EP;
- Evidence given in the proceedings that members of the Munupi clan, as well as other individuals of the Tiwi Island, have sea country in the Timor Sea and to the north of the Tiwi Islands that extends to and beyond the operational area.

Santos' process also resulted in identification of the Croker Island clan members as potentially relevant persons in consideration of the following:

- there had been self-identification for the Barossa Drilling EP of Croker Island clan members and claims of sea country interests that cross into the EMBA;
- Croker Island is reasonably proximate to the boundary of the EMBA

- there is mention of the Croker Island clans in the North Marine Parks Network Management Plan 2018 indicating that the Croker Island clans have sea country interests in the Arafura Marine Park and part of the Arafura Marine Park is within the EMBA.

Santos, therefore, undertook to further explore whether the Croker Island Clans have reasonably ascertainable functions interests or activities that may be affected by the activities proposed under this EP.

While the North Marine Parks Network Management Plan 2018 indicated that the Croker Island clans have sea country interests in the Arafura Marine Park, this may be (although it is not clear) isolated to, or in close proximity to, where the Arafura Marine Park intersects the Croker Island Native Title Determination (DCD1998/001), which is outside the EMBA for the Activity (refer to Figure 4-1). The North Marine Parks Network Management Plan 2018 states that Yuwurrumu members of the Mandilarri-Ildugij, the Mangalara, the Murran, the Gadura-Minaga and the Ngaynjaharr clans (being the registered native title holders under the Croker Island Native Title Determination) have responsibilities for sea country in the Arafura Marine Park, and that these clans have native title determined over part of their sea country.

The Marine Park Management Plan implies, although without reference or evidence, that the Croker Island clans' sea country extends beyond the intersection of the Arafura Marine Park and the Croker Island Native Title Determination. No information is provided in the North Marine Parks Network Management Plan 2018 as to how far outside the Determination those interests extend and where in the Arafura Marine Park those interests might be located. As such, and noting that the EMBA for this activity only partially intersects with the Arafura Marine Park, Santos does not have clear evidence from the North Marine Parks Network Management Plan 2018 that the sea country interests within the Arafura Marine Park are located within the EMBA.

Santos subsequently engaged with representatives of the Croker Island clans via the Mulurryud Consultative Committee (refer to Section 4.6.6). Santos' process did not uncover any other First Nations persons or organisations with reasonably ascertainable functions, interests or activities that may be affected by the activities to be carried out under this EP.

4.5.3 Relevant Persons

The list of Relevant Persons identified through application of the above steps for the purposes of regulation 11A(1) is contained in Table 4-12.

Table 4-12: Relevant Persons

Relevant Person Category	Actions to identify Relevant Persons
Regulation 11A(1)(a) Departments or agencies of the Commonwealth to which the activities to be carried out under the environment plan may be relevant	
Australian Communications and Media Authority (ACMA)	ACMA is responsible for the regulation of communications and media services in Australia. ACMA is a relevant agency because the Activity has the potential to impact future proposed subsea communications cable installations. Whilst there is no impact or risk from the Activity currently anticipated in respect of current subsea communication cables already in situ, there is potential for other/additional future proposed subsea communication cables installation within or proximate to the OA which may be affected by the Activity.
Australian Fisheries Management Authority (AFMA)	AFMA is responsible for managing Commonwealth fisheries and is a relevant agency because the Activity has the potential to impact on fisheries resources in AFMA managed fisheries. Commonwealth fisheries were mapped against the EMBA and incorporated into consultation activity where appropriate.
Australian Hydrographic Office (AHO)	AHO is part of the Department of Defence and is the entity responsible for the provision of hydrographic services to Australia, under the Safety of Life at Sea (SOLAS) Convention and the *Navigation Act 2012* (Cth). This includes the publication and distribution of nautical products and other information required for the safety of ships navigating in Australian waters. AHO is a relevant agency for consultation because the Activity requires nautical products or other maritime safety information to be updated.
Australian Maritime Safety Authority (AMSA)	AMSA is a statutory authority and its principal functions are to: • promote maritime safety and protection of the marine environment. • prevent and combat ship-sourced pollution in the marine environment. • provide infrastructure to support safe navigation in Australian waters. • provide a national search and rescue service to the maritime and aviation sectors. AMSA is a relevant agency for consultation because the Activity may impact on the safe navigation of commercial shipping in Australian waters.
Department of Agriculture, Forestry and Fisheries (DAFF) • Biosecurity (marine pests, vessels, aircraft and personnel) • Fisheries	DAFF administers the *Biosecurity Act 2015* (Cth) (Biosecurity Act). The Biosecurity Act has jurisdiction within Australian territory and does not encompass the full extent of the Commonwealth marine area. DAFF is a relevant agency for consultation because the 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. • the movement of goods or personnel to or from offshore petroleum activities. • an aircraft or vessel seeking permission to return to a non-first point of entry after exposure to offshore petroleum activities. DAFF also has primary policy responsibility for promoting the biological, economic and social sustainability of Australian fisheries. DAFF is a relevant agency for consultation because the Activity has the potential to impact on fishing operations and/or fishing habitats in Commonwealth waters by: • disrupting existing fishing activities. • causing declines in valuable fisheries resources in the area. • damaging habitat or marine eco-systems on which valuable fisheries resources depend.
Department of Climate Change, Energy, the Environment and Water (DCCEEW) – Parks Australia (Parks Australia)	Parks Australia is the statutory authority responsible for administration, management and control of AMPs. It is a relevant agency for consultation because activities proposed to occur outside a reserve may impact on the values within an AMP. An environmental incident which occurs in Commonwealth waters surrounding an AMP due to an Activity under this EP may impact on the values within an AMP.
Department of Defence (DoD)	DoD utilises several maritime exercise areas in Australian waters to perform a unique role in support of Australia's strategic and national security interests. DoD is a relevant agency for consultation because: • the proposed Activity may impact DoD training and operational requirements, in that the EMBA overlaps DoD training areas. • the proposed Activity encroaches on known training areas and/or restricted airspace. • there is a risk of unexploded ordnance in the area where the Activity is taking place.
Department of Foreign Affairs and Trade (DFAT)	DFAT promotes and protects Australia's interests internationally and contributes to global stability and economic growth. The modelled EMBA for this EP extends beyond Australia's territory. DFAT is a relevant agency for consultation as the proposed Activity poses a hydrocarbon spill risk that could result in impacts extending to other international jurisdictions, and where persons or organisations in international jurisdictions may be affected by the proposed Activity, including foreign individuals or governments, vessels, international fishers and/or international marine parks.
Department of Home Affairs and Australian Border Force (ABF)	The Department of Home Affairs is an Australian Government department responsible for overseeing migration, national security and resilience, and border-related functions. ABF is an operationally independent body within the Home Affairs portfolio. ABF is Australia's border law enforcement agency and customs service. ABF's vessels undertake patrols as part of its surveillance and response activities throughout an offshore maritime area of almost 45.1 million km^2. This area includes the EMBA.

Relevant Person Category	Actions to identify Relevant Persons
Department of Industry, Science and Resources (DISR)	DISR is a relevant agency for consultation because its responsibilities include offshore oil and gas development and safety.
National Indigenous Australians Agency (NIAA)	NIAA is an Australian Government agency responsible for whole-of-government coordination of policy development, program design and service delivery for Indigenous Australians.
Regulation 11A(1)(b) of the OPGGS(E)R: Departments or agencies of the Northern Territory to which the activities to be carried out under the environment plan may be relevant. Regulation 11A(1)(c) of the OPGGS(E)R: Department of the responsible Northern Territory Minister.	
Department of Industry, Tourism and Trade (NT) (DITT-NT) – Energy Division	DITT-NT is the department of the responsible Territory Minister and is required to be consulted under subregulation 11A(1)(c) of the OPGGS(E)R.
DITT-NT – Fisheries Division	DITT-NT – Fisheries has functions in relation to NT-managed fisheries. The OA overlaps the Timor Reef Fishery which is jointly managed by the NT and Commonwealth governments.
Department of Infrastructure, Planning and Logistics (NT) (DIPL-NT) – Transport Division	DIPL-NT is responsible for marine safety in NT coastal waters. The OA is located within Commonwealth Waters and the EMBA intersects NT waters.
Department of Territory Families, Housing and Communities (NT) – Heritage branch	The Department of Territory Families, Housing and Communities' Heritage branch has a role in protecting the maritime heritage of the NT.
Tourism NT	Government statutory authority responsible for promoting tourism in the NT, including potential activity by NT-based operators in the EMBA.
Regulation 11A(1)(b) of the OPGGS(E)R: Departments or agencies of Western Australia to which the activities to be carried out under the environment plan may be relevant. Regulation 11A(1)(c) of the OPGGS(E)R: Department of the responsible Western Australian Minister.	
Department of Biodiversity, Conservation and Attractions (DBCA-WA)	DBCA-WA has functions in relation to the protection of WA flora and fauna, including in relation to sensitive receptors within WA waters and works in tandem with DPIRD to promote biodiversity and conservation with an interest in sustainable management of species and ecosystems. Noting that the EMBA does not overlap any sensitive receptors.
Department of Primary Industries and Regional Development (DPIRD-WA) – Fisheries	DPIRD-WA has functions in relation to WA-managed commercial fisheries which extend beyond WA Waters and into Commonwealth Waters of the EMBA. Its interests in primary industries include commercial fisheries and aquaculture. As such, biosecurity is also an area of interest.
Regulation 11A(1)(d) Persons or organisations whose functions, interests or activities may be affected by the activities to be carried out under the environment plan	
Academic and Research Organisations	
Australian Institute of Marine Science (AIMS)	According to its website, AIMS[10] is a government agency established under the *Australian Institute of Marine Science Act 1972* (Cth), which conducts research that supports the sustainable use and protection of oceans. AIMS' focus is on tropical marine research across the top end of Australia from Ningaloo across to the Great Barrier Reef and undertakes research activities in areas within the EMBA. AIMS conducts monitoring activities in key areas for marine environmental research within the EMBA.
Australian Marine Sciences Association – NT (AMSA-NT)	AMSA-NT's website states that AMSA is Australia's peak professional body for marine scientists, with a branch in the NT. Its listed interests and stated activities include promoting all aspects of marine science in the NT and making formal comment on NT marine development assessments and NT Government policies, strategies and plans, and nominations of rare and threatened marine species and habitats in the NT (potentially including within the EMBA).
AusTurtle Inc	According to its website, AusTurtle Inc. is a non-profit organisation that promotes sea turtle conservation and research in northern Australia. AusTurtle self-nominated as a Relevant Person for consultation on the SURF EP.
WorldFish Timor-Leste	According to its website[11]: • WorldFish is a research organisation focusing on sustainable aquatic food systems in Timor-Leste, potentially including within the EMBA • It has an interest in resilient and sustainable aquaculture projects and small-scale fisheries production, promoting community-based resource management of coastal fisheries to strengthen livelihoods and combat poverty and malnutrition • It works in a partnership model with NGOs and governments.
Commercial fishing	
Licence holders in the following Commonwealth-managed fisheries:	The proposed Activity has the potential to affect a number of Commonwealth-managed fisheries. Licence holders are entitled to fish within the EMBA. The North-West Slope Trawl Fishery intercepts the EMBA but does not overlap the OA. There has been little activity in the Western Skipjack Tuna fishery since 2008. The Western Tuna and Billfish Fishery are not known to be active in the vicinity or surrounds of the Barossa Gas Field. The fishing efforts in the Northern Prawn Fishery are distant from the Barossa Gas Field. The Southern Bluefin Tuna Fishery is focused in southern waters.

[10] www.aims.gov.au/about-aims

[11] https://worldfishcenter.org/where-we-work/pacific/timor-leste

Relevant Person Category	Actions to identify Relevant Persons
• Northern Prawn Fishery • Southern Bluefin Tuna Fishery • Western Skipjack Tuna Fishery • Western Tuna and Billfish Fishery • North-West Slope Trawl Fishery	
Licence holders in the following NT-managed fisheries: • Aquarium Fishery • Spanish Mackerel Fishery • Timor Reef Fishery • Offshore Net and Line Fishery • Pearl Oyster Fishery • Demersal Fishery • Coastal Line Fishery	The proposed Activity has the potential to affect a number of NT-managed fisheries. The EMBA intersects with some areas within which licence-holders in all the named fisheries can operate, however the fishing effort within the EMBA is limited. Some fishing effort in the Timor Reef Fishery occurs across the Barossa Field and surrounds but no effort is expected in Aquarium Fishery, Demersal Fishery and Spanish Mackerel Fishery due to the water depths. Fishing efforts in the Pearl Oyster Fishery, Coastal Line Fishery and Offshore Net and Line Fishery are concentrated in coastal areas.
Licence holders in the following WA-managed fisheries: • Mackerel Managed Fishery • Northern Demersal Scalefish Managed Fishery • South-West Costal Salmon Fishery • Kimberley Crab Fishery • Kimberley Prawn Fishery • Marine Aquarium Fishery • Specimen Shell Fishery • West Coast Deep Sea Crustacean Fishery	The proposed Activity has the potential to affect a number of WA-managed fisheries. The EMBA intersects with some areas within which licence-holders in all the named fisheries can operate, however the fishing effort within the EMBA is limited. The boundaries of these fisheries do not overlap the OA. One other fishery, the Abalone Fishery, has been closed since 2012.
Energy Industry	
Australian Marine Oil Spill Centre (AMOSC)	AMOSC operates the Australian oil industry's major oil spill response facility.
Operators: • Eni Australia Ltd • INPEX Ichthys Pty Ltd • Woodside Energy Ltd • Bengal Energy Ltd • Finder No. 1 Pty Ltd • Jadestone Pty Ltd • Melbana Energy Pty Ltd • PTTEP Australia • Shell Development (Australia) Pty Ltd • Timor Sea Oil & Gas Australia Pty Ltd • Vulcan Exploration Pty Ltd	Operators with permits outside the OA and within EMBA.
Environmental organisations	
ATSEA-2 Project	According to its website[12]:

[12] https://atsea-program.com/about-atsea/

Relevant Person Category	Actions to identify Relevant Persons
	• ATSEA-2 is the second phase of the Arafura and Timor Seas Ecosystem Action (ATSEA) Program. • Its area of interest includes areas within the EMBA (including where the Arafura and Timor Seas intersect the EMBA). • ATSEA-2 is a Global Environment Facility-funded programme, managed and executed under the United Nations Development Programme. • It has a Regional Steering Committee made up of representatives from national government and lead agencies in Australia, Indonesia, Papua New Guinea and Timor-Leste. • The ATSEA-2 Project outcome objectives include up to 25% of over-exploited fisheries in the Arafura and Timor Seas region returned to a more sustainable level, support establishment of new Marine Protected Areas (MPAs) and strengthen MPA management effectiveness and a regional MPA network and action plan for the enhanced protection of marine turtles.
Australian Marine Conservation Society – NT (AMCS-NT)	According to its website[13]: • AMCS-NT is a grassroots independent environmental conservation organisation and charity that works to protect ocean wildlife along the NT coastline, waters and seas. • Its members work to protect marine animals and critical ocean ecosystems. • It advocates for evidence-based solutions to conservation activity and works closely with marine research centres. • Its interests for the purposes of this EP relate to marine parks and sanctuary zones within the EMBA for threatened and at-risk species.
Conservation Council of WA (CCWA)	According to its website and correspondence dated 12 April 2023, CCWA[14] promotes an interest in the protection and restoration of the WA natural environment, including waters, a marine park and marine life potentially within the EMBA.
Environment Centre Northern Territory (ECNT)	According to its website, ECNT[15] is a not-for-profit incorporated association whose objects include protection of all aspects of the natural environment, conducting campaigns to protect the natural environment, environmental research, and public education and information about the natural environment. ECNT is involved in the “Stop Barossa Gas” campaign.
Greenpeace	According to its website, Greenpeace’s stated goals include the protection of ocean biodiversity and marine life, including campaigning for protection of whales[16] (fauna identified in this EP as potentially affected by the Activity impacts or risks) and sea turtles[17] (also fauna identified in this EP as potentially affected by the Activity impacts or risks).
Keep Top End Coasts Healthy	According to its website, Keep Top End Coasts Healthy[18] is an alliance of environment groups including the AMCS and the ECNT. In information provided by Keep Top End Coasts Healthy to Santos via Santos’ website portal during consultation for the Drilling EP, Keep Top End Coasts Healthy claims to work with stakeholders with respect to coastal preservation and establishment of marine protected areas, potentially including within the EMBA. Further, two members of the alliance, AMCS and ECNT, are included as Relevant Persons in this EP.
Sea Turtle Foundation	According to its website, the Sea Turtle Foundation[19] is a non-profit, non-government group based in Australia with a stated interest in protecting sea turtles through research, education and action, including specifically the olive ridley turtle, leatherback turtle, loggerhead turtle and flatback turtle, being turtle species cited in this EP as being potentially affected by the impacts or risks of the Activity.
West Timor Care Foundation	According to correspondence sent in respect of the Drilling EP, West Timor Care Foundation claims to be an advocacy organisation concerned with the interests and welfare of people who depend on the coast of Timor for their livelihoods and who have been, or may be, impacted by oil spills from petroleum activities in the Timor Sea, including areas within the EMBA. Santos has been unable to locate a website for West Timor Care Foundation.
World Wildlife Fund (WWF)	According to its website, WWF[20] works to sustain the natural world for the benefit of people and wildlife, collaborating with partners from local to global levels in nearly 100 countries. Its claimed advocacy role extends to the impact of a spill on threatened and protected marine species, including turtles and dugongs (being species occurring within the EMBA and identified in this EP as fauna that may potentially be affected by the impacts or risks of the Activity).
First Nations Peoples	
Kimberley Land Council (KLC)	KLC is the Native Title Representative Body for the Kimberley region in Western Australia. Its primary role is to provide native title services to Kimberley Aboriginal people. KLC’s area of interest includes sea country where non-exclusive native title rights and interests may exist, including within the EMBA.

[13] https://www.marineconservation.org.au/northern-territory-marine-parks/

[14] https://www.ccwa.org.au/about_us

[15] https://www.ecnt.org.au/campaigns

[16] https://www.greenpeace.org.au/what-we-do/protecting-oceans/whales/

[17] https://www.greenpeace.org/international/story/28229/turtle-journey-urgent-protect-the-oceans/; https://www.greenpeace.org/international/publication/28181/turtles-under-threat/

[18] https://www.topendcoasts.org.au/

[19] https://seaturtlefoundation.org/about

[20] https://wwf.org.au/about-us/frequently-asked-questions/

Relevant Person Category	Actions to identify Relevant Persons
Northern Land Council (NLC)	NLC is the Native Title Representative Body for the Northern Region, including sea country. Its functions are prescribed under the NT Act. NLC also has statutory obligations under the ALR Act and is authorised to perform certain functions under the NT Act. NLC's area of interest includes sea country where non-exclusive native title rights and interests may exist, including within the EMBA.
Tiwi Land Council (TLC)	The TLC is governed under the ALR Act and has functions under that Act in relation to coastal waters around the Tiwi Islands, including within the EMBA. The Tiwi Aboriginal Land Trust was also established under the ALR Act and the TLC is the only body with authority to direct the Trust. The authority of the TLC does not extend into Commonwealth offshore waters, although the sea country interests of Tiwi Island clans do, including within the EMBA.
Tiwi Islands Clan Groups and Individuals	The Appeal Judgment found, in respect of the Drilling EP, that "Mr Tipakalippa and the Munupi clan had interests within the meaning of regulation 11A(1)(d) that required them to be consulted"[21]. Mr Tipakalippa had claimed that he and the Munupi clan, as well as other Tiwi Island people, have "sea country" in the Timor Sea to the north of the Tiwi Islands, extending to and beyond the Operational Area for the Drilling EP (which overlaps the OA for this EP).[22] The Tiwi Islands are located approximately 80 km north of Darwin in the Arafura Sea. There are three major communities on the Tiwi Islands. The largest community is Wurrumiyanga (on Bathurst Island), with smaller communities of Milikapiti and Pirlangimpi located on Melville Island. There are eight landowning groups (clans) on the islands, Mantiyupwi, Munupi, Yimpinari, Malawu, Wulirankuwu, Wurankuwu, Mirrikawuyanga and Jikilaruwu (or Tikalaru). Santos was expressly requested to consult by clan groups, as set out in Section 4.6.5.
Infrastructure Operators	
Darwin Port	Private consortium responsible for the management of shipping and other commercial activities requiring use of Darwin Harbour. Santos-contracted vessels plan to use Darwin Harbour.
NT Ports and Marine	Private consortium that owns and operates the commercial port at Port Melville on the Tiwi Islands.
Industry Associations	
Amateur Fishermen's Association of the Northern Territory (AFANT)	AFANT is the peak body representing NT recreational fishers whose interests may intersect the EMBA.
Association of Marine Tourism Timor-Leste (AMT-TL)	A registered, national industry body that represents the marine tourism sector in Timor-Leste. It represents a wide range of actors in the marine tourism sector, whose interests may intersect the EMBA.
Australian Southern Bluefin Tuna Industry Association (ASBTIA)	ASBTIA is listed by AFMA as a contact for petroleum operators to use when consultation with Commonwealth fishing operators is required with fishing operators in a number of Commonwealth-managed tuna fisheries, including within the EMBA.
Commonwealth Fisheries Association (CFA)	CFA is listed by AFMA as a contact for petroleum operators to use when consultation is required with fishing operators for a number of Commonwealth-managed fisheries, including within the EMBA.
Northern Prawn Fishery Industry (NPFI)	NPFI is listed by AFMA as a contact for petroleum operators to use when consultation is required with fishing operators in the Northern Prawn Fishery whose interests may intersect the EMBA.
Northern Territory Guided Fishing Industry Association (NTGFIA)	NTGFIA is the peak body responsible for promoting, developing, and maintaining the guided fishing industry in the NT. It represents professional fishing guides and operators. Interests may intersect the EMBA.
Northern Territory Seafood Council (NTSC)	NTSC is the peak representative body for the wild catch, aquaculture and trader/processor seafood sectors in the NT. Interest may intersect the EMBA.
Pearl Producers Association (PPA)	The PPA is the peak representative organisation of the Australian South Sea Pearling Industry. Membership covers all of the Pinctada maxima pearl oyster licensees issued under the legislation that governs the North-west Bioregion.
Tourism Top End	Tourism Top End is the Regional Tourism Association, a non-profit entity serving businesses, individuals and organisations involved in tourism activities in the NT. Interests may intersect the EMBA.
Western Australian Fishing Industry Council (WAFIC)	WAFIC is the peak industry body representing professional fishing, pearling and aquaculture enterprises, processors and exporters in WA. Interests may intersect the EMBA.
Local Government Authorities	
Nil	Nil
Marine and Coastal Tourism Operators	

[21] *Santos NA Barossa Pty Ltd v Tipakalippa* [2022] FCAFC 193 [80]

[22] *Santos NA Barossa Pty Ltd v Tipakalippa* [2022] FCAFC 193 [3], [5].

Relevant Person Category	Actions to identify Relevant Persons
Arafura Bluewater Charters	Arafura Bluewater Charters[23] is a Darwin-based reef and game fishing charter tourism operator (fishing charter) operating out of Cullen Bay in Darwin. According to information available on its website, it operates in locations that may be within, or transit, the EMBA.
Bathurst Island Lodge/Tiwi Island Retreat	The Bathurst Island Lodge/Tiwi Island Retreat[24] is situated at Munanampi Point on the south-western coast of Bathurst Island, the smaller of the two major islands which make up the Tiwi Islands. According to its website, there are a variety of activities offered by the Lodge including private fishing charters in locations that may be within or transit the EMBA.
Clearwater Island Lodge/Tiwi Adventures	Clearwater Island Lodge/Tiwi Adventures[25] is a tourism operator located on Melville Island on the outskirts of Pirlangimpi (Tiwi Islands). From information available on its website, the Lodge offers a variety of fishing charters in areas around the Tiwi Islands including in locations that may be within or transit the EMBA.
Dreamers Dive Academy (Timor)	According to its website, the Dreamers Dive Academy[26] is a tourism and diver training business operating from a base near Dili on the north shore of Timor-Leste. Diving activity is undertaken around Atauro Island in locations that may be within or transit the EMBA.
Regulation 11A(1)(e) People or organisations who Santos had previously recognised as relevant under this category.	
Croker Island Clans	Croker Island is located in the Arafura Sea off the coast of the Northern Territory. The shortest distance from the northern tip of Croker Island to the Operational Area for the drilling and completion activities is approximately 252 km. Croker Island clans have sea country interests in the Arafura Marine Park. Their sea country interests have been determined to exist in the area marked by their communally held Native Title, which does not extend into the EMBA. It is also well outside the OA where planned activities will occur. (Refer to Section 4.6.6).

[23] https://www.arafurablue.com.au/

[24] https://tiwiislandretreat.com.au/NIAA

[25] https://www.clearwaterislandlodge.com.au/

[26] https://timordiveacademy.com/

4.6 Consultation activities

A summary report of consultation activities, addressing the requirements of regulation 16(b)(i)-(iii), is at Table 4-14. This report relates to consultation with all Relevant Persons for the Activity of this EP.

4.6.1 Consultation design

Santos designed and implemented its consultation process, acknowledging that the consultation process may need to be adapted to the nature of the person or organisation to be consulted.

To assist in designing an appropriate consultation process, Santos sought feedback about consultation methods and information needs in its correspondence and via a portal and form available on its website. Santos also sought information as to functions, interests or activities that may be affected by the Activity.

Santos offered and provided information in different formats and via a range of different mediums both at the request of Relevant Persons and of its own volition, having regard to the nature of particular Relevant Persons and their potentially affected functions, interests or activities.

Section 4.6.2 outlines Santos' provision of sufficient information. Preferences expressed by Relevant Persons regarding design of the consultation process were considered and accommodated by Santos, where reasonably practicable and appropriate.

Santos tailored its consultation for the commercial fishing industry by producing and providing a fishers-specific fact sheet for the purposes of consultation.

Santos also adopted a tailored approach to consultation with Tiwi Islands clans and individuals, in respect of consultation session structure and format, and consultation materials, based on their specific requests and feedback. Further detail is set out in Section 4.6.5.

4.6.2 Provision of sufficient information

Santos is required to give Relevant Persons sufficient information so they can make an informed assessment about the possible consequences of the Activity on their functions, interests or activities. Santos provided Relevant Persons with information regarding:

- the Activity proposed under this EP
- the environment that may be affected by the Activity, including depictions of the modelled EMBA and explaining how the EMBA is determined
- the potential environmental impacts and risks of the Activity and proposed control measures
- the environmental approval process
- the purpose of consultation, who may be a Relevant Person and how to self-nominate as a potential Relevant Person
- the titleholder's obligations during consultation in the course of preparing an environment plan, including the obligation of the titleholder not to publish particular information if so requested by the Relevant Person
- how to provide feedback.

At a minimum, this information was available on the Santos website (see Table 4-6) and also included in the Information Booklet, which Santos sent to Relevant Persons by email or letter or made available during consultation sessions.

Relevant Persons were provided access to information using different mediums and platforms, including by telephone, email, website (**https://www.santos.com/barossa/**), hard copy and electronic materials, social media, in person and virtual meetings.

Santos also developed targeted consultation material appropriate to Relevant Persons, including visual aids and videos for First Nations groups and specific fact sheets for the Commonwealth and NT commercial fishing industry and for Tiwi people (discussed above).

Examples of the consultation materials used are included in Appendix E and included the following:

- Information booklet
- Consultation fact sheets:
    - The Barossa Gas Project Subsea Infrastructure Installation Environment Plan (SURF EP) Consultation Fact Sheet (general)
    - The Barossa Gas Project Subsea Infrastructure Installation Environment Plan (SURF EP) Consultation Factsheet (targeting consultation with Tiwi People)
    - Commercial Fishing Industry Consultation Factsheet – The Barossa Gas Project Subsea Infrastructure Installation Environment Plan (targeting consultation with Relevant Persons in Commonwealth and NT-managed commercial fisheries)
- A FAQ document, responding to queries and feedback during consultation with Tiwi People provided as part of the consultation process (published on Santos' website and updated): **https://www.santos.com/wp-content/uploads/2023/06/Barossa-Gas-Project-FAQs.pdf**
- For particular Relevant Persons or particular groups of Relevant Persons, videos, animations and maps to convey technical information to different audiences in a clear and accessible way.

Santos also disseminated and promoted the NOPSEMA community information brochure, *Consultation on offshore petroleum environment plans*. This brochure contains information for community members to better understand the responsibilities of titleholders to consult Relevant Persons in the development of environment plans, the purpose of consultation and how Relevant Persons can provide feedback.

Santos considered and responded to further information requests as and where appropriate, including as captured in Table 4-14. Where requests for translated materials were made, these were considered on a case-by-case basis, including having regard to matter such as the timing of the request relative to the date such requests were invited and also the pre-notified consultation end-date. Santos also had regard to the extent to which the person or organisation's functions, interests and activities may be affected by the Activity.

For example, Santos responded to translation requests made, with reasonable notice, by Tiwi Islands clans by providing interpretation services at Tiwi Islands consultation sessions (see Section 4.6.5). In the case of requests made by international Relevant Persons for translated materials, Santos considered the reasonableness of requests for translated materials made after the communicated deadline for consultation preferences and/or only shortly before the previously notified consultation closure date. Santos also considered the very low likelihood of functions, interests and activities of international Relevant Persons being affected by an unplanned event from the Activity, and the extent to which impact reduction measures applied through OPEP implementation further reduce the likelihood of impact to functions, interests and activities of international Relevant Persons. Where Santos advised Relevant Persons about online translation services, such as Google translate, this was provided as a courtesy and for information only.

Santos also circulated to subscribers and published on its website a Barossa Quarterly Update in July 2023 during the consultation period for this EP.

4.6.3 Reasonable period for consultation

Santos is required to allow a Relevant Person a reasonable period for consultation.

Santos directly contacted Relevant Persons notifying them of the consultation process and consultation period. Emails or letters were sent to Relevant Persons to invite feedback for the EP, confirming the date by which feedback was sought and outlining how feedback may be provided.

For the vast majority of Relevant Persons Santos initially provided a minimum of 40 days from the date of initial consultation information being provided to review and respond with feedback about the proposed activities. Following this, Santos extended the feedback period, such that most Relevant Persons were given a total of 60 days or more to respond, from the date of Santos providing consultation materials In cases where Relevant Persons did not receive this this amount of time, this was due to there being other agreed arrangements or there being indications that no feedback was proposed to be given for this EP.

Santos' consultation approach also included a 30-day public awareness campaign, commencing from 20 April 2023 (see Phase 1 in Table 4-8), to seek out Relevant Persons and to raise public awareness of the Barossa Gas Project generally.

This was followed by a comprehensive 60-day public awareness campaign, which ran from 12 June to 4 August 2023, specifically seeking feedback from Relevant Persons for this EP. (see Phase 2 in Table 4-9).

4.6.4 Consultation opportunities

Santos offered multiple avenues and mediums for consultation, including:

- Provision of a toll free 1800 number
- Dedicated email address
- Community meetings and drop-in sessions
- In-person or virtual meetings, as appropriate.

Following initial correspondence, attempts were made (using different mediums) to follow up contact and a response if/where no response was received, e.g. by phone, email or letter, to confirm receipt of emails/letters and to prompt provision of a response. In most cases multiple follow-up attempts were made.

Santos also held advertised drop-in consultation sessions at the Darwin Convention Centre as well as pop-up stalls in the Darwin Mall and at Arts in the Grass (see Table 4-6 and Table 4-10).

4.6.5 Consultation with Tiwi Islands clans and individuals

Between 6 and 8 February 2023 (inclusive), Santos attended the Tiwi Islands and held community engagement sessions in Milikapiti, Pirlangimpi and Wurrumiyanga to provide project information and seek feedback from the clan members as to how they would like to be consulted. Santos received feedback during those sessions to the effect that consultation should occur by clan through clan group meetings, with approximately a month's notice of consultation sessions to allow time to consider information. Santos also received feedback about a preference for videos and visual aids to be used to communicate information about the proposed project activities. Santos also had representatives remain on the Tiwi Islands on 9 and 10 February 2023 to answer questions and receive feedback (including as to the consultation process).

As a result of specific requests and feedback expressed by Tiwi people as to the consultation process and consultation preferences, Santos implemented the following tailored consultation approach for Tiwi people:

- Consultation activities were conducted face-to-face in the form of clan meetings.
- Clan meetings were arranged for each clan at a location convenient for that clan (members of other clans attended with clan trustee consent).
- Clan meetings were scheduled with four weeks' prior written notice (see Table 4-13).
- Use of visual aids, videos and animations in presenting information (including information of a more technical nature) to improve accessibility and comprehension.
- Santos representatives and subject matter experts explained the Activity, risks and impacts during in person presentations, assisted by video content, and PowerPoint slides and responded to questions.
- For each consultation session, Santos developed short videos explaining the purpose of the session and key information relating to the consultation process, how feedback could be provided, privacy obligations and non-publication requests. Parts of these videos were recorded by a local Tiwi man in Tiwi language.
- After each consultation session, Santos representatives and subject matter experts were available to answer additional questions or provide further information to clan members and individuals. This offered people the opportunity to speak to Santos representatives or subject matter experts one-on-one or in a smaller group setting (based on feedback this was a more comfortable format for some people).
- A leading turtle expert attended the February and April/May sessions to provide information and answer questions about potential impacts on marine life, specifically turtles. The expert was available before and after these sessions for discussions with clan group members.
- An independent, qualified interpreter assisted Santos at the April/May (where available), June and August sessions to provide translation as required. Santos also used local interpreters where qualified interpreters were not available through the Aboriginal Interpreter Service (AIS). Santos' observation at clan group meetings was that many Tiwi people spoke and understood English and this was noted by members of the Tiwi Island community themselves.
- Written consultation materials tailored for Tiwi Islands clan groups and individuals were produced and distributed or made available at consultation sessions, including a fact sheet and maps.
- A FAQ document in response to questions posed by Tiwi Islands clan groups and individuals was prepared and distributed or made available and this was updated throughout the consultation process and published on Santos' website: **https://www.santos.com/wp-content/uploads/2023/06/Barossa-Gas-Project-FAQs.pdf**.
- Following the release of NOPSEMA's consultation on offshore petroleum environment plans brochure in May, Santos provided information about the brochure and distributed it at the June consultation sessions.
- On occasions Santos assisted in organising transport for clan members who were having difficulty attending the consultation sessions due to road closures.
- On occasions Santos rescheduled consultation sessions to accommodate 'sorry business' on the Islands.
- The ECNT attended a number of the consultation sessions.
- The Environmental Defenders Office (EDO) attended a number of the consultation sessions with their clients (Santos understands that they represent approximately 7 Tiwi people). During those consultation sessions, a number of the EDO's clients asked questions and provided feedback directly to Santos. The EDO and Santos have also corresponded in relation to the EDO's clients feedback.

- Consultation sessions for Tiwi people were notified and advertised as set out in Table 4-13. Consultation with the Tiwi Islands clan groups and individuals is summarised in more detail in Table 4-14.

Appendix F provides a chronology of consultation with Tiwi Islands clans.

Table 4-13: Notification and Advertising of Consultation Sessions

Date	Advertising type	Description	Reach
Tiwi community engagement sessions February 2023			
7 January 2023	Press ad – NT News	Half page, page 6	Target NT with reach of 25,000
7 January 2023 – 4 February 2023	Social media ad	Facebook, Instagram and Messenger	Geotargeted Tiwi Islands
21 January 2023	Press ad – NT News	Half page, page 6	Target NT with reach of 25,000
28 January 2023	Press ad – NT News	Half page, page 5	Target NT with reach of 25,000
Tiwi consultation sessions April/May 2023			
28 March 2023 – 5 May 2023	Social media ad	Facebook, Instagram and Messenger	Geotargeted Tiwi Islands
29 March 2023	Press ad – NT News	Full page, page 23	Target NT with reach of 25,000
1 April 2023	Press ad – NT News	Full page, page 12	Target NT with reach of 25,000
8 April 2023	Press ad – NT News	Full page, page 12	Target NT with reach of 25,000
15 April 2023	Press ad – NT News	Full page, page 15	Target NT with reach of 25,000
22 April 2023	Press ad – NT News	Full page, page 8	Target NT with reach of 25,000
Tiwi consultation sessions June 2023			
12 May 2023 – 16 June 2023	Social media ad	Facebook, Instagram and Messenger	Geotargeted Tiwi Islands
13 May 2023	Press ad – NT News	Full page, page 19	Target NT with reach of 25,000
20 May 2023	Press ad – NT News	Full page, page 11	Target NT with reach of 25,000
27 May 2023	Press ad – NT News	Full page, page 23	Target NT with reach of 25,000
Tiwi consultation sessions August 2023 (Rescheduled from July due to Sorry Business)			
22 June 2023	Press ad – NT News	Full page, page 53	Target NT with reach of 20,000
1 July 2023	Press ad – NT News	Full page, page 16	Target NT with reach of 25,000

Date	Advertising type	Description	Reach
8 July 2023	Press ad – NT News	Full page, page 10	2 Target NT with reach of 25,000
17 July 2023 – 8 August 2023	Social media ad	Facebook, Instagram and Messenger	Geotargeted Tiwi Islands
18 July 2023	Press ad – NT News	Full page, page 9	2 Target NT with reach of 25,000
22 July 2023	Press ad – NT News	Full page, page 17	2 Target NT with reach of 25,000
5 August 2023	Press ad – NT News	Full page, page 53	2 Target NT with reach of 25,000
7 August 2023	Press ad – NT News	Full page, page 32	2 Target NT with reach of 25,000

4.6.6 Consultation with Croker Island People

Santos notes in Appendix C that the North Marine Parks Network Management Plan 2018 states that the Croker Island clans have sea country interests in the Arafura Marine Park. Their sea country interests have been determined to exist in the area marked by their communally held Native Title which according to the North Marine Parks Network Management Plan 2018 has been determined over part of the Croker Island clans' sea country, which the area of determined Native Title surrounding Croker Island (DFD1998/001) does not extend into the EMBA. It is also well outside the OA where planned activities will occur. The shortest distance from the northern tip of Croker Island to the OA is approximately 260 km (Figure 4-1).

In *Yarmirr v Northern Territory and Others (No 2)* (1998) 82 FCR 533, the Court held that communal native title existed in relation to the sea and seabed within the claimed area (beyond the low water mark), which was upheld on appeal to the High Court. In reaching its decision on the extent of the sea country, the Court accepted the evidence of community use of the waters within the claimed area to catch fish, hunt for and catch turtle and dugong and collect oysters and crustacea, both for personal consumption and for use in relation to ceremonial activities.

The shortest distance from the northern tip of Seagull Island (part of the Tiwi Islands) to the OA is approximately 140 km, as depicted in Figure 4-1.

Santos advertised extensively from 20 April 2023 as set out in Table 4-8, calling for Relevant Persons whose functions, interests or activities may be affected, to contact it by 14 July 2023 (later extended to 4 August 2023). This included extensive advertising in the NT News, which is circulated on Croker Island. From 12 June 2023 – 4 August 2023, Santos' advertising campaign (seeking feedback about the EP) included 170 plays on the Top End Aboriginal Bush Broadcasting Association (TEABBA), which reaches 29 remote communities across top end of Australia, including Croker Island.

In addition, Santos met with the NLC on 13 January 2023 to advise that it would be consulting with Relevant Persons from February 2023. Santos has kept the NLC updated about First Nations consultation and engagement throughout 2023, most recently on 30 June and 17 August 2023.

Santos received correspondence from the EDO on behalf of Croker Island people regarding the Drilling EP (the EDO initially stated it acted for one traditional owner, and Santos understands the EDO currently acts for two individuals on Croker Island), which made statements about possible sea country interests that may be located in the Drilling EMBA.

On 28 June 2023, after having earlier made enquiries to visit Croker Island on 4 July 2023, Santos received an email from the EDO saying that it had been instructed and informed by members of the community that Santos was "not welcome nor permitted to visit" [Con-1590]. It was not clear on what

basis the EDO was purporting to act for all the members of the Croker Island community, and the EDO had not purported to act on behalf of any member of the Croker Island community in relation to this EP.

Santos met with the NLC on 30 June 2023 to discuss the appropriate process for travelling to Croker Island so that Santos could inform Croker Island people about the Barossa Gas Project.

On 7 July 2023, Santos obtained approval from the NLC for Santos to visit Croker Island on 13 July 2023 for the purpose of a "preliminary visit to the Croker Island to share some information on Santos and its business activities in northern waters and to gauge level of interest in further consultation sessions."

This purpose was intended to include engaging with Croker Island people, providing information about the Barossa Gas Project and the project activities, obtaining information as to whether or not their functions, interests or activities may be affected and planning for future consultation activities, including under the post-acceptance consultation implementation strategy for this EP.

Santos notes that, despite being authorised to visit Croker Island under the NLC permit system, on 7 July and twice on 11 July 2023, Santos received further email correspondence from the EDO saying that Santos was not welcome, invited nor permitted to visit Croker Island on 13 July 2023 [Con-1593 & Con-1597]. Again, it was not clear on what basis the EDO was purporting to act for members of the Croker Island community other than its client, and the EDO had not purported to act on behalf of any member of the Croker Island community in relation to this EP. No Croker Island people contacted Santos to express concerns about its proposed visit to the island despite Santos liaising with the local council about logistics for the visit.

Santos visited Croker Island on 13 July and held discussions with a range of Croker Island people.

Subsequent meetings were held in Darwin on 1 and 8 September 2023 with Croker Island clan members for the purpose of building relationships ahead of Regulation 11A consultation. Presentations at the Darwin-based meetings focused on providing an overall project overview, summaries of proposed drilling and subsea installation activities, discussions on activity impacts and risks, as well as providing regional context of historic petroleum industry activities in the region dating back to the drilling of exploration wells within proximity of Croker Island by other Operators from the 1970s.

The 8 September 2023 meeting was held at the Santos-operated Darwin LNG gas plant, at the request of attendees at the 1 September 2023 meeting. Handouts and maps were provided to attendees who were invited to share these materials with family and community members on Croker Island.

The Croker Island clan members in attendance on 1 and 8 September 2023 did not provide information regarding functions, interest or activities within the EMBA, and when considering this in the context of the information outlined above, Santos' view is that it is uncertain whether the Croker Island clans do have relevant functions, interests or activities within the EMBA. In light of this uncertainty, Santos has elected to treat the Croker Island clans as relevant under reg 11A(1)(e) instead of 11A(1)(d) of the OPGGS(E)R.

Santos coordinated these meetings with the advice and support of cultural advisers external to Santos, all of whom hold leadership positions within their own communities and formal representative bodies. The advisers played a key role in liaising with Croker Island Elders and cultural leaders to allow for a process of self-determination in establishing a consultative committee, known as the Mulurryud Consultative Committee.

Santos recognises the Mulurryud Consultative Committee as a representative forum for the purpose of 11A consultation. Santos has been provided a copy of the Committee's charter, which includes details the committee's purpose of enabling culturally appropriate consultation with the Croker Island

people through committee membership representing and comprising First Nations and custodians of Croker Island and surrounding sea country.

The Mulurryud Consultative Committee met with Santos on 15 September 2023 as part of Regulation 11A consultation [Con-2401]. Discussion was held on the overall project, proposed subsea infrastructure installation activities and regulatory requirements for consultation on activity impacts and risks.

Discussion was also held on the identification and management of potential impacts to cultural heritage. The committee considered that these matters should be discussed in an appropriate cultural forum.

No claims or objections were made about proposed activities at the 11A consultation meeting held on 15 September 2023.

The Committee met further on 26 September 2023 on Croker Island (without Santos attendees) and provided confirmation to Santos that consultation was complete for this EP.

Santos recognises the Mulurryud Consultative Committee as a representative forum for the purpose of Reg 11A consultation. Santos has been provided a copy of the Committee's charter, which includes details the committee's purpose of enabling culturally appropriate consultation with the First Nations peoples of Croker Island through committee membership representing and comprising First Nations and custodians of Croker Island and surrounding sea country.

More detail on Santos' approach to supporting the activities of the Mulurryud Consultative Committee is outlined in the EP implementation strategy in Section 8.11.

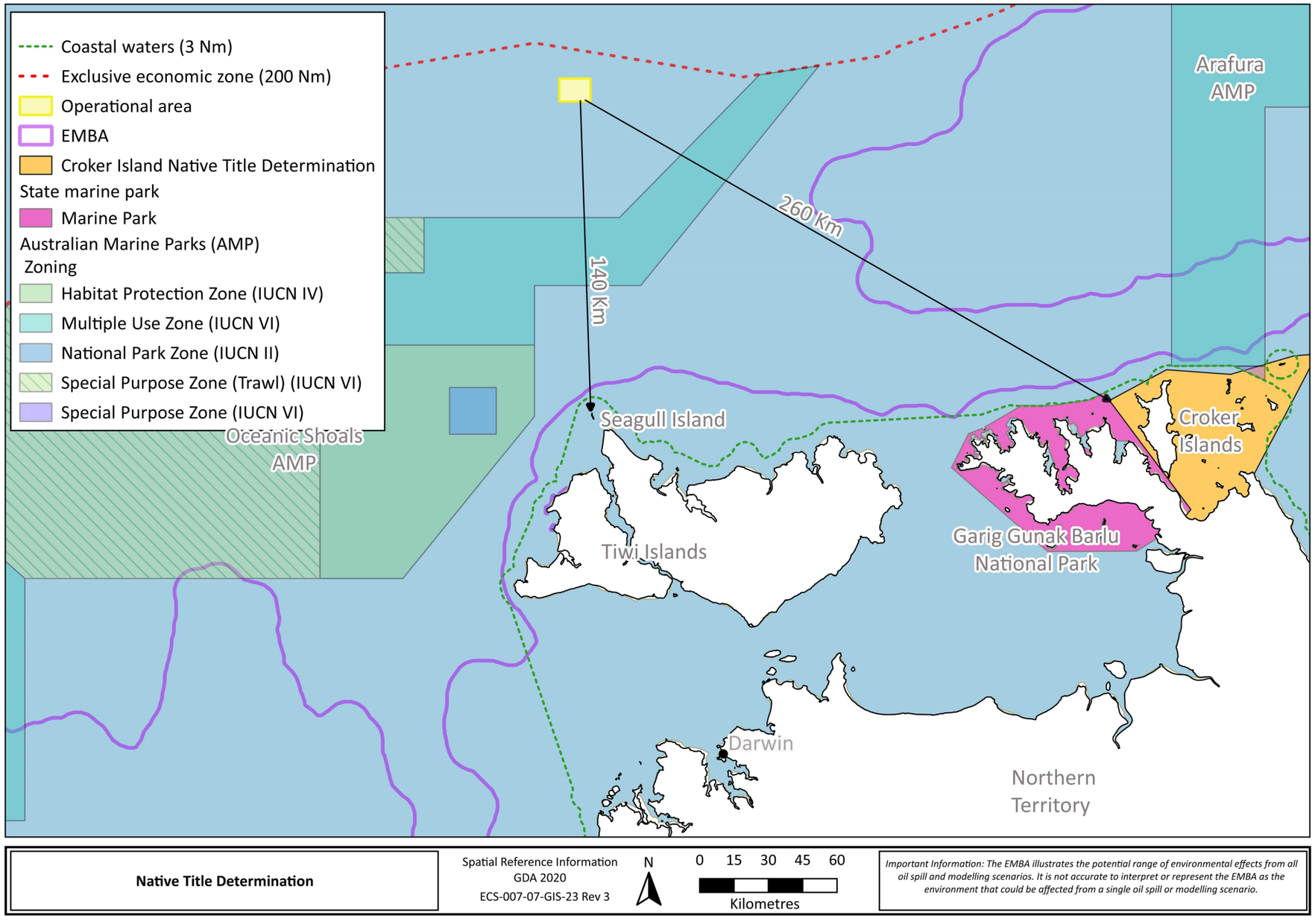


Figure 4-1: Proximity map for Croker Islands (Croker Island native title area) and Tiwi Islands to the OA and EMBA

4.7 Consultation report

Table 4-14: Summary of consultation activities

Australian Communications and Media Authority (ACMA)			
Summary of consultation effort: • On 2 June 2023 Santos emailed the Australian Communications and Media Authority (ACMA) to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how ACMA would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and a link to NOPSEMA's consultation Guideline: Consultation in the course of preparing an Environment Plan. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1606]** • On 5 June 2023 ACMA emailed Santos, reiterating the advice it had previously provided for consultation on Barossa Project EPs, i.e. that project activities may occur in the vicinity of a cable system owned and operated by Vocus and engagement should occur with that operator. **[Con-1616]** ACMA also advised the following: ○ Santos should engage with any operators of any submarine cables in the vicinity of Santos' activities and contact the Australia Hydrographic Office (AHO) for locations of submarine cables. ○ Santos should engage with the owners of two other forthcoming submarine cable projects with proposals to install cables landing in Darwin. ○ ACMA does not require further consultation on the Barossa Project at this time. • On 21 July 2023 Santos emailed ACMA the Barossa Development Quarterly Update, which included information on the consultation process for the SURF EP. **[Con-2022]** • On 28 July Santos emailed ACMA to confirm that ongoing engagement was occurring with Vocus and the two owners of forthcoming projects cited by ACMA in its email of 5 June 2023. **[Con-1632]** No feedback specific to the SURF EP was received from the three companies during these engagements. • On 1 August ACMA emailed Santos and stated it had no comments to provide at this stage. **[Con-2207]** • No further correspondence or feedback was received from ACMA.			
Summary of Objection or Claim	***Assessment of Merits***	***Santos' Response Statement***	***EP Reference***
ACMA recommended Santos engage with Vocus, BW Digital and Inligo Networks. ***[Con-1616]***	*Santos noted and actioned ACMA's advice.*	*Santos has engaged with the cited companies.* ***[Con-1632]***	*No additional EP controls required.*
ACMA recommended Santos engage with AHO. ***[Con-1616]***	*Santos noted and actioned ACMA's advice.*	*Santos has consulted with the AHO in preparing this Environment Plan.* ***[Con-1632]***	*No additional EP controls required.*

Australian Fisheries Management Authority (AFMA)			
Summary of consultation effort: • On 2 June 2023 Santos emailed the Australian Fisheries Management Authority (AFMA) to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how AFMA would like to be consulted and what, if any, further information it required. A Barossa Subsea Infrastructure Installation Information Booklet was also provided and a link to NOPSEMA's consultation Guideline: Consultation in the course of preparing an Environment Plan. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1606]** • On 6 June 2023 AFMA emailed Santos stating its preferred consultation methods and encouraged Santos to consult directly with relevant fishing industry stakeholders with details of relevant associations to be found at: Petroleum industry consultation with the commercial fishing industry | Australian Fisheries Management Authority (afma.gov.au). **[Con-1617]** AFMA further stated the following: o Potential interaction of SURF activities may occur with Commercial Fisheries that operate in the area – namely the Northern Prawn Fishery. o Emails, fact sheets and website content continued to be the preferred consultation methods and consultation requests be directed to petroleum@afma.gov.au o No additional information on the SURF EP is required by AFMA. • On 21 July 2023 Santos emailed AFMA the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]** • On 28 July Santos emailed AFMA noting the Authority's consultation method preferences and confirming that the relevant fishing industry stakeholders were consulted for the SURF EP. Santos also noted the Authority's advice that it did not require any additional information on the SURF EP. **[Con-1633]** • No further correspondence or feedback was received from AFMA.			
Summary of Objection or Claim	***Assessment of Merits***	***Santos' Response Statement***	***EP Reference***
AFMA requested Santos consult directly with commercial fishing industry stakeholders. ***[Con-1617]***	*Santos noted and actioned AFMA's advice.*	*Santos has consulted relevant fishing industry associations in preparing this Environment Plan.* ***[Con-1633]***	*No additional EP controls required.*
Australian Hydrographic Office (AHO)			
Summary of consultation effort: • On 2 June 2023 Santos emailed the Australian Hydrographic Office (AHO) to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how the AHO would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and a link to NOPSEMA's			

consultation Guideline: Consultation in the course of preparing an Environment Plan. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1606]**

- On 5 June 2023 AHO emailed Santos an automated response with standard information for Operators of offshore activities. **[Con-1615]**
- On 21 July 2023 Santos emailed AHO the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- On 28 July 2023 Santos emailed AHO to confirm that all information on the cited AHO legislative requirements, standards and notification requirements will be appropriately referenced in the SURF EP. **[Con-1631]**
- No further correspondence or feedback was received from AHO.

Summary of Objection or Claim	***Assessment of Merits***	***Santos' Response Statement***	***EP Reference***
The AHO provided its standard response on activity notifications that is issued to an operator developing an EP. ***[Con-1615]***	*Santos noted and actioned AHO advice.*	*As per the approach followed by Santos for all EPs in response to AHO's standard advice, the AHO's notification requirements will be incorporated into the relevant sections of the EP.* ***[Con-1631]***	*Activity Notifications Table (Table 8-5).*

Australian Maritime Safety Authority (AMSA)

Summary of consultation effort:

- On 2 June 2023 Santos emailed the Australian Marine Safety Authority (AMSA) to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how AMSA would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and a link to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1606]**
- On 9 June 2023 AMSA emailed Santos and stated that its initial advice on Barossa Project activities would continue to apply and Santos should continue to provide updates to AMSA as the project progresses. **[Con-1620]**
- On 3 July 2023 AMSA emailed Santos with a summary of its marine safety process, equipment standards and notification requirements and relevant citations of documents and legislation. **[Con-1626]**
- On 21 July 2023 Santos emailed AMSA the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- On 28 July Santos emailed AMSA in response to both AMSA's earlier emails on 9 June and 3 July. **[Con-1636]**
- No further correspondence or feedback was received from AMSA.

Summary of Objection or Claim	Assessment of Merits	Santos' Response Statement	EP Reference
AMSA requested Santos advise of any changes to the Environment Plan. ***[Con-1620]***	*Santos noted and will action AMSA's advice.*	*Santos will provide AMSA with a copy of the accepted EP.* ***[Con-1636]***	*Activity Notifications Table (Table 8-5).*
AMSA advised Santos of the required formal notifications process prior to and during activities. ***[Con-1626]***	*Santos noted and actioned AMSA's advice.*	*Santos will include all formal notification requirements in the relevant sections of the EP, specifically the following:* *Requirement to notify AMSA's Joint Rescue Coordination Centre (JRCC) through rccaus@amsa.gov.au (Phone: 1800 641 792 or +61 2 6230 6811) for promulgation of radio-navigation warnings 24-48 hours before operations commence* *Requirement to notify the Australian Hydrographic Office through datacentre@hydro.gov.au no less than four working weeks before operations commence for the promulgation of related notices to mariners.* *Vessel obligations to comply with the International Rules for Preventing Collisions at Sea (COLREGs), in particular, the use of appropriate lights and shapes to reflect the nature of operations (e.g. restricted in the ability to manoeuvre). Vessels should also ensure their navigation status is set correctly in the ship's AIS unit.* *Evaluation and implementation of adequate anti-collision measures,*	*Activity Notifications Table (Table 8-5).*

		including the collision risk mitigation measures cited by AMSA, being additional warnings and/or lights to attract attention and offshore guard vessel/s that can monitor traffic and take early action to alert a vessel approaching the area of operations. ***[Con-1636]***	

Department of Agriculture, Forestry and Fisheries (DAFF) – Biosecurity (marine pests) and Fisheries

Summary of consultation effort:

- On 2 June 2023 Santos emailed the Department of Agriculture, Forestry and Fisheries (DAFF) to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how DAFF would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and a link to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1606]**. DAFF sent Santos an auto-response email on the same day, which stated if would endeavour to respond as soon as possible, or within 10 working days. **[Con-2169]**
- On 21 July 2023 Santos emailed DAFF the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- On 24 August 2023 Santos emailed DAFF, confirming that the standard advice provided by DAFF would be followed for the SURF EP. **[Con-2318]** DAFF provided a confirmation of receipt via email the same day **[Con-2411]**
- No further correspondence or feedback was received from DAFF.

Summary of Objection or Claim	***Assessment of Merits***	***Santos' Response Statement***	***EP Reference***
DAFF provided its standard automated response on activity notifications that is issued to an operator developing an EP. ***[Con-2169]***	*Santos noted DAFF's response was the standard advice provided by DAFF for all EP consultation.*	*All DAFF biosecurity requirements are understood and referenced in relevant commitments documented in the EP.* *Santos will report and engage directly with DAFF for the management of biosecurity risk post EP acceptance as stated in the cited offshore biosecurity guidelines and other associated documentation.*	*No additional EP controls required.*

		Santos will continue to keep DAFF informed and incorporate DAFF's assistance offer into relevant management plans. ***[Con-2318]***	

Department of Climate Change, Energy, the Environment and Water (Parks Australia)

Summary of consultation effort:

- On 2 June 2023 Santos emailed Parks Australia to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how Parks Australia would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and a link to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1606]**
- On 18 July 2023 Santos followed up the email of 2 June 2023 with a phone call to Parks Australia seeking its feedback. **[Con-1953]**
- On 21 July 2023 Santos emailed Parks Australia the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- On 28 July 2023 Santos followed up the phone call of 18 July 2023 with an email to Parks Australia seeking its feedback which was requested by the later timeframe of 4 August 2023. **[Con-1953]**
- On 4 August 2023 Parks Australia emailed Santos in response to Santos' email of 2 June 2023. Parks Australia advised it had no authorisation requirements and no further input or objections or claims at this time. It advised it welcomed EMBA and MEVA modelling. It also advised Santos that Santos should consider Australian marine parks and ensure the EP 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 and clearly demonstrate that the Activity will not be inconsistent with the management plan. Parks Australia requested it 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. **[Con-2209]**
- On 8 August 2023 Santos emailed Parks Australia in response to its email on 4 August 2023. Santos confirmed the EP prepared for submission to NOPSEMA will consider the cited NOPSEMA Petroleum Activities and Australian Marine Parks Guidance Note; identify and manage all impacts and risks on Australian marine park values (including ecosystem values) to an acceptable level and consider all options to avoid or reduce them to as low as reasonably practicable; clearly demonstrate that the activity will not be inconsistent with the relevant marine parks management plan(s); and reflect all DNP emergency response notification requirements. **[Con-2220]**
- No further correspondence was received.

Summary of Objection or Claim	***Assessment of Merits***	***Santos' Response Statement***	***EP Reference***
Parks Australia requested Santos refer to the NOPSEMA Petroleum Activities and Australian Marine Parks Guidance Note in identifying and managing all impacts	*Santos noted and actioned Parks Australia's advice.*	*In preparing the EP Santos has completed the following actions:*	*No additional EP controls required.*

and risks on Australian marine park values. ***[Con-2209]***		*Considered the NOPSEMA Petroleum Activities and Australian Marine Parks Guidance Note* *Identified and proposed management measures for all impacts and risks on Australian marine park values (including ecosystem values) to an acceptable level and considered all options to avoid or reduce them to as low as reasonably practicable* *Clearly demonstrated that the activity will not be inconsistent with the relevant marine parks management plan(s).* ***[Con-2220]***	
Parks Australia requested that Santos follow all DNP emergency response notification requirements for the accepted activities. ***[Con-2209]***	*Santos noted Parks Australia's advice which was similar to previous advice issued for EP consultation.*	*In preparing the EP Santos has incorporated all DNP emergency response notification requirements in the relevant sections of the EP.* ***[Con-2220]***	*No additional EP controls required.*
Department of Defence (DoD)			
Summary of consultation effort: • On 2 June 2023 Santos emailed the Department of Defence (DoD) to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how DoD would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and a link to NOPSEMA's Guideline:			

Consultation in the course of preparing an Environment Plan. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1606]**

- On 18 July 2023 Santos followed up the email of 2 June 2023 with a phone call to DoD seeking its feedback by the later timeframe of 4 August 2023 **[Con-2412]**
- On 21 July 2023 Santos emailed DoD the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- On 21 August 2023 Santos made a further attempt by phone and email to seek any feedback from DoD. **[Con-2412]**
- On 28 August 2023 DoD emailed Santos advising it had no further comments on the SURF EP and recommended consultation with Navy due to their operations in the region. **[Con-2418]**
- On 28 September 2023 Santos emailed DoD confirming that Navy had been consulted. **[Con-2419]**
- No further correspondence or feedback was received from DoD.

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Santos has followed DoD's standard advice for all EPs.*	*Santos is aware of the potential presence of unexploded ordinance in the military exercise area within the EMBA and related responsibilities of an Operator and all required actions have been included in the relevant sections of the EP.*	*No additional EP controls required.*

Department of Foreign Affairs and Trade (DFAT)

Summary of consultation effort:

- On 2 June 2023 Santos emailed the Department of Foreign Affairs and Trade (DFAT) to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how DFAT would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and a link to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1606]**
- On 21 July 2023 Santos emailed DFAT the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- On 21 July 2023 Santos followed up the email of 2 June 2023 with a phone call to DFAT seeking its feedback. **[Con-1966]**
- On 28 July 2023 Santos emailed DFAT seeking its feedback which was requested by the later timeframe of 4 August 2023. **[Con-1966]**
- On 30 July 2023 DFAT emailed Santos and referred to its previous advice that it has no role in Australian waters and to submit plans to NOPSEMA in accordance with relevant regulations. In its previous advice DFAT observed that in the event Indonesia and Timor-Leste may be impacted by an oil spill,

DFAT could assist via NOPSEMA if it is determined there is a need to consult the Indonesian or Timor-Leste Governments. DFAT advised it would look at the SURF aspect of the project before 4 August 2023. **[Con-2225]**

- On 1 August 2023 Santos emailed DFAT and stated that DFAT's previous advice would be applied for the SURF EP. **[Con-2203]**
- On 9 August 2023 DFAT emailed Santos to reiterate its full previous advice and provided additional details of DFAT contacts. **[Con-2210]**. Santos responded via email to DFAT the same day and again noted the advice provided. **[Con-2221]**
- No further correspondence or feedback was received from DFAT.

Summary of Objection or Claim	***Assessment of Merits***	***Santos' Response Statement***	***EP Reference***
DFAT advised Santos that it may be able to assist via NOPSEMA with any liaison that may be required with foreign governments. ***[Con-2225], [Con-2221]***	*Santos noted DFAT's advice.*	*As requested, DFAT's previous advice will also be applied for the SURF EP.* ***[Con-2203]***	*No additional EP controls required.*

Department of Home Affairs and Australian Border Force

Summary of consultation effort:

- On 2 June 2023 Santos emailed the Department of Home Affairs and its agency Australian Border Force to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how AMCA would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and a link to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1606]**
- On 21 July 2023 Santos emailed the Department/ABF the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- On 21 July 2023 Santos phoned the Department/ABF following up on Santos' email of 2 June 2023 seeking its feedback. **[Con-2053]**
- On 31 July 2023 Santos followed up the phone call of 21 July 2023 with an email to the Department and ABF seeking its feedback which was requested by the later timeframe of 4 August 2023. **[Con-2129], [Con-2130]** The Department emailed Santos an auto-response on the same day. **[Con-2228]**

No further correspondence or feedback was received from the Department of Home Affairs or Australian Border Force.

Summary of Objection or Claim	***Assessment of Merits***	***Santos' Response Statement***	***EP Reference***
Nil	*Nil*	*Nil*	*No additional EP controls required.*

Department of Industry, Science and Resources (DISR)

Summary of consultation effort:

- On 2 June 2023 Santos emailed the Department of Industry, Science and Resources (DISR) to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how DISR would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and a link to

NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1606]**

- On 18 July 2023 Santos followed up the email of 2 June 2023 with a phone call to DISR seeking its feedback. **[Con-1975]**
- On 21 July 2023 Santos emailed DISR the Barossa Development Quarterly Update, which included information on the EP consultation process. **[Con-2022]**
- On 28 July 2023 Santos emailed DISR seeking its feedback which was requested by the later timeframe of 4 August 2023. **[Con-1975]**
- No further correspondence or feedback was received from DISR.

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Nil*	*Nil*	*No additional EP controls required.*

National Indigenous Australians Agency (NIAA)

Summary of consultation effort:

- On 7 September 2023 Santos emailed the National Indigenous Australians Agency (NIAA) in follow-up to a phone call on 5 September 2023. In the email Santos that it understood from previous discussions and an email from the NIAA in July 2023 that its interest was in providing feedback on EPBC Referrals.
- The email explained the consultation approach for the SURF EP, asking if NIAA would like to be consulted, how it would like to be consulted and what information it required. Santos provided a Barossa Drilling and Completions Information Booklet and Fact Sheet and links to NOPSEMA Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community.
- Santos advised that it was providing the NIAA an opportunity to provide feedback on the SURF EP, if interested, by Friday, 22 September 2023 and indicate what, if any, further information may be required. Santos advised that it intended to submit the SURF EP to NOPSEMA at the end of the month/early October. [**Con-2417**]
- No further correspondence or feedback was received

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Nil*	*Nil*	*No additional EP controls required.*

Departments or agencies of the Northern Territory to which the activities to be carried out under the environment plan may be relevant

Department of Industry, Tourism and Trade, NT – Energy Division (DITT-NT Energy)

Summary of consultation effort:

- On 2 June 2023 Santos emailed the Department of Industry, Tourism and Trade's Energy division (DITT-NT Energy) to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how DITT-NT Energy would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact

Sheet was also provided and a link to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1606]**

- On 18 July 2023 Santos followed up the email of 2 June 2023 with a phone call to DITT-NT Energy seeking its feedback. **[Con-1976]**
- On 21 July 2023 Santos emailed DITT-NT Energy the Barossa Development Quarterly Update, which included information on the EP consultation process. **[Con-2022]**
- On 28 July 2023 Santos emailed DITT-NT Energy seeking its feedback which was requested by the later timeframe of 4 August 2023. **[Con-1976]**
- No further correspondence or feedback was received from DITT-NT Energy.

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Nil*	*Nil*	*No additional EP controls required.*

Department of Industry, Tourism and Trade – Fisheries Division (DITT-NT Fisheries)

Summary of consultation effort:

- On 2 June 2023 Santos emailed the Department of Industry, Tourism and Trade's Fisheries Division (DITT-NT Fisheries) to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how DITT-NT Fisheries would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and a link to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1606]**
- On 7 June 2023 DITT-NT Fisheries emailed Santos reiterating its preferred consultation methods and first point of contact for all EP, stating how its activities could be affected by SURF activities and stating it did not require any additional information on the SURF EP**. [Con-1618]**
- On 21 July 2023 Santos emailed DITT-NT Fisheries the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- On 28 July 2023 Santos emailed DITT-NT Fisheries confirming that Santos would continue to consult with DITT-NT Fisheries via its preferred consultation methods and noting the Department's advice on its activities that may be affected by SURF activities and that it did not require any additional information on the SURF EP. Santos sought any specific feedback on the SURF EP from the Department by the later timeframe of 4 August 2023. **[Con-1634]**
- No further correspondence or feedback was received from DITT-NT Fisheries.

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil.	*Nil*	*Nil*	*No additional EP controls required.*

Department of Infrastructure, Planning and Logistics – Transport Division (DIPL-NT-Transport)

Summary of consultation effort:

- On 2 June 2023 Santos emailed the Department of Infrastructure, Planning and Logistics' Transport division (DIPL-NT Transport) to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how DIPL-NT Transport would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP)

Consultation Fact Sheet was also provided and a link to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1606]**

- On 16 June 2023 DIPL-NT Transport emailed Santos advising which divisions of the Department should be consulted. No specific feedback on the SURF EP was provided. **[Con-1622]**
- On 21 July 2023 Santos emailed DIPL-NT Transport the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- On 28 July 2023 Santos emailed DIPL-NT confirming the cited divisions of the Department were being consulted for the SURF EP and provided additional information on the consultation being undertaken for approval of activities in Commonwealth and NT Waters and sought feedback on the SURF EP by the later timeframe of 4 August 2023. **[Con-1641]**
- No further correspondence or feedback was received for DIPL-NT.

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Nil*	*Nil*	*No additional EP controls required.*

Department of Territory Families, Housing and Communities, NT - Heritage branch

Summary of consultation effort:

- On 2 June 2023 Santos emailed the Department of Territory Families, Housing and Communities' Heritage Branch to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how the Heritage Branch would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and a link to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1606]**
- On 18 July 2023 Santos followed up the email of 2 June 2023 with a phone call to the Heritage Branch seeking its feedback. **[Con-1955]**
- On 21 July 2023 Santos emailed the Heritage Branch the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- On 28 July 2023 Santos emailed the Heritage Branch seeking its feedback which was requested by the later timeframe of 4 August 2023. **[Con-1955]**
- No further correspondence or feedback was received from the Heritage Branch.

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Nil*	*Nil*	*No additional EP controls required.*

Tourism NT

Summary of consultation effort:

- On 2 June 2023 Santos emailed Tourism NT to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how Tourism NT would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas

Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and a link to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1606]**

- On 18 July 2023 Santos followed up the email of 2 June 2023 with a phone call to Tourism NT seeking its feedback. **[Con-1957]**
- On 21 July 2023 Santos emailed Tourism NT the Barossa Development Quarterly Update, which included information on the EP consultation process. **[Con-2022]**
- On 28 July 2023 Santos emailed Tourism NT seeking its feedback which was requested by the later timeframe of 4 August 2023. **[Con-1957]**
- On 31 July 2023 Tourism NT emailed Santos to advise it had no issues to raise with the SURF EP. **[Con-2230]**

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Nil*	*Nil*	*No additional EP controls required.*

Departments or agencies of Western Australia to which the activities to be carried out under the environment plan may be relevant

Department of Biodiversity, Conservation and Attractions (DBCA-WA)

Summary of consultation effort:

- On 2 June 2023 Santos emailed the Department of Biodiversity, Conservation and Attractions (DBCA-WA) to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how AMCA would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and a link to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1606]** On the same day DBCA-WA emailed Santos an auto-receipt for the email. **[Con-2167]**
- On 18 July 2023 Santos followed up the email of 2 June 2023 with a phone call to DBCA-WA seeking its feedback. **[Con-1979]**
- On 21 July 2023 Santos emailed DBCA-WA the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- On 28 July 2023 Santos emailed DBCA-WA seeking its feedback which was requested by the later timeframe of 4 August 2023. **[Con-1979]**
- No further correspondence or feedback was received from DBCA-WA.

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Nil*	*Nil*	*No additional EP controls required.*

Department of Primary Industries and Regional Development – Fisheries (DPIRD-WA Fisheries)

Summary of consultation effort:

- On 2 June 2023 Santos emailed DPIRD-WA Fisheries to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how AMCA would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas

Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and a link to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1606]**

- On 7 June 2023 DPIRD-WA Fisheries emailed Santos and stated it had no comments to make at this stage on the SURF EP and would be interested to see the next stage draft when it is available. **[Con-1619]**
- On 21 July 2023 Santos emailed DPIRD-WA Fisheries the Barossa Development Quarterly Update, which included information on the EP consultation process. **[Con-2022]**
- On 28 July 2023 Santos emailed DPIRD-WA Fisheries to advise that Santos was planning to submit a draft EP to NOPSEMA during this quarter for its assessment and once approved for release by NOPSEMA the draft EP will be available on the NOPSEMA website during the assessment period. Santos will be happy to advise the DPIRD when the draft EP is available. **[Con-1635]**
- No further correspondence or feedback was received.

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Nil*	*Nil*	*No additional EP controls required.*

Persons or organisations whose functions, interests or activities may be affected by the activities to be carried out under the environment plan

Academic and Research Organisations

Australian Institute of Marine Science (AIMS)

Summary of consultation effort:

- On 2 June 2023 Santos emailed AIMS to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how AIMS would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community. Santos advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1607]**
- On 21 July 2023 Santos followed up the email of 2 June 2023 with a phone call to AIMS seeking its feedback. **[Con-2036]**
- On 21 July 2023 Santos emailed AIMS the Barossa Development Quarterly Update, which included information on the EP consultation process. **[Con-2022]**
- On 28 July 2023 Santos emailed AIMS seeking its feedback which was requested by the later timeframe of 4 August 2023. **[Con-2036]**
- On 31 July 2023 AIMS emailed Santos and stated it would not be providing feedback on the SURF EP. **[Con-2226]**

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Nil*	*Nil*	*No additional EP controls required.*

Australian Marine Sciences Association – NT (AMSA-NT)

Summary of consultation effort:

- On 2 June 2023 Santos emailed Australian Marine Sciences Association-NT (AMSA-NT) to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how AMSA-NT would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1607]**
- On 21 July 2023 Santos emailed AMSA-NT the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- On 28 July 2023 Santos followed up the email of 21 July 2023 with a phone call to the National President of AMSA advising that feedback was requested by 4 August 2023.
- No further correspondence or feedback was received from AMSA-NT.

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Nil*	*Nil*	*No additional EP controls required.*

AusTurtle Inc

Summary of consultation effort:

- On 2 June 2023 Santos emailed AusTurtle Inc to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how AusTurtle Inc would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1607]**
- On 14 July 2023 AusTurtle Inc emailed a letter to Santos in which it provided information on the occurrence and distribution of sea snakes and sea turtles and requested information on how risks and impacts to these species would be managed by Santos under the SURF EP. **[Con-1627]**
- On 18 July 2023 Santos met with AusTurtle Inc to discuss the information and queries provided in AusTurtle Inc's submission. **[Con-1629]**
- On 21 July 2023 Santos emailed AusTurtle Inc the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- On 1 August 2023 Santos emailed AusTurtle Inc, providing responses to the feedback provided in its correspondence of 14 July 2023 and at the meeting held on 18 July 2023. A record of the meeting was provided to AusTurtle Inc and is included in the Sensitive Information Report supporting this EP. **[Con-2201]**

  No further correspondence or feedback was received from AusTurtle Inc.

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
[Con-1627]	*The cited information will be examined to*	***[Con-2201]***	*No additional EP controls required.*

The most thorough survey of sea snake of the Arafura and Timor seas remain that of the Russian Trawls in the late 1960s. Surveys of specific reefs of the Sahul Shelf and the reefs of the Timor Sea provide a list of and respective densities of sea snake species in shallow waters. A glimpse of the species away from the reef edge reveals different species and in lower densities.	*assist in accurately describing the existing marine environment and assessing potential impacts and risks to sea snakes.*	*Santos notes the information referenced on the occurrence and density of sea snake species within the environment that may be affected (EMBA), mainly in shallow water areas near specific reefs but occasionally in deeper water at low numbers.* *Santos confirms the cited information will be examined to assist in accurately describing the existing marine environment and assessing potential impacts and risks to sea snakes.* *Santos' current understanding is that due to the remote location of the OA in deep water only low numbers of sea snakes are expected to be at risk of impact from the planned activities.*	
Species such as olive sea snakes will be attracted to the lights and vibrations of divers and ROVs, increasing interactions and possible entanglement in structures and propellers of the ROV causing injury. Observations and recordings of species by the ROVs provide valuable information on new species and new limits of depths frequented by sea snakes	*The risk of impact to sea snakes from the use of ROVs is noted but, due to the water depths where the activities will be occurring, only low numbers of sea snakes are expected.* *Santos will examine the practicality of implementing an observational component during ROV operations.*	*Santos notes the comment on olive sea snakes being attracted to the lights and vibrations of divers and ROVs, increasing interactions and possible entanglement in structures and propellers of the ROV causing injury.* *Santos does not intend to employ divers to conduct any of the activities covered under the SURF EP. The risk of impact to sea snakes from the use of ROVs is noted but, due to the water depths where the activities will be occurring, only low numbers of sea snakes are expected. As a result, for ROVs, observation and avoidance where possible will be the principal mitigation measures. For larger vessels on the surface, lighting*	*No additional EP controls required.*

		reduction measures will be employed and detailed in the EP. *Santos notes the suggestion that, in addition to trained observers on vessels on the water surface, ROV cameras can provide valuable information on new species and new limits of depths frequented by sea snakes. Santos will examine the practicality of implementing an observational component during ROV operations.*	
In the event of an unscheduled release of hydrocarbons, sea birds, sea snakes and sea turtles are impacted.	*Santos acknowledges that marine life will be impacted in the unlikely event of an accidental release of hydrocarbons.*	*Santos acknowledges that marine life will be impacted in the unlikely event of an accidental release of hydrocarbons. Santos notes the comment on the vulnerability of sea snakes compared to sea birds and sea turtles in an unplanned scenario and the published literature on the impacts of specific incidents on sea snakes, including the causes.* *The worst-case scenario for an unplanned event for the activities covered by the SURF EP is a release of 500 cubic metres of marine diesel oil to the marine environment and involves a specific range of factors and potential outcomes that are markedly different to the incidents cited in your references.* *Information on the impacts and risks, mitigation measures and response actions is provided on pages 26-30 of the SURF EP information booklet. The*	*No additional EP controls required.*

		submitted EP will include an Oil Pollution Emergency Plan (OPEP) which will be published along with the EP during the NOPSEMA assessment process.	
The Barossa Gas Project is likely to encounter all six species of sea turtle inhabiting Australian waters. All life stages, hatchlings, juveniles, breeding and migrating adults, are likely to be present and appropriate measures need be taken to avoid negative interactions. An Observer program and recordings of interaction would provide valuable information on likely impacts and means of avoiding further impacts.	*SURF activities will be conducted in water depths ranging from 230-280 metres where there is a variety of highly mobile marine fauna, including sea turtles, with a wide distribution that may transit the area in low numbers.*	*Santos notes the comment on the presence of flatback and olive ridley sea turtles within the EMBA for the SURF EP and request that appropriate measures, including an observer program, be taken to avoid negative interactions.* *Santos also notes the comment that short-term impacts and risks on sea turtles during SURF activities include entrainment in low pressure areas such as voids down current of barges or light traps, entanglement in gear and equipment, impact by boat or propeller strike.* *SURF activities will be conducted in water depths ranging from 230-280 metres where there is a variety of highly mobile marine fauna, including sea turtles, with a wide distribution that may transit the area in low numbers.* *Information on the impacts and risks to marine fauna, including those that AusTurtle Inc has cited, is provided on pages 15-21 of the SURF EP information booklet and will be discussed in detail in the SURF EP.*	*No additional EP controls required.*
Short term impacts on sea turtles during the SURF include entrainment in low pressure areas such as voids down-	*Presence of wildlife observers on vessels will be among the control measures implemented*	*Presence of wildlife observers on vessels will be among the control measures implemented.*	*No additional EP controls required.*

current of barges or light traps, entanglement in gear and equipment, impact by boat or propeller strike. Such risks place sea turtles in an area where, energy is expended needlessly, risk of predation increases, and physical injury is sustained. By appointing a wildlife observer either independently or from amongst the crew, records of impact and near misses provides a comprehensive assessment of the effectiveness of the perceived risks, planned mitigation measures and the actual impact of the SURF and Barossa Gas Project overall.			
In previous offshore operations, recuperation facilities existed at Charles Darwin University through AusTurtle Inc to care for sick and injured marine life. The facilities with isolation tanks and filtered sea water have been relocated to the Territory Wildlife Park and await reconstruction.	*Santos will investigate the availability of facilities in Darwin to care for sick and injured marine life. Santos will implement its Oiled Wildlife Response Framework, which includes guidance for coordinating an oiled wildlife response.*	*As part of the SURF EP and OPEP preparation Santos will also investigate the availability of facilities in Darwin to care for sick and injured marine life. Santos will implement its Oiled Wildlife Response Framework, which includes guidance for coordinating an oiled wildlife response.*	*No additional EP controls required.*
Baseline date on aspects of the SURF should include impact and refence sites for the expected impacts of seabed disturbance, discharges intentional and accidental, and unplanned events such as invasive marine species, interactions with marine fauna and unexpected release of hydrocarbons. Such impacts may be detected well beyond the footprint of the SURF and moorings with the potential to reach to the limits of the EMBA.	*Based on the information already gathered by Santos and available, Santos does not propose to conduct additional baseline studies. A monitoring program in the event of an unplanned event such as an oil spill will be proposed and outlined in the SURF EP and OPEP.*	*Santos notes the comment that baseline data on aspects of the SURF EP should include impact and reference sites for the expected impacts of seabed disturbance, discharges intentional and accidental and unplanned events such as invasive marine species, interactions with marine fauna and unexpected release of hydrocarbons.* *A comprehensive description of the environmental values and sensitivities of the existing environment in the*	*No additional EP controls required.*

		EMBA will be part of the SURF EP. The description is informed by the environmental baseline studies program that was undertaken to characterise the existing marine environment within and surrounding the entire offshore development area. *While the SURF EP Operational Area (OA) and EMBA overlap several key ecological features (KEFs), Santos is not aware of any information indicating that the OA contains any sensitive habitat or any benthic habitats that are not represented across other areas and/or regions.* *The seabed within the OA is generally flat and on a plain that is devoid of any significant bathymetric features and geophysical surveys undertaken also report that the seabed is smooth and featureless.* *Based on this information, Santos does not propose to conduct additional baseline studies. A monitoring program in the event of an unplanned event such as an oil spill will be proposed and outlined in the SURF EP and OPEP.*	
WorldFish Timor-Leste (WorldFish)			
Summary of consultation effort:			

- On 2 June 2023 Santos emailed WorldFish to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how WorldFish would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1608]**
- On 21 July 2023 Santos followed up the email of 2 June 2023 with a phone call to WorldFish seeking its feedback. **[Con-1968]**
- On 21 July 2023 Santos emailed WorldFish the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- On 28 July 2023 Santos emailed WorldFish seeking its feedback which was requested by the later timeframe of 4 August 2023. **[Con-1968]**
- No further correspondence or feedback was received from WorldFish.

Summary of Objection or Claim	***Assessment of Merits***	***Santos' Response Statement***	***Summary of Objection or Claim***
Nil	*Nil*	*Nil*	*No additional EP controls required.*

Commercial Fishing

Commonwealth-managed fisheries

Northern Prawn Fishery Licence Holders (in addition to the consultation undertaken with representative body Northern Prawn Fishery Pty Ltd)

Summary of consultation effort:

- On 2 June 2023, in addition to emailing Northern Prawn Fishery Ltd, the licence-holders' representative body, Santos also emailed Northern Prawn Fishery Licence Holders (for whom email addresses were provided) to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how they would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community.

Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1607]**

- On 18 July 2023 Santos followed up the email of 2 June 2023 with phone calls to Northern Prawn Fishery licence-holders Austfish, Raptis and Sons and WA Seafoods seeking their feedback. No comments specific to the SURF EP were provided. **[Con-1980], [Con-1990], [Con-2217]**
- On 21 July 2023 Santos emailed Northern Prawn Fishery Licence Holders (for whom email addresses had been provided) the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- On 28 July 2023 Santos followed up phone calls to Austfish and WA Seafoods with emails seeking their feedback which was requested by the later timeframe of 4 August 2023. **[Con-1980], [Con-1990]**
- On 7 August 2023 Santos had a further phone discussion with Raptis and Sons. No comments specific to the SURF EP were provided. The same day Santos followed up the phone calls to Raptis and Sons with an email confirming there were no comments related to the SURF EP. **[Con-2217]**
- No further correspondence was received.

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Nil*	*Nil*	*No additional EP controls required.*

Southern Bluefin Tuna/ Western Skipjack Tuna and Western Tuna and Billfish Fisheries Licence Holders

Summary of consultation effort:

These stakeholders were consulted via their representative body, the Australian Southern Bluefin Tuna Industry Association (ASBTIA). Refer to ABSTIA entry in this table for details.

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Nil*	*Nil*	*No additional EP controls required*

North-West Slope Trawl Fishery Licence Holders

Summary of consultation effort:

These stakeholders were consulted via their representative body, the Western Australian Fishing Industry Association (WAFIC). Refer to WAFIC entry in this table for details.

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Nil*	*Nil*	*No additional EP controls required.*

NT-managed fisheries Licence Holders: Aquarium Fishery, Spanish Mackerel Fishery, Timor Reef Fishery, Demersal Fishery, Coastal Line Fishery, Offshore Net and Line Fishery, Small Pelagic (Development) Fishery, Pearl Oyster Fishery

(In addition to consultation undertaken with representative bodies the Northern Territory Seafood Council and the Pearl Producers Association)

Summary of consultation effort:

- Licence holders were consulted via their representative body, the Northern Territory Seafood Council (NTSC). Refer to the separate NTSC entry in this table for details.
- On 2 June 2023, in addition to emailing the NTSC, Santos also emailed NT Licence Holders (for whom email addresses had been provided) to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how they would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1607]**
- As per NTSC's standing request, the same information was posted to all NT Licence Holders on 6 June 2023. **[Con-1612]**
- On 18 July 2023 Santos followed-up its email of 2 June 2023 with phone calls to licence-holders Northern Wildcatch Fisheries, Australia Bay Seafoods, WA Seafoods, Fischer Wholesale, Monsoon Aquatics and Taroona Pty Ltd seeking feedback on the SURF EP. **[Con-1982], [Con-1985], [Con-1990], [Con-2043], [Con-2215]**
- On 19 July 2023 licence-holder Austral Fisheries emailed Santos stating that its history of operation in the Timor Reef Fishery showed considerable annual fishing effort within the footprint of the proposed Barossa Gas Export Pipeline pathway and the subsea installation area. Austral attached modelling of fishing information it had previously provided to Santos to indicate that it has an interest in the area and will be displaced through both the installation and the potential exclusion areas of the infrastructure. Austral stated the modelling would need to be updated. **[Con-1630]**
- On 21 July 2023 Santos emailed NT Licence Holders (for whom email addresses had been provided) the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- On 28 July 2023 Santos followed up the phone calls with emails to the above NT Licence Holders requesting their feedback by 4 August 2023. **[Con-1982], [Con-2043], [Con-1985], [Con-1990]**
- On 31 July 2023 Santos posted the SURF EP information booklet containing specific information for NT commercial fishers to all NT licence-holders, as requested by their representative body, the NT Seafood Council. **[Con-2200]**
- On 4 August Santos met with Austral Fisheries where it was agreed that modelling of fishing information previously provided to Santos should be updated prior to further discussions as part of ongoing consultation. The discussion was followed-up via emails on 11 August 2023. **[Con-2283], [Con-2284]**
- On 7 August 2023 Santos followed up the phone call to Northern Wildcatch Fisheries with an email. No issues related to the SURF EP were raised. **[Con-2215]**
- On 8 August 2023 Santos emailed Austral Fisheries, providing requested data sets for proposed infrastructure and exclusion zones. **[Con-2223]**
- On 11 August 2023 Santos and Austral Fisheries agreed via email that the previous modelling should be updated prior to further discussion. **[Con-2284]**
- On 23 August 2023 Santos phoned and emailed Taroona Fisheries. No issues related to the SURF EP were raised. **[Con-2388]**

Summary of Objection or Claim	***Assessment of Merits***	***Santos' Response Statement***	***EP Reference***
Austral Fisheries operate five fish trapping vessels in the Timor Reef Fishery and are the	*The feedback relates to a wider concern over displacement of Austral Fisheries'*	*Santos agrees that the best way forward is to have the previous*	*No additional EP controls required.*

biggest holder of quota in the fishery. Austral Fisheries history of operation in the Timor Reef Fishery shows considerable annual fishing effort within the footprint of the proposed Barossa Gas Export Pipeline pathway and the subsea installation area. *Modelling of fishing information previously provided to Santos indicates Austral has an interest in the area and will be displaced through both the installation and the potential exclusion areas of the infrastructure. The modelling information will need to be updated.* ***[Con-1630]***	*operations by some activities proposed under the Santos' Barossa Gas Project and will be addressed as part of an ongoing consultation process covering activities proposed under different Eps.*	*modelling (undertaken in 2019) updated prior to further discussion.* ***[Con-2283]***	
WA-managed fisheries Licence Holders (entitled to fish in EMBA): Mackerel Managed Fishery, Northern Demersal Scalefish Managed Fishery, South-West Costal Salmon Fishery, Kimberley Crab Fishery, Marine Aquarium Fishery, Specimen Shell Fishery, West Coast Deep Sea Crustacean Fishery			
Summary of consultation effort: • These Licence Holders were approached via their representative body, the Western Australian Fishing Industry Council (WAFIC). Refer to the WAFIC entry in this table for details of its consultation requirements.			
Summary of Objection or Claim	***Assessment of Merits***	***Santos' Response Statement***	***EP Reference***
Nil	*Nil*	*Nil*	*No additional EP controls required.*
Energy Industry			
Australian Marine Oil Spill Centre (AMOSC)			
Summary of consultation effort: • On 2 June 2023 Santos emailed AMOSC to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how AMOSC would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community. Santos			

also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1607]**

- On 18 July 2023 Santos followed up the email of 2 June 2023 with a phone call to AMOSC seeking its feedback. **[Con-2056]**
- On 21 July 2023 Santos emailed AMOSC the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- On 28 July 2023 Santos emailed AMOSC seeking its feedback which was requested by the later timeframe of 4 August 2023. **[Con-2056]**
- On 3 August 2023 AMOSC emailed Santos and stated that it had no additional comments at this stage. **[Con-2233]**
- No further correspondence or feedback was received.

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Nil*	*Nil*	*No additional EP controls required.*

Energy Industry Operators: (INPEX, Bengal Energy, Carnarvon Energy, Eni, Finder Energy, Jadestone Energy, Melbana Energy, PTTEP Australia, Shell, Timor Sea Oil & Gas, Vulcan Exploration and Woodside)

Summary of consultation effort:

- On 6 June or 11 June 2023 Santos emailed all energy industry operators in the EMBA to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how they would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1611], [Con-1613]**
- On 13 June Carnarvon Energy emailed Santos and stated it had no comments on the SURF EP. **[Con-1621]**
- On 20 June 2023 PTTEP emailed Santos and stated it had no comments on the SURF EP. **[Con-1623]**
- On 27 June 2023 Melbana Energy emailed Santos and stated it had no comments on the SURF EP. **[Con-1625]**
- On 21 July 2023 Santos emailed energy industry operators the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- On 28 July 2023 Santos phoned and emailed all other energy industry operators in the EMBA seeking their feedback by 4 August 2023. **[Con-1993], [Con-1996], [Con-1998], [Con-2000], [Con-2003], [Con-2006], [Con-2008], [Con-2010], [Con-2013], [Con-2047]**
- On 28 July 2023 Finder Energy emailed Santos and stated it had no comments on the SURF EP. **[Con-2174]**
- No further correspondence or feedback was received.

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Nil*	*Nil*	*No additional EP controls*

			required.
Environmental Organisations			
ATSEA-2 Project			
Summary of consultation effort: • On 2 June 2023 Santos emailed ATSEA-2 to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how ATSEA-2 would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1608]** • On 18 July 2023 Santos followed up the email of 2 June 2023 with a phone call to ATSEA-2 seeking its feedback. **[Con-2132]** • On 21 July 2023 Santos emailed ATSEA-2 the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]** • On 28 July 2023 Santos emailed ATSEA-2 seeking its feedback which was requested by the later timeframe of 4 August 2023. **[Con-2132]** • On 3 August 2023 ATSEA-2 emailed Santos and stated that it did not have adequate manpower and time to organise a consultation workshop with its stakeholders and queried whether Santos could facilitate a workshop. **[Con-2208]** • On 11 August Santos emailed ATSEA-2 and stated that Santos considered it had provided ATSEA-2 with sufficient information and a reasonable time to provide any feedback it had, and that there was ample opportunity to raise the request for a workshop earlier. Santos stated it was available to discuss Barossa Project activities generally with ATSEA-2. [**Con-2282]** • No further correspondence or feedback was received.			
Summary of Objection or Claim	***Assessment of Merits***	***Santos' Response Statement***	***EP Reference***
Nil	*Nil*	*Nil*	*No additional EP controls required.*
Australian Marine Conservation Society – NT branch (AMCS-NT)			
Summary of consultation effort: • On 2 June 2023 Santos emailed AMCS-NT to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how AMCS-NT would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community. Santos			

also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1607]**

- On 18 July 2023 Santos followed up the email of 2 June 2023 with a phone call to AMCS-NT seeking its feedback. **[Con-2127]**
- On 21 July 2023 Santos emailed AMCS-NT the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- On 28 July 2023 Santos emailed AMCS-NT seeking its feedback which was requested by the later timeframe of 4 August 2023. **[Con-2127]**
- No further correspondence or feedback was received.

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Nil*	*Nil*	*No additional EP controls required.*

Conservation Council of WA (CCWA)

Summary of consultation effort:

- On 2 June 2023 Santos emailed CCWA to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how CCWA would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1607]**
- On 18 July 2023 Santos followed up the email of 2 June 2023 with a phone call to CCWA seeking its feedback. **[Con-2126]**
- On 21 July 2023 Santos emailed CCWA the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- On 28 July 2023 Santos emailed CCWA seeking its feedback which was requested by the later timeframe of 4 August 2023. **[Con-2126]**
- No further correspondence or feedback was received.

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Nil*	*Nil*	*No additional EP controls required.*

Environment Centre NT (ECNT)

Summary of consultation effort:

- ECNT representatives attended certain meetings and consultation sessions held by Santos on the Tiwi Islands between February and July 2023 during which activities covered by the SURF EP were discussed.
- On 3 June 2023 Santos emailed the ECNT to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how ECNT would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1609]**
- On 14 July 2023 the ECNT emailed Santos providing its concerns in relation to the proposed activities and requesting additional information that ECNT stated it required in order to provide informed feedback on the SURF EP. The ECNT's objections, claims and requests for information and Santos' responses to each are detailed in the assessment section of this entry. **[Con-1628]**
- On 21 July 2023 Santos emailed the ECNT the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- On 14 August 2023 Santos emailed the ECNT in response to its email on 14 July 2023 and provided responses to the concerns that had been raised in that email. **[Con-2288]**
- No further correspondence or feedback was received.

Summary of Objection or Claim	***Assessment of Merits***	***Santos' Response Statement***	***EP Reference***
[Con-1628] *Santos has recognised that ECNT is a Relevant Person in the other EPs for the Project, and by its conduct in seeking to consult ECNT by way of the email correspondence provided.*	*Santos notes the information.*	***[Con-2288]*** *The information provided by ECNT on identification of Relevant Persons under the Environment Regulations is noted.*	*No additional EP controls required.*
ECNT considers the information provided in the Booklet inadequate to allow us to provide informed feedback on the SURF EP.	*Santos believes ECNT has been provided sufficient information to assess potential impacts, risks and proposed control measures for the proposed activity on the ECNT's functions, interests and activities, and to provide any feedback it may have.*	*On 3 June 2023 Santos provided ECNT with the Subsea Infrastructure Installation and Pre-commissioning Activity Information Booklet supporting consultation for this Environment Plan. Santos considers the detail in this 32-page booklet provided the ECNT with sufficient information to assess potential impacts, risks and proposed control measures for the proposed activity on the ECNT's functions,*	*No additional EP controls required.*

		interests and activities, and to provide any feedback it may have.	
Santos should provide detail on the methodologies used to identify and quantify impacts and risks, the results of surveys or other analyses conducted, as well as details of other studies or data sources that have been drawn upon to inform the EP	*The methodology used for this assessment process will be described in the SURF EP to be submitted to NOPSEMA and will be consistent with the methodology described in previously accepted and publicly available Santos EPs.*	*Santos operates under an overarching risk management policy, underpinned by a company risk management standard and supporting procedure and is consistent with the requirements of AS/NZS ISO 31000:2018. The methodology used for this assessment process will be described in the SURF EP to be submitted to NOPSEMA and will be consistent with the methodology described in previously accepted and publicly available Santos EPs. Studies and data sources along with the results of surveys and analyses will be detailed in the EP published by NOPSEMA during its formal assessment.*	*No additional EP controls required.*
ECNT notes that Marine Protected Areas outside of Australia's maritime territory have not been considered in this Booklet. We submit that Santos should consider what protected and significant maritime areas of Timor-Leste and Indonesia fall within the EMBA and MEVA.	*The SURF EP recognises Indonesian and Timor-Leste marine parks that are within the EMBA.*	*The SURF EP recognises Indonesian and Timor-Leste marine parks that are within the EMBA. By virtue of the modelled EMBA extending into international waters, Santos has considered the potential socioeconomic and cultural impacts and risks to receptors at these locations, including in relation to credible worst case spill scenarios. For clarity, please note that the EMBA represents the maximum extent of a hydrocarbon spill for the EP for the purposes of response planning and monitoring while the MEVA within the EMBA represents the extent of the*	*No additional EP controls required.*

		area in which a spill could impact marine life. *With the exception of hydrocarbon spills (the likelihood of which is remote), environmental risks and impacts from the SURF EP are localised and remain within Australia's Exclusive Economic Zone. The risk assessment and controls for hydrocarbon spills will be described in the EP and within the accompanying OPEP. In the unlikely event that hydrocarbon spills enter international or neighbouring country waters, Santos will seek direction and guidance from the Commonwealth Department of Foreign Affairs and Trade on the most appropriate responses.*	
Santos have provided an estimate of the greenhouse gas emissions that will occur as a direct result of activities covered under the SURF EP. Santos does not provide detail on how its 'control measures' will limit the overall emissions generated. We request a breakdown of emissions sources as well as the expected contribution of each mitigation effort to any reduction in emissions	*Santos has reviewed and adopted all reasonably practicable control measures to reduce the impacts of greenhouse gas emissions from the SURF activity to as low as reasonably practicable and to an acceptable level.*	*As stated in the SURF Information Booklet provided to ECNT, air emissions from SURF activities will occur from fuel combustion to operate vessels and helicopters and operation of vessel incinerators. The estimated direct GHG emissions associated with the activities are approximately 21,210 tonnes of CO2-e, which is less than 0.0046% of the total 2022 annual Australian GHG emissions. Emissions were calculated based on forecast fuel usage using the National Greenhouse and Energy Reporting (NGER) Emissions and Energy Threshold Calculator 2022-2023.*	*No additional EP controls required.*

		Air emissions may result in a temporary, localised reduction of air quality. In the offshore environment, air emissions rapidly dissipate into the surrounding atmosphere. Impacts are very localised and not significant. Seabirds and migratory shorebirds are unlikely to be impacted by the localised and temporary reduction in air quality. Detectable environmental impacts are not predicted from GHG emissions during activities under the SURF EP. Santos has reviewed and adopted all reasonably practicable control measures to reduce the impacts of greenhouse gas emissions from the SURF activity to as low as reasonably practicable and to an acceptable level.	
Activities to be carried out under the SURF EP are necessary components of the Barossa Project, and as such these activities facilitate significant greenhouse gas emissions and undermine the Paris Agreement goal of limiting warming to 1.5 degrees and reaching "net zero" emissions by 2050. Santos should provide detail of the entire project's emissions profile, as well as proposed mitigation measures. Further, Santos should demonstrate how the project will comply with Safeguard Mechanism requirements and Australia's Paris Agreement goals.	*The scope of the SURF EP is limited to the installation of subsea umbilicals, risers and flowlines (SURF) and Floating Production Storage and Offloading (FPSO) moorings infrastructure.*	*The scope of the SURF EP is limited to the installation of subsea umbilicals, risers and flowlines (SURF) and Floating Production Storage and Offloading (FPSO) moorings infrastructure. The SURF activity has no resource recovery component. NOPSEMA's acceptance of the SURF EP does not permit the recovery, production or transportation of reservoir hydrocarbons. There are a number of subsequent petroleum activities that must be authorised under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth) and then undertaken before any*	*No additional EP controls required.*

		natural gas is capable of being recovered. *Consequently, ECNT's feedback regarding the greenhouse gas emissions associated with other Barossa Project activities is not relevant to the SURF EP and is beyond the scope of consultation for this EP. Details with regard to productions operations phase greenhouse gas emissions of the Barossa Project will be provided when Santos consults about the Production Operations EP.* *Santos provided in the Barossa OPP an estimated range of total project emissions of 2.1-3.8 Mtpa CO2e. This was accepted by NOPSEMA in 2018. This remains within the range of our latest estimate. Santos continues to optimise the design of the Barossa facilities to minimise emissions to ALARP and an acceptable level.*	
The Booklet does not provide information about cumulative risks in the context of the broader Barossa Project. The duration of the Activity is estimated to be nine months, and this will occur in close temporal and spatial proximity to the development of six subsea production wells and the FPSO, which are dealt with in separate EPs. *The impacts and risks of activities conducted under the SURF EP cannot be adequately assessed without addressing*	*Assessment of cumulative impact from concurrent activities is described in the SURF EP to be submitted to NOPSEMA.* *On the basis that concurrent activities will occur within the OA, the potential for cumulative activity discharge impacts is acknowledged. These concurrent activities will be limited to a very short duration (days). Any overlapping discharge plumes will be temporary and localised (within hundreds of metres) of the discharge location.*	*The Barossa Development activities under the Barossa Development Drilling and Completions EP (BAD-200 0003) (referred to as the Drilling EP), the NOPSEMA-accepted Barossa Gas Export Pipeline Installation EP (BAA-210 0010) (referred to as the Barossa GEP Installation EP) and this SURF EP are planned to occur concurrently in the Operational Area (referred to as concurrent activities). Concurrent activities include situations where two or more Barossa Development*	*No additional EP controls required*

the cumulative effect of activities that will occur simultaneously, or in close succession. These simultaneous or successive impacts will contribute to the intensity and duration of impacts. Impacts considered minor in the context of this EP, could be significant in light of cumulative harms from other components of the Barossa Project. *Santos should assess and provide detail on the cumulative impacts and risks of activities conducted under the SURF EP, taking into account drilling and FPSO activities. Without such an assessment, it is not possible to conclude that impacts and risks have been reduced to acceptable levels that are as low as reasonably practicable.*	*Therefore, cumulative activity discharges effects are considered negligible, and no change to the overall consequence level has resulted.*	*activities occur nearby but continuously remain at a 'safe' level of separation (<500 m).* *All concurrent activities will be managed under an interface management plan. The cumulative impacts of any concurrent activities are summarised below:* • No identified additive or cumulative effects are associated with the physical presence and interaction with other marine users within the Operational Area (OA), given the low intensity of fishers and other marine users' activity, and the short duration of concurrent activities. Therefore, no change to the overall consequence level has resulted. • No identified cumulative impacts associated with benthic habitat disturbance resulting from concurrent activities. The cumulative area of benthic disturbance is an incidental proportion of similarly representative regional habitat. Therefore, cumulative effects are considered negligible, and no change to the overall consequence level has resulted. • On the basis that concurrent activities will occur within the OA, the potential for cumulative noise impacts is acknowledged. However, given the short and duration of concurrent activities	

		and the mobility of noise sensitive fauna species that may transit through the area, noise generated is predicted to attenuate below injury and disturbance thresholds in close proximity to the OA. Therefore, cumulative noise effects are considered to be negligible, and no change to the overall consequence level has resulted. *The remoteness of the OA means that it is unlikely that there will be a cumulative impact above noise thresholds with other marine users. Therefore, cumulative noise emission impacts are not predicted for the SURF Activity with other marine users.* • On the basis that concurrent activities will occur within the OA, the potential for cumulative light impacts is acknowledged. *Notwithstanding the potential for overlap of the extent of light effects from concurrent activities, due to the absence of significant feeding, breeding or aggregations areas within the Activity light assessment area (and up to 54 km from the Activity OA) and the short and intermittent duration of the concurrent activities, additive and cumulative light effects can reasonably be expected to be negligible. The lighting control measures identified reduce the extent practicable and the*	

		potential for impacts to sensitive marine fauna. • Cumulative atmospheric emission impacts are unlikely to occur from either concurrent activities or in conjunction with other marine users. This is based on the following: • atmospheric emissions from concurrent activities may result in a localised reduction in air quality in the immediate vicinity of the source and hence are unlikely to overlap with other marine users due to cautionary zone and PSZs around sources and the remoteness of the OA; • the addition of atmospheric emissions from concurrent activities will be a negligible contribution to overall Australian GHG emissions. Therefore, no change to the overall consequence level of emissions due to cumulative impacts are reasonably expected. • Although vessel discharges resulting in overlapping plumes from MODU and vessel operations discharges may occur during concurrent activities, it is considered unlikely. Vessel (including the MODU) interactions will be managed under an interface management plan. *A relatively small volume (incremental increase) over a very short duration*	

		(hours) is expected if concurrent discharges occur. Any overlapping plume may result in a highly localised and temporary decrease in water quality, considering the high dilution levels in open water and the nature of the marine environment near the OA. As a result, the effects of additive nor cumulative vessel (including MODU) discharges are considered negligible. *The remoteness of the OA means that it is unlikely that there will be a cumulative impact with other marine users. Therefore, no change to the overall consequence level due to cumulative vessel discharge impacts can reasonably be expected.* • On the basis that concurrent activities will occur within the OA, the potential for cumulative activity discharge impacts is acknowledged. These concurrent activities will be limited to a very short duration (days). Any overlapping discharge plumes will be temporary and localised (within hundreds of metres) of the discharge location. *Therefore, cumulative activity discharges effects are considered negligible, and no change to the overall consequence level has resulted.*	
The Booklet notes that cultural values and relevant risks and impacts "will continue to be identified, including through consultation with Indigenous	*Information on cultural heritage and values within the Operational Area and associated potential risks and impacts, as identified to date through consultation with Indigenous*	*Santos notes ECNT's comments. Santos is required by the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations*	*No additional EP controls required.*

people and their representative bodies, so that these can be assessed." *Comprehensive assessment of cultural values, based on genuine engagement with Indigenous people, should be completed and communicated prior to submission of this EP. In stating that identification of risks and impacts to cultural heritage will be ongoing, Santos demonstrates that this process is incomplete. As such, we submit that it is impossible for Santos to demonstrate that risks have been sufficiently identified or reduced to an acceptable level.*	*people and their representative bodies, will be assessed and presented in the EP which will be published and available for public viewing at NOPSEMA's website.*	*2009 (Cth) to provide opportunities for ongoing consultation as part of the implementation strategy in the EP. Criticisms of the current regulatory framework are outside the scope of this consultation.* *Information on cultural heritage and values within the Operational Area and associated potential risks and impacts, as identified to date through consultation with Indigenous people and their representative bodies, will be assessed and presented in the EP which will be published and available for public viewing at NOPSEMA's website.* *Santos has sought, and continues to seek, information about aspects of the environment that may be affected by the relating to these consultations.* *This may include information in relation to ecological, socio-cultural and Indigenous 'sea country' aspects, however any Relevant Person that provides information during the course of consultation has the ability to request that particular information not be published on NOPSEMA's website.*	
Santos is pursuing approvals for several elements of its Barossa project simultaneously. The capacity of Relevant Persons including ECNT to provide informed feedback to Santos on EPs for each component is limited by the overlap of processes. As such we feel that we	*ECNT's comments are noted.*	*ECNT's comments are noted. As per the response to paragraph 6 (above) on 3 June 2023 Santos provided ECNT with the Subsea Infrastructure Installation and Pre-commissioning Activity Information Booklet supporting consultation for this Environment Plan*	*No additional EP controls required.*

have not been in a position to adequately consider the contents of the Booklet. ECNT urges Santos to adopt a schedule for the pursuit of environmental approvals that avoids the overlap of consultation periods.		*and ECNT has subsequently responded in its correspondence of 14 July 2023. Santos considers ECNT has been provided with sufficient information and reasonable time to assess any possible impacts of the proposed activities on the ECNT's functions, interests and activities, and to provide any feedback it may have.*	
ECNT requests that Santos make the information requested above available to the public as soon as possible, and allow Relevant Persons adequate time to provide informed feedback on the proposed EP based on this information.	*ECNT's view on the consultation process is noted. The consultation processes followed by Santos will be described in the EP submitted to NOPSEMA for assessment.*	*ECNT's view on the consultation process is noted. Santos has undertaken a media and advertising campaign in relation to consultation for the EP and has made information publicly available on its website regarding the proposed activities, the risks and impacts and proposed controls.* *Santos' processes are informed and guided by the principles outlined in the NOPSEMA guideline 'Consultation in the course of preparing an environment plan' (N-04750-GL2086 A900179; 12/05/2023).* *The consultation processes followed by Santos will be described in the EP submitted to NOPSEMA for assessment. It is NOPSEMA's role to assess whether Santos' Relevant Persons consultation process has met the requirements of the Environment Regulations.*	*No additional EP controls required.*
Greenpeace			

Summary of consultation effort:

- On 2 June 2023 Santos emailed Greenpeace to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how Greenpeace would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1607]** Greenpeace sent Santos an auto-response email on the same day. **[Con-2173]**
- On 18 July 2023 Santos followed up the email of 2 June 2023 with a phone call to Greenpeace seeking its feedback. **[Con-2041]**
- On 21 July 2023 Santos emailed Greenpeace the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- On 28 July 2023 Santos emailed Greenpeace seeking its feedback which was requested by the later timeframe of 4 August 2023. **[Con-2041]**
- No further correspondence or feedback was received.

Summary of Objection or Claim	***Assessment of Merits***	***Santos' Response Statement***	***EP Reference***
Nil	*Nil*	*Nil*	*No additional EP controls required.*

Keep Top End Coasts Healthy			
Summary of consultation effort: • On 2 June 2023 Santos emailed Keep Top End Coasts Healthy to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how Keep Top End Coasts Healthy would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1607]** • On 18 July 2023 Santos followed up the email of 2 June 2023 with a phone call to Keep Top End Coasts Healthy seeking its feedback. **[Con-2127]** • On 21 July 2023 Santos emailed Keep Top End Coasts Healthy the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]** • On 28 July 2023 Santos emailed Keep Top End Coasts Healthy seeking its feedback which was requested by the later timeframe of 4 August 2023. **[Con-2127]** • No further correspondence or feedback was received.			
Summary of Objection or Claim	***Assessment of Merits***	***Santos' Response Statement***	***EP Reference***
Nil	*Nil*	*Nil*	*No additional EP controls required.*
Sea Turtle Foundation			
Summary of consultation effort: • On 2 June 2023 Santos emailed Sea Turtle Foundation to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how Sea Turtle Foundation would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1607]** • On 18 July 2023 Santos followed up the email of 2 June 2023 with a phone call to Sea Turtle Foundation seeking its feedback. **[Con-2040]** • On 21 July 2023 Santos emailed Sea Turtle Foundation the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]** • On 28 July 2023 Santos emailed Sea Turtle Foundation seeking its feedback which was requested by the later timeframe of 4 August 2023. **[Con-2040]** • On 11 August 2023 the Sea Turtle Foundation emailed Santos stating the SURF EP information provided on 2 June 2023 would be put on the Foundation Board's agenda and circulated to its Scientific Advisory Group in readiness for further opportunities for communication and clarification on the Barossa Project. **[Con-2285]** On the same day Santos acknowledged the response**. [Con-2286]** • No further correspondence or feedback was received.			

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Nil*	*Nil*	*No additional EP controls required.*

West Timor Care Foundation

Summary of consultation effort:

- On 2 June 2023 Santos emailed West Timor Care Foundation to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how West Timor Care Foundation would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1608]**
- On 21 July 2023 Santos emailed West Timor Care Foundation the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- No further correspondence or feedback was received on the SURF EP. Santos has sought to arrange a meeting to discuss proposed activities under Barossa Project EPs.

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Nil*	*Nil*	*No additional EP controls required.*

World Wildlife Fund (WWF)

Summary of consultation effort:

- On 2 June 2023 Santos emailed World Wildlife Fund to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how World Wildlife Fund would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1607]**
- On 18 July 2023 Santos followed up the email of 2 June 2023 with a phone call to World Wildlife Fund seeking its feedback. **[Con-2039]**
- On 21 July 2023 Santos emailed World Wildlife Fund the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- On 28 July 2023 Santos emailed World Wildlife Fund seeking its feedback which was requested by the later timeframe of 4 August 2023. **[Con-2039]** Santos received an auto-response receipt from WWF via email the same day. **[Con-2175]**
- No further correspondence or feedback was received.

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Nil*	*Nil*	*No additional EP controls required.*
First Nations Peoples			
Croker Island People			
Summary of consultation effort: • On 30 June 2023 Santos met with the Northern Land Council to discuss the appropriate process for travelling to Croker Island so that Santos could inform Croker Island people about the Barossa Gas Project. • On 7 July 2023, Santos obtained approval from the NLC for Santos to visit Croker Island on 13 July 2023 for the purpose of a "preliminary visit to the Croker Island to share some information on Santos and its business activities in northern waters and to gauge level of interest in further consultation sessions." • On 13 July 2023 Santos conducted a familiarisation visit to Croker Island and while there held informal discussions with a range of Croker Island people during which Barossa project activities were discussed in general. • During August and September of 2023, Santos coordinated discussions with Croker Island community members with the advice and support of cultural advisers external to Santos, all of whom hold leadership positions within their own communities and formal representative bodies. The advisers played a key role in liaising with Croker Island Elders and cultural leaders to allow for a process of self-determination in establishing an initial consultative committee. • On 22 August, 1 September and 3 September 2023 Santos met with a range of Croker Island community members in Darwin for the purpose of building relationships ahead of Regulation 11A consultation. Presentations at the meetings focused on providing an overall project overview, summaries of proposed drilling and subsea installation activities, discussions on activity impacts and risks, as well as providing regional context of historic petroleum industry activities in the region. • On 8 September 2023 Santos met with Croker Island community members at the Santos-operated Darwin LNG gas plant. The meeting was held at this location at the request of attendees at the 1 September 2023 meeting. Handouts and maps were provided to attendees who were invited to share these materials with family and community members on Croker Island. • On 15 September 2023 the Mulurryud Consultative Committee (MCC) met with Santos as part of Regulation 11A consultation. Discussion was held on the overall project, proposed subsea infrastructure installation activities and regulatory requirements for consultation on activity impacts and risks. No claims or objections were made about the proposed activities. • Discussion at the 15 September 2023 meeting also occurred on the identification and management of potential impacts to cultural heritage with the committee considering that these matters should be discussed in an appropriate cultural forum. **[Con-2401]** • Santos is committed to appropriate post acceptance consultation for this Activity and will continue to consult with the Croker Island People and the Northern Land Council in accordance with the strategy outlined above and further explained in Section 4.6.6. More detail on Santos' discussions with First Nations peoples and representative bodies on the consultation process is outlined in the EP implementation strategy in Section 8.11. On 23 September 2023 Santos provided a record of outcomes and actions from the 15 September 2023 meeting to the MCC attendees. **[Con-2410]**			

- On 26 September 2023 the consultant, on behalf of the Mulurryud Consultative Committee Chair, advised that a meeting of the committee had been held that day and expressed unanimous satisfaction with MCC responded to Santos via its nominated contacts and confirmed that: **[Con-2409]**
  - It was satisfied with all of the responses provided by Santos to the actions that arose from the Santos Regulation 11A consultation meeting at Darwin on 15 September 2023.
  - It decided that the responses provided by MCC Committee members, and First Nations advisors and observers present at the Santos Regulation 11A consultation held in Darwin on 15 September 2023 are to be treated as confidential to NOPSEMA and to Santos and as such should not be made publicly available.

On 27 September 2023 Santos responded to the MCC acknowledging its satisfaction with Santos' responses from the meeting of 15 September 2023. Santos also noted MCC's feedback for feedback to remain confidential to NOPSEMA. Santos considers consultation to be complete for this EP. **[Con-2422]**

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Nil*	*Nil*	*No additional EP controls required.*

Kimberley Land Council

Summary of consultation effort:

- On 4 September 2023 Santos emailed the Kimberley Land Council in follow-up to a phone discussion on 1 September 2023 during which Santos was advised it could send information to the Council related to the Barossa Subsea Infrastructure Installation Environment Plan (SURF EP). In the email Santos advised the Council that the boundary of the environment that may be affected (EMBA) by the SURF activities (in an unplanned event) was approximately 180 km offshore from the Kimberley coastline; a part of the EMBA did intersect with the KLC's Native Title Representative Body Area; but the EMBA did not intersect any Native Title Determined Areas, Native Title Determination Applications, Indigenous Protected Areas or Indigenous Land Use Agreement Areas.
- The email explained the consultation approach for the SURF EP, asking if KLC would like to be consulted, how it would like to be consulted and what information it required. Santos provided a Barossa Drilling and Completions Information Booklet and Fact Sheet and links to NOPSEMA Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community.
- Santos advised that it was providing the KLC an opportunity to provide feedback on the SURF EP, if interested, by Friday, 22 September 2023 and indicate what, if any, further information may be required. Santos advised that it intended to submit the SURF EP to NOPSEMA at the end of the month/early October. **[Con-2416]**

  No further correspondence or feedback was received

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Nil*	*Nil*	*No additional controls required*

Northern Land Council (NLC)			
Summary of consultation effort: • On 2 June 2023 Santos emailed NLC to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how NLC would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1607]** • On 30 June 2023 Santos met with the NLC to keep the NLC updated about First Nations consultation and engagement by Santos throughout 2023. • On 21 July 2023 Santos emailed NLC the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]** • On 17 August 2023 met with the NLC to keep the NLC updated about First Nations consultation and engagement by Santos throughout 2023.			
Summary of Objection or Claim	***Assessment of Merits***	***Santos' Response Statement***	***EP Reference***
Nil	*Nil*	*Nil*	*No additional controls required*
Tiwi Land Council (TLC)			
Summary of consultation effort: • On 23 June 2023 Santos emailed the TLC to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how the TLC would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1614]** • On 21 July 2023 Santos emailed the TLC the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]** • On 18 August 2023 Santos emailed the TLC, to follow up any feedback related to this EP and requesting that the TLC advise if it had feedback by the following week. **[Con-2303]** • No response or feedback has been received. • Representatives of TLC have also attended and facilitated Tiwi clan consultation sessions (refer to consultation with Tiwi clans below).			
Summary of Objection or Claim	***Assessment of Merits***	***Santos' Response Statement***	***EP Reference***
Nil	*Nil*	*Nil*	*Nil*

Tiwi Islands Clan Groups and Individuals
Summary of consultation effort: • Santos adopted a staged approach to consultation with Tiwi Islands clan groups and individuals. • Santos understands approximately seven Tiwi people are represented by the Environmental Defenders Office (EDO). Before and throughout the consultation period, the EDO on behalf of various of its clients has corresponded with Santos in relation to the consultation process. **[Con-1523], [Con-1551], [Con-1574], [Con-1576], [Con-1577], [Con-1579], [Con-1580], [Con-1582], [Con-1583], [Con-1585], [Con-1587] [Con-1588], [Con-1591], [Con-2526], [Con-2527].** • Consultation activities were conducted in person, primarily through discussions or presentations. • Written consultation materials were also made available or supplied. • Santos used visual aids, maps, videos, animations to present information regarding the Activity and the project more generally. • On 7 January 2023, Santos provided notice (by half-page advertisement in the NT News) of community sessions scheduled on the Tiwi Islands for 6, 7 and 8 February. • Between 6 and 8 February 2023 (inclusive), Santos attended the Tiwi Islands and held community engagement sessions in Milikapiti, Pirlangimpi and Wurrumiyanga to seek feedback from the clan members as to how they would like to be consulted. Santos received feedback during those sessions to the effect that consultation should occur through clan group meetings, with approximately a month's notice of consultation sessions to allow time to consider information and then re-group. • Santos representatives remained on the Tiwi Islands on 9 and 10 February 2023 and were available to answer questions regarding the project and proposed activities (including risks and impacts), the consultation process and consultation preferences, and to receive any feedback. • On 26 and 28 April and 4 and 5 May 2023, Santos held consultation sessions with Tiwi Islands clans, at three locations around the Tiwi Islands (Milikapiti, Pirlangimpi and Wurrumiyanga). Information regarding this EP and the Activity was communicated to the clan members and feedback was sought. One session was held for each clan group, however other clan group members attended some meetings with the approval of the clan elders and/or trustee. In total, 820 clan members attended these sessions. Notice for these consultation sessions was provided a month prior on 29 March 2023 (by full page advertisement in the NT News). Santos also advertised the sessions on social media and the Tiwi Noticeboard Facebook page on 28 March 2023. **[Con-1537 to Con-1543 inclusive]** • Between 13 and 16 June 2023 (inclusive), Santos held follow-up consultation sessions with Tiwi Islands clans, at three locations around the Tiwi Islands (Milikapiti, Pirlangimpi and Wurrumiyanga), during which information regarding this EP was communicated to the clan members and feedback was sought. One session was held for each clan group, however other clan group members attended some meetings with the approval of the clan elders and/or trustees. In total, 679 clan members attended these sessions. Notice for these consultation sessions were provided a month prior on 13 May 2023 (by full page advertisement in the NT News). Santos also publicised the sessions on social media and the Tiwi Noticeboard Facebook page on 12 May 2023. **[Con-1544 to Con-1550 inclusive].** • Between 8-9 August 2023 (inclusive), Santos held final consultation sessions with Tiwi Islands clans, at two locations around the Tiwi Islands (Milikapiti and Wurrumiyanga). The same information regarding this EP was communicated to the clan members and the manner in which their feedback was intended to be addressed in this EP was communicated to the clan members and the manner in which their feedback was intended to be addressed in this EP was communicated to clan members. Clan groups were combined for these sessions, following approval to do so received from clan representatives, via Tiwi Resources. In total, 505 clan members attended these sessions. Notice for these consultation sessions was originally provided a month in advance, in July

however, these sessions were required to be rescheduled due to sorry business in the community and the revised dates were communicated on 3 August 2023, shortly in advance of the sessions.

- Due to sorry business in the community, Santos was unable to host the planned final consultation session regarding this EP with the Munupi clan in August 2023. Therefore, on 23 August 2023 Santos requested Tiwi Resources arrange for a notice seeking final feedback from the Munupi clan to be posted on the Pirlangimpi notice board. The notice sought final feedback from the Munupi clan by 31 August 2023 and outlined a number of ways in which feedback could be provided.
- Tiwi Islands clan members were encouraged to provide their name to Santos if they wished to however, were not obliged to do so. Therefore, in some cases, feedback received is able to be identified to the individual who asked the question and in other cases, this information is not available. Santos respected confidentiality and anonymity requests.

A detailed chronology of all steps taken to consult with the Tiwi Island clan groups and individuals is included at Appendix F

Summary of Objection or Claim	***Assessment of Merits***	***Santos' Response Statement***	***EP Reference***
Tiwi Islanders clan members have requested to be trained in spill response and have spill kits located on the Islands.	*Santos has responded to this feedback and included an additional commitment in the OPEP (BAS-210 0109).*	*Santos will deliver three-hour rapid assessment training in consultation with Tiwi Rangers groups prior to the commencement of the activity. The training will be tailored specifically for Tiwi Rangers. Additional on-the-job training will be provided post-spill to additional personnel (if required).* *Santos will make rapid assessment kits available on the Tiwi Islands to perform sampling and monitoring.*	*Section 5.4.2 of the OPEP (BAS-210 0109) has been updated to reflect the training and materials that will be made available to Tiwi Islands Ranger groups.*
Tiwi Islands clan members have requested to be notified as soon as practicable in the event of a spill event.	*Santos has responded to this feedback and included an additional commitment in the OPEP (BAS-210 0109).*	*Santos will notify the clan members who have requested to be notified via phone call within 8 hours of a spill incident being identified that may be moving towards the Tiwi Islands.*	*Section 7.1 of the* OPEP (BAS-210 0109) *has been updated to reflect the notification requirements.*
Tiwi Islands clan members raised concerns about potential impacts to marine life in the event of a hydrocarbon	*Santos acknowledges these concerns and has provided detailed responses*	*Santos acknowledges feedback received with respect to concerns*	*Adopted prevention and mitigation control measures in the SURF EP (Table 7-12), including a reduction*

spill. Tiwi people have a particular interest in turtles as a food source.	*both written and verbal at the sessions with clan members.*	*about potential impacts to marine life in the event of a hydrocarbon spill.* *The likelihood of a worst-case loss of containment from a vessel during SURF activities is extremely low. In the unlikely event of a worst-case event, Santos will implement response strategies contained in the OPEP (BAS-210 0109) to reduce potential impacts to marine life to as low as reasonably practicable and to an acceptable level.*	*in fuel capacity on activity vessels to reduce the risk of MDO spill resulting in shoreline accumulation on the Tiwi Islands and the OPEP (BAS-210 0109), are considered sufficient to reduce the risks and impacts to marine life from a worst-case loss of containment to as low as reasonably practicable and to an acceptable level.* *No further EP controls required.*
Tiwi Islanders asked whether the Barossa project will significantly increase marine vessel traffic around the Tiwi Islands.	*Santos notes this feedback.*	*Over the construction phase of the project, the number of associated vessels between Darwin Port and the activity area will vary depending on the project activity.* *For SURF activities, there are estimated to be approximately 5-7 vessel movements around the Tiwi Islands per week for approximately nine months.* *For context, Darwin Port currently has on average 30 commercial vessel movements per week.*	*No further EP controls required.*
Tiwi Islanders have raised queries regarding job opportunities for Tiwi People associated with the Barossa Project.	*Santos notes this feedback.*	*Santos will consider this request as part of its post acceptance consultation implementation process and associated strategy and activities.*	*No further EP controls required.*
During a conversation with a Traditional Owner on August 9th 2023, they pointed out the location of a Sacred Site that	*Santos noted this feedback and has assessed options for reducing the risk of impact.*	*Santos thanks the individual for providing this information. A new Control Measure has been introduced*	*A new control measure has been developed (C7.6.5): Additional spill modelling has identified that intersection with the sacred site will*

intersects with the modelled SURF EMBA (MDO at low accumulation value).		*to the SURF EP to reduce the risk of impact to the nominated Sacred Site.*	*not occur if the modelled MDO spill is reduced from 500m^3 to 450m^3. Santos will therefore limit the fuel capacity on activity vessels as follows:* *1. Vessels where the fuel tanks are protected by only a single skinned hull will be limited to a tank capacity of no more than 450 m^3* *2. Vessels where the fuel tanks are protected by a double skinned hull will be limited to a tank capacity of no more than 900 m^3*

Infrastructure Operators

Darwin Port

Summary of consultation effort:

- On 2 June 2023 Santos emailed Darwin Port to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how Darwin Port would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1607]**
- On 18 July 2023 Santos followed up the email of 2 June 2023 with a phone call to Darwin Port seeking its feedback. **[Con-2050]**
- On 21 July 2023 Santos emailed Darwin Port the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- On 28 July 2023 Santos emailed Darwin Port seeking its feedback which was requested by the later timeframe of 4 August 2023. **[Con-2050]**
- No further correspondence or feedback was received.

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Nil*	*Nil*	*No additional EP controls required.*

NT Ports and Marine

Summary of consultation effort:

- On 2 June 2023 Santos emailed NT Ports and Marine to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how NT Ports and Marine would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1607]**
- On 18 July 2023 Santos followed up the email of 2 June 2023 with a phone call to NT Ports and Marine seeking its feedback**. [Con-2034]**
- On 21 July 2023 Santos emailed NT Ports and Marine the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- On 28 July 2023 Santos emailed NT Ports and Marine seeking its feedback which was requested by the later timeframe of 4 August 2023. **[Con-2034]**
- No further correspondence or feedback received.

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Nil*	*Nil*	*No additional EP controls required.*

Industry Associations

Amateur Fisherman's Association of the NT (AFANT)

Summary of consultation effort:

- On 2 June 2023 Santos emailed the Amateur Fisherman's Association of the NT (AFANT) to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how AFANT would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1607]**
- On 21 July 2023 Santos emailed AFANT the Barossa Development Quarterly Update, which included information on the consultation process for this EP. [Con-2022]
- On 18 July 2023 Santos followed up the email of 2 June 2023 with a phone call to AFANT seeking its feedback. **[Con-2219]**
- On 7 August 2023 Santos followed-up the phone call of 18 July with another email to AFANT. **[Con-2219]**
- On 9 August 2023 AFANT emailed and stated it had no comments on the SURF EP. **[Con-2214]**
- No further correspondence or feedback was received.

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Nil*	*Nil*	*No additional EP controls required.*

Association of Marine Tourism Timor-Leste (AMT-TL)

Summary of consultation effort:

- On 2 June 2023 Santos emailed AMT-TL to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how AMT T-L would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1606]**
- On 21 July 2023 Santos followed up the email of 2 June 2023 with a phone call to AMT-TL seeking its feedback. **[Con-1971]**
- On 21 July 2023 Santos emailed AMT-TL the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- On 28 July 2023 Santos emailed AMT-TL seeking its feedback which was requested by the later timeframe of 4 August 2023. **[Con-1971]**
- No further correspondence or feedback was received.

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Nil*	*Nil*	*No additional EP controls required.*

Australian Southern Bluefin Tuna Industry Association (ASBTIA)

Summary of consultation effort:

- On 2 June 2023 Santos emailed ASBTIA to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how ASBTIA would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1607]**
- On 18 July 2023 Santos followed up the email of 2 June 2023 with a phone call to ASBTIA seeking its feedback. **[Con-2052]**
- On 21 July 2023 Santos emailed ASBTIA the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- On 28 July 2023 Santos emailed ASBTIA seeking its feedback which was requested by the later timeframe of 4 August 2023. **[Con-2052]**
- No further correspondence or feedback was received.

Summary of Objection or Claim	Assessment of Merits	Santos' Response Statement	EP Reference
Nil	*Nil*	*Nil*	*No additional EP controls required.*

Commonwealth Fisheries Association (CFA)

Summary of consultation effort:

The Commonwealth Fisheries Association (CFA) has advised Santos that it does not wish to be provided information during the development of EPs and consultation should occur directly with the relevant commercial fishing industry associations. Santos acknowledges the CFA's stance and will consult directly with the relevant associations.

Summary of Objection or Claim	Assessment of Merits	Santos' Response Statement	EP Reference
Nil	*Nil*	*Nil*	*No additional EP controls required.*

Northern Prawn Fishing Industry Pty Ltd (NPFI)

Summary of consultation effort:

- On 2 June 2023 Santos emailed NPFI to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how NPFI would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1607]**
- On 18 July 2023 Santos followed up the email of 2 June 2023 with a phone call to NPFI seeking its feedback. **[Con-1988]**
- On 21 July 2023 Santos emailed NPFI the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022**]
- On 28 July 2023 Santos emailed NPFI seeking its feedback which was requested by the later timeframe of 4 August 2023. **[Con-1988]**
- No further correspondence or feedback was received.

Summary of Objection or Claim	Assessment of Merits	Santos' Response Statement	EP Reference
Nil	*Nil*	*Nil*	*No additional EP controls required.*

Northern Territory Guided Fishing Industry Association (NTGFIA)			
Summary of consultation effort: • On 2 June 2023 Santos emailed NTGFIA to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how NTGFIA would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1607]** • On 18 July 2023 Santos followed up the email of 2 June 2023 with a phone call to NTGFIA seeking its feedback. **[Con-1961]** • On 21 July 2023 Santos emailed NTGFIA the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]** • On 28 July 2023 Santos emailed NTGFIA seeking its feedback which was requested by the later timeframe of 4 August 2023. **[Con-1961]** • No further correspondence or feedback was received.			
Summary of Objection or Claim	***Assessment of Merits***	***Santos' Response Statement***	***EP Reference***
Nil	*Nil*	*Nil*	*No additional EP controls required.*
Northern Territory Seafood Council (NTSC)			
Summary of consultation effort: • On 2 June 2023 Santos emailed NTSC t to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how NTSC would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1607]** • On 6 June 2023 Santos also posted the Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet to all NT licence-holders, as requested by their representative body, the NT Seafood Council. **[Con-1612]** • On 18 July 2023 Santos followed up the email of 2 June 2023 with a phone call to NTSC seeking its feedback. **[Con-2045]** • On 21 July 2023 Santos emailed NTSC the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]** • On 28 July 2023 Santos emailed NTSC seeking its feedback which was requested by the later timeframe of 4 August 2023. **[Con-2045]** • As per NTSC's standing request, the same information was posted to all NT Licence Holders on 31 July 2023. **[Con-2200]** • No further correspondence or feedback was received.			

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Nil*	*Nil*	*No additional EP controls required.*

Pearl Producers Association (PPA)

Summary of consultation effort:

- On 2 June 2023 Santos emailed PPA to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how PPA would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1607]**
- On 18 July 2023 Santos followed up the email of 2 June 2023 with a phone call to PPA seeking its feedback. **[Con-1960]**
- On 21 July 2023 Santos emailed PPA the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- On 28 July 2023 Santos emailed PPA seeking its feedback which was requested by the later timeframe of 4 August 2023. **[Con-1960]**
- No further correspondence or feedback was received.

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Nil*	*Nil*	*No additional EP controls required.*

Tourism Top End

Summary of consultation effort:

- On 2 June 2023 Santos emailed Tourism Top End to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how Tourism Top End would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1607]**
- On 18 July 2023 Santos followed up the email of 2 June 2023 with a phone call to Tourism Top End seeking its feedback. **[Con-1963]**
- On 21 July 2023 Santos emailed Tourism Top End the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- On 28 July 2023 Santos emailed Tourism Top End seeking its feedback which was requested by the later timeframe of 4 August 2023. **[Con-1963]**
- No further correspondence or feedback was received.

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Nil*	*Nil*	*No additional EP controls required.*

Western Australian Fishing Industry Council (WAFIC)

Summary of consultation effort:

- On 2 June 2023 Santos emailed to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how WAFIC would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information for the Community. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1607]**
- On 21 July 2023 Santos emailed WAFIC the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]**
- On 1 August 2023 Santos emailed WAFIC seeking its feedback which was requested by the later timeframe of 4 August 2023. Santos advised WAFIC that it was following WAFIC's stated advice (https://www.wafic.org.au/what-we-do/access-sustainability/oil-gas/consultation-approach-for-unplanned-events/) to consult only on impact where the risk involved for the activities proposed under an EP was very low. **[Con-2205]**
- On 22 September 2023 WAFIC responded to Santos' email of 1 August 2023 stating that it still holds the same position as published on its website. **[Con-2420]**
- On 28 September 2023 Santos emailed WAFIC to acknowledge its confirmation. **[Con-2421]**
- No further correspondence or feedback was received.

Summary of Objection or Claim	*Assessment of Merits*	*Santos' Response Statement*	*EP Reference*
Nil	*Santos acknowledges that WAFIC's stated approach does not require consultation for the activities proposed under this EP.*	*Santos has confirmed with WAFIC its understanding of WAFIC's approach to consultation for the activities proposed under this EP. [Con-2205] and [Con-2420]*	*No additional EP control are required.*

Marine and Coastal Tourism Operators			
Clearwater Island Lodge/Tiwi Adventures/Melville Lodge; Bathurst Island Lodge/Tiwi Island Retreat; Arafura Bluewater Charters			
Summary of consultation effort: • On 2 June 2023 Santos emailed the Fishing Tourism Operators listed to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how they would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and a link to NOPSEMA's Guideline: Consultation on offshore petroleum environment plans. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1607]** • On 18 July 2023 Santos followed up the email of 2 June 2023 with phone call to all the listed tourism operators seeking their feedback. **[Con-2031], [Con-2033], [Con-2048]** • On 21 July 2023 Santos emailed the tourism operators the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]** • On 28 July 2023 Santos followed-up the phone calls with emails to the tourism operators seeking their feedback which was requested by the later timeframe of 4 August 2023. **[Con-2031], [Con-2033], [Con-2048]** • On 11 August 2023 Clearwater Island Lodge emailed Santos to complain about the provision of ongoing emails and adverse impact of the Barossa Project on the Tiwi Islands. **[Con-2289]** • On 15 August 2023 Santos emailed Clearwater Island Lodge advising that Santos would not be making further contact in relation to the SURF EP as that consultation had concluded and proposed an amended future consultation process for Clearwater Island Lodge to consider. Santos also noted that Clearwater Island Lodge's feedback was related to the Barossa Project overall. **[Con-2290]** • No further correspondence or feedback was received.			
Summary of Objection or Claim	***Assessment of Merits***	***Santos' Response Statement***	***EP Reference***
Nil	*Nil*	*Nil*	*No additional EP controls required.*
Dreamers Dive Academy Timor			
Summary of consultation effort: • On 2 June 2023 Santos emailed Dreamers Dive Academy to provide information about the proposed activities under this EP, explaining the consultation and proposed approach, asking how Dreamers Dive Academy would like to be consulted and what, if any, further information it required. An Information Booklet and Barossa Gas Project Subsea Infrastructure Installation Plan (SURF EP) Consultation Fact Sheet was also provided and links to NOPSEMA's Guideline: Consultation in the course of preparing an Environment Plan and NOPSEMA Brochure: Consultation on offshore petroleum environment plans – Information			

for the Community. Santos also advised that feedback on the EP was being sought by 14 July 2023 and Santos was aiming to submit the EP to NOPSEMA in or around August 2023. **[Con-1608]** • On 18 July 2023 Santos followed up the email of 2 June 2023 with a phone call to Dreamers Dive Academy seeking its feedback. **[Con-1971]** • On 21 July 2023 Santos emailed Dreamers Dive Academy the Barossa Development Quarterly Update, which included information on the consultation process for this EP. **[Con-2022]** • On 28 July 2023 Santos emailed Dreamers Dive Academy seeking its feedback which was requested by the later timeframe of 4 August 2023. **[Con-1971]** • No further correspondence or feedback was received.			
Summary of Objection or Claim	***Assessment of Merits***	***Santos' Response Statement***	***EP Reference***
Nil	*Nil*	*Nil*	*Nil*

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 is the process by which planned and unplanned events that will or may occur during an activity are assessed for their impacts on the environment (as defined in regulation 4 of the OPGGS(E)R) at a defined location and specified time period. In addition, unplanned events are assessed on the basis of their likelihood of occurrence, which defines their risk level.

Santos has undertaken environmental impact and risk assessments for the planned events and unplanned events in accordance with the OPGGS(E)R.

This section of the EP provides information relating to the environmental impact and risk assessment approach, specifically:

- terminology used
- summary of the approach used.

The process used to identify, analyse and evaluate environmental impacts and risks is fully described in Santos' Offshore Division 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 environmental impact and risk assessment process, and used in this EP, are defined in Table 5-1.

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 following management controls. Acceptability of unplanned events is in part determined from its risk ranking following 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 information received through consultation when determining management controls.
Activity	Specific tasks and actions undertaken throughout the lifecycle of oil and gas exploration, development, production and decommissioning.

Term	Definition
ALARP	As Low as Reasonably Practicable The term refers to reducing impact and 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 practical measures that could reasonably be taken to reduce impacts or risks further (NOPSEMA Guidance Note: ALARP, dated 1/08/2022 (N-04300-GN01660166 A138249); NOPSEMA Guideline: Environment plan decision making guideline, dated 16/12/2022 (N-04750-GL1721 A524696).
Authorised person	Person with the authority to make a decision or take an action. Examples are vessel master, superintendent, supervisor, person-in-charge, company authorised representative, and project manager.
Control measure	Is defined by the OPGGS(E)R to mean a system, an item of equipment, a person or a procedure that is used as a basis for managing environmental impacts and risks
ENVID workshop	Environmental hazard identification workshop.
Environment	Is under the OPGGS(E)R 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; and includes (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 the OPGGS(E)R as any change to the environment, whether adverse or beneficial, wholly or partly resulting from an activity.
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.
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.
Hazard	A situation with the potential to cause harm.
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 time period.
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	The activity to be undertaken under this EP, including the services, equipment, products, assets, personnel, timing, duration and location and aspect of the activity.
Planned event	An event arising from the activity that is done with intent (i.e. 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

Term	Definition
	infrequently if at all). Air emissions and activity discharges are examples of planned events.
Receptor	A feature of the environment that may have 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 time period.
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.
Unplanned event	An event that results in some level of environmental impact and may occur despite preventive 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 (QE-91-IF-10050). The company Risk Management Standard (SMS-MS1) and supporting Procedure (SMS-MS1-ST01-TP1) 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, as defined in the Santos Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004).

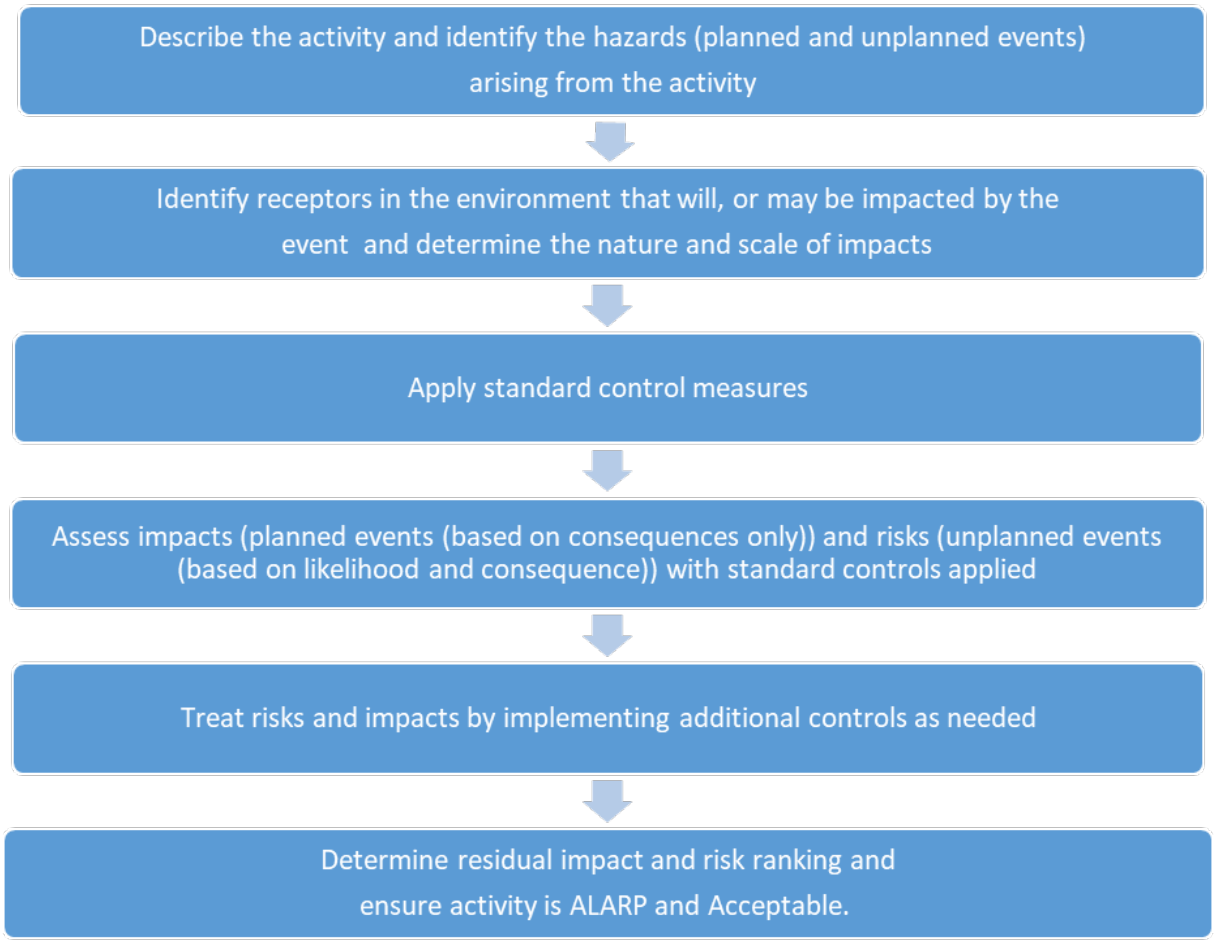


Figure 5-1: Hazard identification and assessment guideline

These steps are considered in activity-specific environmental assessment workshop(s) (ENVID workshop) and in the development of this EP. The workshop involves participants from Santos' Health, Safety and Environment (HSE), Spill Response and relevant departments, and specialist environmental consultants.

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

The location, timing and scope of the Activity must be understood to define the hazards and determine the impacts from planned events, and the impacts and risks from unplanned events since these have a bearing upon the EMBA.

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 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 environmental, socioeconomic and cultural features values and sensitivities 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 the SURF Values & Sensitivities of the Marine Environment (BAS-210 0132, Appendix C) document, which describes the existing environment that may be affected by the Activity and informed through consultation (refer to Section 3.2.5.10). A protected matters search

was conducted over the Activity EMBA to identify occurring or potentially occurring receptors. These receptors are detailed in Section 3.

An ENVID workshop (as described in Section 5.1) was held in April 2022. A second ENVID workshop was held in August 2023 to revalidate the impact assessment based on new information relating to receptors (including values and sensitivities obtained during consultation) and any changes to the Activity description. New requirements (such as changes to legislation, other requirements and guidelines) were also considered.

The extent of impacts from planned Activities or risks and impacts from unplanned events were assessed using, where required, modelling (e.g. hydrocarbon release) and scientific reports. The expected duration of each event was also defined using subject matter expertise.

Santos assessed the cumulative impacts of the Activity with other marine users. However, due to the remote location of the OA, it is unlikely that there will be a cumulative impact above impact thresholds with other marine users. Concurrent activities (as described in Section 2.10) may occur between the Drilling and Completions Activity, GEP Installation Activity and the Activity. Hence the potential cumulative impacts of concurrent activities were considered within each relevant aspect.

5.3 Describe the environmental performance outcomes and control measures

As required by the OPGGS(E)R, environmental performance outcomes(s) (EPOs), control measures, environmental performance standards (EPSs) and measurement criteria were identified for the identified environmental impacts and risks.

All reasonably practicable control measures were considered and either accepted for use or rejected based on whether impacts and risks had been reduced to levels considered acceptable and ALARP.

Accepted control measures were allocated in order of preference, as shown in 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

The consequence level of a potential impact was determined for each planned and unplanned event using Santos' environment consequence descriptors (Appendix J) and assuming that all control measures had been implemented.

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
- socioeconomic receptors
- cultural features.

Consequence descriptors are based on set criteria for each receptor category and take 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.

When assessing impacts to cultural features that are part of the environment that may be affected by the Activity, Santos considered cultural features of the environment as defined under the OPGGS(E)R):

(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

When assessing the consequence level of impact to cultural features, Santos considers the different types of cultural features and types of impacts. For impacts to cultural features, in the form of impacts to marine species that are either a cultural food source or are considered culturally significant to First Nations people, Santos assesses impacts with reference to the consequence assessment for threatened/migratory/local fauna. Similarly, where cultural features are linked to a specific place, impacts to cultural features are assessed with reference to the consequence assessment for physical environment/threatened ecological communities/protected areas as applicable. Where there are concerns raised by individuals about cultural and spiritual beliefs that do not link to a specific location or place, Santos will evaluate impact and risk acceptability with consideration for assessment of impacts from analogous activities (e.g. historical drilling, trawl fishing activity, industrial shipping) and consider culturally appropriate measures in response to concerns raised by individuals.

As planned events are expected to occur during the Activity, the likelihood of their occurrence was not considered during the environmental assessment, and only a consequence level was 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 was combined with the likelihood of the impact occurring (Table 5-3) to determine a residual risk ranking using Santos' corporate risk matrix (Table 5-4).

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

No.	Matrix	Description
a	Remote	Requires exceptional circumstances and is unlikely to occur 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 was 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 to reduce the level of impact or risk. If this cannot be demonstrated, then 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 (e.g. more detail is required for a risk ranked as 'Medium' compared with 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 each of the following criteria, where relevant, is satisfied:

- 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 that sufficient information or studies have been considered to validate the consequence assessment
- the principles of ESD have been assessed
- the acceptable levels of impact and risks have been informed by relevant species recovery plans, threat abatement plans and conservation advice
- performance outcomes, control measures and associated performance standards:
  - are consistent with legal and regulatory requirements
  - are consistent with Santos' Environment, Health and Safety Policy (Appendix A)
  - are consistent with industry standards
  - take into consideration Relevant Person feedback
  - have been demonstrated to reduce the impact or risk to ALARP.

6 Planned activities 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 as low as reasonably practicable 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.

An ENVID workshop (as described in Section 5) for planned activities was held in April 2022. Santos' environmental assessment identified 7 causes of environmental and socioeconomic impacts associated with the planned activities to be undertaken within the OA. A second ENVID workshop was held in August 2023 to revalidate the impact assessment based on new information relating to receptors (including values and sensitivities) (as described in Section 5.2.3) and updates to the Activity. New requirements (such as changes to legislation, other requirements and guidelines) were also considered. The results of the impact assessments are summarised in Table 6-1 and described in the next subsections.

Table 6-1: Environmental impact assessment summary

EP section	Hazard	Residual consequence level
6.1	Interaction with other marine users	I – Negligible
6.2	Seabed and benthic habitat disturbance	II – Minor
6.3	Noise emissions	I – Negligible
6.4	Light emissions	I – Negligible
6.5	Atmospheric emissions	I – Negligible
6.6	Vessel discharges	II – Minor
6.7	Activity discharges	II – Minor

6.1 Interactions with other marine users

6.1.1 Description of event

Event	Sources of impact to other marine users may occur as a result of: • vessels frequently moving within and occasionally moving to and from the OA • helicopter operations to and from the OA. Other marine users within the OA may include commercial shipping and fishing. Concurrent activities (Section 2.10) may result in an additional MODU, up to 3 support vessels, pipelay vessel, construction vessel and helicopter flights within the OA.
Extent	Contained within the OA and limited to exclusion zones around zones. Concurrent activities are contained within the OA. A 500 m PSZ will be established around the MODU and around each of the 3 wellheads (covered under the Drilling EP). Additionally, the GEP pipelay vessel (covered under the Barossa GEP Installation EP) will also have a 500 m exclusion zone.
Duration	Temporary and intermittent interaction with third-party vessels when transiting the OA during the Activity duration (approximately 9 months). Section 2.10 describes the temporal extent of concurrent activities.

6.1.2 Nature and scale of environmental impacts

Potential receptors: socioeconomic (primarily commercial fisheries and shipping traffic).

Eight managed fisheries (4 Commonwealth, 4 NT) overlap the OA (Section 3.2.4.1). Table 3-12 provides a summary of the commercial fisheries and Santos' understanding of fishing effort based on publicly available information and consultation with Relevant Persons. No active commercial fishing effort for five of the managed fisheries has occurred within the OA. Fishing effort for the Timor Reef Fishery and Offshore Net and Line Fishery is possible but highly unlikely due to a concentration of fishing effort in near coastal areas and targeted species preferring water shallower than 200 m. The Northern Prawn Fishery medium and high fishing effort is greater than 113 km from the OA. Prawn fishing is not expected in waters greater than 130 m, however scampi fishing may occur in waters >250 m during the months of December and January. These water depths occur in the outermost northern area of the OA where low fishing effort may be possible during December and January but unlikely (Table 3-12).

Indonesian and Timorese traditional fishers may traverse the OA to reach permitted fishing areas (e.g. MoU Box)(see Section 3.2.4.2). The OA does not overlap the Perth Treaty area and impact Indonesian fishing activity.

Tourism, recreational or traditional owner fishing are not expected in the OA given the water depths, distance from land (~143 km north of the Tiwi Islands) and lack of seabed features (see Sections 3.2.5.8 and 3.2.4.7). Consultation feedback from organisations with knowledge of recreational fishing in NT waters, indicated that while it is possible that recreational fishing charter vessels may operate in the vicinity of the OA, this would only occur on a very infrequent basis due to the cost and resources required to mount such a long distance operation. One charter operator has advised they visit the area around Evans Shoal (~66 km west of the OA) up to 2 times per year.

The closest shipping lane is approximately 60 km from the OA, and the closest energy industry facility (Santos' Bayu–Undan Platform) is approximately 410 km distant. There are no designated military/defence exercise areas within the OA. Therefore, general shipping traffic within the OA is expected to be low (see Section 3.2.4.6).

Other marine users may be inhibited by the temporary presence of the OA and activities of the activity vessels. Note: Existing regulatory access restrictions occur over sections of the OA due to the

ongoing presence of the several Barossa PSZs (outside the scope of this EP), hence there are already a limited number of marine users (i.e. commercial fishers may have already modified their presence in this area).

Helicopter operations within the OA will be infrequent (approximately 3 times a week) and unlikely to interfere with other marine users as access around activity vessels will be restricted.

6.1.2.1 Potential cumulative impacts from concurrent activities

On the basis that concurrent activities (see Section 2.10) will occur within the OA, the potential for cumulative impacts to other marine users is acknowledged. A 500m PSZ will be established around the MODU and each of the 3 wellheads (covered under the Drilling EP). Additionally, the GEP pipelay vessel (covered under the Barossa GEP Installation EP) will have a 500m exclusion zone established. The additional PSZs and pipelay vessel exclusion zone will result in an incremental increase in the exclusion area for other marine users. However, due to the low activity intensity of fishers and other marine users, and the short duration of concurrent activities, the additive or cumulative effects to marine users can reasonably be expected to be negligible.

6.1.3 Environmental performance outcomes and control measures

The EPO relating to this event is:

- No significant impacts to other marine users [EPO-01].

An assessment of the environmental benefits and the potential costs or issues associated with control measures for this activity are described in Table 6-2 to demonstrate the potential impacts from this aspect are ALARP. Control measures that are adopted have associated EPSs and measurement criteria, and are presented in Table 8-2. Rejected control measures have an ALARP evaluation provided to justify their rejection.

Table 6-2: Control measures evaluation for interaction with other marine users

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
Standard control measures				
C6.1.1	Activity vessels equipped and crewed in accordance with Australian maritime requirements (administrative control)	Ensures vessel lighting, radios and equipment is inspected and maintained so that other marine users are aware of the vessel's physical presence, thus reducing the potential for interaction and collision. Demonstrates appropriately trained and competent personnel are used to navigate vessels to reduce interaction with other marine users.	Regulatory requirement and therefore the cost is not identified as an issue.	**Adopted**
C6.1.2	Undertake consultation with Relevant Persons (including applicable notifications)	Relevant Persons consultation ensures identified marine users are aware of the proposed activities, reducing the likelihood of unplanned	Cost to prepare and distribute information, and to address any feedback provided.	**Adopted**

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
	(administrative control)	interactions around activity vessels. Maritime notifications ensure marine users are informed of the proposed activities, reducing the likelihood of unplanned interactions. Subsea infrastructure will be clearly marked on Australian nautical charts published by the AHO alerting other marine users to the presence of activity vessels and exclusion zones and restrictions, thus reducing the likelihood of vessel collision and fishing gear snagging.		
C6.1.3	The Activity will be undertaken in accordance with Santos HSE management and marine vessel vetting processes (administrative control)	Santos marine vetting process ensures vessel lighting, radios and equipment are inspected and maintained so that other marine users are aware of the vessel's physical presence, thus reducing the potential for interaction and collision.	Standard maritime safety and navigational equipment; regulatory requirement and therefore the cost is not identified as an issue.	**Adopted**
Additional control measures				
C6.1.4	Concurrent Barossa Development activities will be managed under the Barossa Interface Management Plan (administrative control)	Implementation of the plan will control and manage concurrent activities occurring within the OA. This will ensure that concurrent activities can be conducted safely and reduce the risk of unplanned vessel interactions.	Cost associated with implementing procedures.	**Adopted**
C6.1.5	Vessel speed restrictions (administrative control)	Reduces consequence of collisions (causing harm) and likelihood as vessels have longer to detect and avoid the vessel by restricting vessel speeds.	Administrative costs to update existing Santos procedure and induction materials and train personnel.	**Adopted**
C6.1.6	Communications plan will be implemented for engagement prior to and during the Activity	Communications plan will improve awareness of the Activity, encourage engagement with stakeholders, and provide up-to-date information regarding key activities.	Cost associated with implementing procedures.	**Adopted**

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
	(administrative control)			
C6.1.7	HSE inductions will include environmental requirements (administrative control)	Ensures that crew are aware of the stringent EP, Santos and legislative requirements.	Administrative costs to update existing Santos procedure and induction materials and train personnel.	**Adopted**
N/A	Manage the timing of the activity to avoid peak marine users periods (e.g. fishing) (elimination control)	Would eliminate potential impacts to fisheries and other marine users	Significant costs to demobilise/remobilise the vessels.	**Rejected** – marine users could be present in the OA at any time of the year infrequently. Santos understands scampi fishing occurs in the northern extremity of the OA and surrounding deep water (where vessel activities will not occur). Hence, avoiding the fishing period is not considered necessary.
N/A	Dedicated guard vessel in place during the Activity to reduce potential for collision or interference with other marine users (administrative control)	Identifies and communicates with approaching third-party vessels to ensure exclusion (safety) zone is observed, preventing potential interaction or interference.	Significant additional cost of guard vessel, and emission (fuel use) for the duration of activities/campaign.	**Rejected** – Cost grossly disproportionate to benefit, given the location of the Activity has low usage by commercial fishers and does not overlap with any commercial shipping lanes or areas of tourism.

6.1.4 Environmental impact assessment

Receptor	Consequence level
Interaction with other marine users	
Threatened, migratory or local fauna	Not applicable – related to socioeconomic receptors.
Physical environment or habitat	
Threatened ecological communities	
Protected areas	
Socioeconomic receptors	Shipping and other incidental marine traffic in the area is expected to be very low based on AMSA's vessel traffic data (AMSA, 2022) and the established shipping fairways designed to keep shipping traffic away from offshore infrastructure (AMSA, 2013). With the exception of one fishery, the managed fisheries do not have targeted species that are supported in waters deeper than 200 m (OA is 227-269 m water depths). The Northern Prawn Fishery has low effort scampi fishing in waters >250 m during December and January. It is possible during these months for interaction to occur, but it is unlikely. The OA is approximately 143 km north of the Tiwi Islands and 300 km north-north-west of Darwin, NT. Water depths over the OA area range from approximately 227 m to 269 m. Consultation feedback indicated that fishing charter vessels may undertake activities at Evans Shoal (~67 km west of the OA) on an infrequent (1-2 times a year) basis. Otherwise, there are no records of recreational or traditional fishing occurring in the OA. Therefore, it is highly improbable that recreational or traditional fishing or uses will occur in the OA. Interactions with Indonesian or other international vessels are not expected as the Perth Treaty area is outside of the OA. The area from which marine users will be excluded is small when compared to the area available for their use. Marine users within the OA have coexisted with previous Barossa petroleum activities (e.g. exploration and development drilling) and other nearby restricted areas (e.g. military exercises). Communication before and during the activity will reduce the likelihood of unplanned interaction with other commercial marine users. Therefore, the consequence level for potential interaction with other marine users is considered to be I – Negligible.
Cumulative impacts	
It is considered that negligible additive and cumulative effects associated with concurrent activities (e.g. physical presence) to other marine users may result, given the limited interaction with other marine users (including fishers) expected within the OA and the short duration of concurrent activities. Therefore, no change to the overall consequence level is expected.	
Overall worst-case consequence	I – Negligible

6.1.5 Demonstration of as low as reasonably practicable

There are no alternatives to using vessels to undertake the Activity. Around each wellhead there will be existing 500 m PSZ within the proposed OA. Activity vessels must have a 500 m cautionary zone, in accordance with the OPGGS Act. Santos' consultation process is described in Section 3.2.5.10. Throughout the consultation period, Relevant Persons were made aware of the proposed cautionary

zone over the OA and the implications to other marine users including the indicative schedule. No concerns have been raised by Relevant Persons regarding the potential cautionary zone. One or more Notice to Mariners will be issued that detail the location and nature of activities and that vessels will maintain navigation aids.

All reasonably practicable control measures were reviewed and those adopted are considered appropriate to manage the impacts such that the residual consequence is assessed to be I – Negligible. The proposed control measures are in accordance with Santos' risk management criteria and are considered appropriate to reduce impacts to ALARP.

6.1.6 Acceptability evaluation

Is the consequence ranked as I or II?	Yes – maximum consequence from interaction with other marine users is I – Negligible.
Is further information required to validate the consequence assessment?	No – potential impacts and risks are well understood through the information available and Relevant Person consultation.
Are the risks and impacts consistent with the principles of ecologically sustainable development (ESD)?	Yes – activity evaluated in accordance with Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004), which considers principles of ESD.
Have the acceptable levels of impact and risks been informed by relevant species recovery plans, threat abatement plans and conservation advice and Australian marine park zoning objectives?	Not applicable. The OA does not intersect any AMPs.
Are performance outcomes, control measures and associated performance standards consistent with legal and regulatory requirements?	Yes – management measures are consistent with the SOLAS and various Commonwealth Acts (*Marine Safety (Domestic Commercial Vessel) National Law Act 2012*, *Navigation Act 2012* and OPGGS Act). Through acceptance of this EP, legislative and regulatory requirements will be met as per Section 1.6.2.
Are performance outcomes, control measures and associated performance standards consistent with Santos' Environment, Health and Safety Policy?	Yes – aligns with Santos' Environment, Health and Safety Policy (Appendix A).
Are performance outcomes, control measures and associated performance standards consistent with industry standards?	Yes – the most recent and comparable EPs accepted by NOPSEMA were reviewed for consistency with the performance outcomes, control measures and associated performance standards proposed in this EP.
Have performance outcomes, control measures and associated performance standards taken into consideration Relevant Person feedback?	Yes – Relevant Person feedback indicated no recommendations for revising the EPO, CMs or EPSs.
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – ALARP assessment conducted, with additional control measures adopted.

The consequence of interaction with other marine users is assessed as I – Negligible. Based on an assessment of Santos' acceptability criteria and with the control measures in place, potential impacts are considered acceptable.

6.2 Seabed and benthic habitat disturbance

6.2.1 Description of event

Event	As described in Section 2.5, installation activities will physically disturb the seabed. Disturbance to the seabed may result from: • long-term placement of subsea infrastructure on the seabed (e.g. flowlines, manifolds, span rectification, mooring suction anchors) • temporary placement and set down of equipment on the seabed (e.g. clump weights, ROV) • temporary seabed and sediment disturbance during installation. The seabed footprint is detailed in Table 2-8. Seabed disturbance may also cause a temporary increase in water turbidity. Concurrent activities (Section 2.10) may result in cumulative direct and indirect impacts associated with seabed disturbance.
Extent	Localised: within the OA for the Activity and concurrent activities.
Duration	Temporary disturbances for the duration of the activity and long–term subsea infrastructure placements for the operational life (approximately 25 years). Section 2.10 describes the temporal extent of concurrent activities.

6.2.2 Nature and scale of environmental impacts

Potential receptors: physical environment (benthic habitat and KEF); threatened, migratory or local fauna (benthic fauna); and socioeconomic (commercial fisheries, underwater cultural heritage and cultural features).

The total seabed footprint from the Activity is approximately 7 ha (~0.008% of the total area of Petroleum Production Licence NT/L1), which includes a 20% contingency (Table 2-8). Section 2.5 describes the installation activities in detail. The seabed disturbance, extent of contact and potential impacts are described Appendix C.

6.2.2.1 Physical environment

The activity will involve equipment directly contacting the sea floor and will inevitably result in localised impact to benthic habitat (and associated fauna) in the OA.

Benthic habitats and fauna assemblages that are expected to be impacted are considered widespread throughout the region (Section 3.2.1.3). Depressions on the seabed caused by the activity are predicted to infill naturally with sediments and detrital matter over time and recovery and recolonisation of soft sediment habitats is expected to happen within a short time (weeks to months).

The OA overlaps one KEF—Shelf break and slope of the Arafura Shelf. The sea floor features associated with this KEF (i.e. the shelf break and patch reefs, hard substrate pinnacles and submerged reefs on the shelf slope) were not observed within the OA during the Barossa marine studies program, nor are these topographically distinct features evident from the bathymetry data derived from multiple surveys undertaken across this area. The nearest elevated natural seabed structures are 2 scarps (referred to as HM014 and HM019) that are approximately 10 km and 13 km south of the OA (Figure 7-3).

6.2.2.2 Threatened, migratory or local fauna

Habitat modification is identified as a potential threat to several marine fauna species in relevant recovery plans and conservation advice (Table 3-10), some of which have cultural significance as

totems of cultural food sources; however, seabed disturbance at the proposed scale is not anticipated to significantly affect marine fauna that may be present, such as marine mammals, marine reptiles, sharks, rays and other fish. No known BIAs are present in the OA. The seabed within the OA is predominantly bare sediment and contains low abundance and diversity of infauna.

Based on the habitat preferences (shallower coastal and estuarine waters) of sawfish and the deep offshore marine environment of the OA, it is considered highly unlikely that they will be present in large numbers. It is recognised that individuals may be encountered, as advised by Northern Prawn Fishery, and 3 sawfish species were identified in the PMST report for the OA (Appendix D).

The area of seabed to be disturbed within the OA also represents a negligible portion of the habitat available for threatened, migratory or local fauna.

6.2.2.3 Socioeconomic

6.2.2.3.1 Commercial fisheries

Potential impacts to benthic habitats, and subsequently to associated 'fish' species of commercial importance (e.g. scampi), will be localised and the potential impact to, and displacement of, fish is expected to be insignificant at a stock level.

6.2.2.3.2 Underwater Maritime Heritage

There are no known heritage sites (including First Nations) within the OA. Cosmos Archaeology confirmed that there is no clear evidence of shipwrecks or aircraft wrecks within the OA using SSS and MBES geophysical survey data (Cosmos Archaeology, 2023; Appendix H). Although the survey data did not yield clear evidence of such wrecks, one sonar anomaly could potentially be the remains of a small shipwreck and was classified as category A. Category A is defined as most likely to be a cultural (e.g. maritime object), as opposed to a natural object. The sonar anomaly is more than 500 m from the proposed northern umbilical location. Additionally, there were 18 sonar anomalies classified as category B, defined as an object that may be a maritime object, as opposed to natural such as a single event discard, which is likely associated with potential maritime heritage sites (e.g. non-Indigneous) such as debris fields, isolated debris, or discarded debris.

Cosmos Archaeology concluded that the Activity is unlikely to impact any sonar anomalies defined as category A and B sites (Cosmos Archaeology, 2023; Appendix H).

6.2.2.4 Cultural features

No First Nations people feedback was provided about potential seabed impacts to cultural features during consultation for the SURF EP. The potential impacts to cultural features from seabed disturbance are associated with the impacts to culturally significant marine fauna habitat and species.

Feedback provided during the Drilling EP consultation identified concerns about the impact of drilling on their dreaming totems (including turtle totems), and about the impact of drilling on their spiritual dreaming which protects the Tiwi Islands and the potential for a disaster to strike the Tiwi Islands because of the drilling.

During consultation on the Drilling EP, Tiwi clients of the EDO raised concerns about:

- disturbance to important ancestral spirits and beings, including Ampiji, that could result in loss of protection of the Tiwi Islands and result in exposure to natural disasters, reduced access to marine food sources and that it will cause Tiwi people to become sick. For example, if Ampiji is disturbed, there are concerns that there could be tidal waves or king tide, and that it may also disturb the three serpents who will shoot up out of the water like a cyclone, making a big wave causing a lot of damage.

- damage to the seabed from drilling could also harm imunga: spiritual places that are often connected to other sites, marine species and to Tiwi people. A related concern of the Tiwi clients of the EDO is that harming imunga could also impact on the health of land and sea country and access to food through traditional hunting and fishing.
- the drilling activity as “drilling through us, through our very being”, “that if drilling starts, then that is killing our body” and that “Disturbing the sea has a domino effect on other things, on the life of the sea animals and on our lives and our very existence, including the spirit world. Disturbing the sea is disturbing the spirit world.”

During consultation on the Drilling EP, Croker Island clients of the EDO raised concerns about potential impacts to sacred sites and songlines from the Activity, and that any disturbance or threat to these sacred sites or songlines was considered a threat to the future of Minjilang people. Consultation meetings with Croker Island people in Darwin for the SURF and Drilling EPs did not identify any sacred sites or songlines within the OA, and no objections or claims were raised.

Santos notes that almost 900 wells have been drilled previously in the region, and there is also significant historical and ongoing industrial shipping and fish trawling activities in the area that may be affected (EMBA) by the Activity in this EP. There is no evidence to support actual adverse effects from the actions of spiritual beings in response to impacts on the environment from those activities.

Santos understands the spiritual protection believed to be afforded to the Tiwi people is broadly maintained by protecting the features of the natural environment and through ceremonial practices alerting the spiritual beings to the presence of people travelling through country and the like.

6.2.2.5 Potential cumulative impacts from concurrent activities

On the basis that concurrent activities (see Section 2.10) will occur within the OA, the potential for cumulative seabed and benthic disturbance impacts is acknowledged.

The total direct seabed footprint within the OA is approximately 1.55 ha for the GEP activities (including the GEP and PLET foundation) and approximately 0.945 ha for the Drilling activities. The concurrent activities will be conducted in water depths greater than 200 m and in predominantly bare sediment that contains a low abundance and diversity of infauna. There are no known BIAs within the OA. The habitats and fauna assemblages that are expected to be disturbed are widespread throughout the region. As noted in Section 6.2.2.1, even though the OA intersects the KEF (Shelf break and slope of the Arafura Shelf), the seafloor features associated with this KEF were not observed within the OA during the Barossa marine studies program. The turbidity generated is expected to be short-term and localised within the Activity OA.

The direct or indirect impacts from the concurrent activities are considered unlikely to substantially change or adversely impact on biodiversity or ecological integrity of benthic communities.

When considering the absence of BIAs and significant regional habitats within the OA, and the short and intermittent duration of concurrent activities, additive and cumulative seabed and benthic disturbance effects are expected to be negligible.

6.2.3 Environmental performance outcomes and control measures

The EPOs relating to this event include:

- Seabed disturbance limited to planned activities and defined locations within the OA [EPO-02]
- No significant impacts to cultural features from the Activity [EPO-14].

An assessment of the environmental benefits and the potential costs or issues associated with control measures for this activity are described in Table 6-3 to demonstrate the potential impacts from this aspect are ALARP. Control measures that are adopted have associated EPSs and measurement criteria, and are presented in Table 8-2.

Table 6-3: Control measures evaluation for seabed and benthic habitat disturbance

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
Standard control measures				
C6.2.1	Vessel planned maintenance system (administrative control)	Ensures DP equipment is operating within its parameters eliminating, the requirement for a vessel to anchor.	Costs are expected as part of standard procedure.	**Adopted**
Additional control measures				
C.6.2.2	Subsea infrastructure inventory (administrative control)	Enables Santos to fulfil future decommissioning and removal responsibilities.	Cost of surveys, maintaining equipment and records.	**Adopted**
C.6.2.3	Vessel anchoring: no planned vessel anchoring within the OA (elimination control)	No planned vessel anchoring within the OA reduces seabed disturbance area as no anchor or anchor chain drag/placement will occur.	Cost of contracting activity vessels with DP equipment. Using DP requires continuous engagement of thrusters, which will increase noise emissions.	**Adopted**
C.6.2.4	Vessel anchoring: use reel-lay and construction vessels with DP equipment (substitution control)	Reel-lay and construction vessels with DP equipment enables reduced seabed disturbance as it eliminates the requirement for vessel anchoring. It also enables flowlines to be installed along the designed route due to high precision station-keeping thus reducing the need for additional span rectification.	The use of DP requires main engines to remain online and power thrusters resulting in increased fuel usage, and air and continuous noise emissions.	**Adopted**
C6.1.7	HSE inductions will include environmental requirements (administrative control)	Ensures that crew are aware of the stringent EP, Santos and legislative requirements.	Administrative costs to update existing Santos procedure and induction materials and train personnel.	**Adopted**
C6.2.5	Barossa Unexpected Finds Protocol (BAS-210 0051) (administrative control)	Provides guidance in the event that an unexpected find is encountered. By implementing the protocol, potential impacts to heritage objects and values will be minimised.	Administrative costs to update existing Santos procedures and induction materials and train personnel.	**Adopted**

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
C6.2.6	Cultural Heritage (administrative control)	Shows respect for beliefs and culture of First Nations people.	Time and cost to work with First Nations communities.	**Adopted**

Table 6-15 of the accepted OPP (ConocoPhillips, 2018) states a number of commitments to manage seabed disturbance related to the Activity. Two commitments are considered to have been met already and are not included as control measures within this EP:

- OPP Commitment 1: The MODU/FPSO facility mooring design analysis will include environmental sensitivity and seabed topography analysis to inform selection of mooring locations to avoid areas of seabed that are associated with the sea floor features/ values of the Shelf break and slope of the Arafura Shelf KEF (i.e. patch reefs and hard substrate pinnacles).
- OPP Commitment 2: The location of subsea infrastructure within the Barossa offshore development area will be informed by pre-installation surveys/studies that identify and avoid areas of seabed that are associated with the sea floor features/values of the Shelf break and slope of the Arafura Shelf KEF (i.e. patch reefs and hard substrate pinnacles).

The OPP commitment for a vessel anchoring plan was considered. Control measure C.6.2.3 stipulates no planned vessel anchoring within the OA, thereby eliminating the requirement for this OPP commitment.

6.2.4 Environmental impact assessment

Receptor	Consequence level
Seabed and benthic habitat disturbance	
Physical environment or habitat	The OA overlaps one KEF—Shelf break and slope of the Arafura Shelf. The sea floor features associated with this KEF (i.e. the shelf break and patch reefs, hard substrate pinnacles and submerged reefs on the shelf slope) were not observed within the OA during the Barossa marine studies program, nor are these topographically distinct features evident from the bathymetry data derived from multiple surveys undertaken across this area. The total seabed disturbance footprint represents a very small portion of this KEF (less than 0.002%). Species associated with the continental slope and patch reefs that characterise this KEF (such as demersal fish, whale sharks, sharks and turtles) are unlikely to aggregate within the OA due to the lack of seafloor features. However, potential impacts to these species are described below. Localised turbidity caused by seabed disturbance is expected to be minor in nature and limited to within the OA. Therefore, the consequence level is considered to be II – Minor.
Threatened, migratory or local fauna	Given the limited scale of seabed disturbance and knowledge of the existing environment, potential impact to threatened/migratory/local marine fauna species is unlikely. Marine invertebrates that may inhabit disturbed soft sediment benthic habitats are expected to occur elsewhere within the OA and surrounds and therefore the disturbance is not expected to affect prey availability or protected fauna species. Habitat modification is identified as a potential threat to several marine fauna species in relevant recovery plans and conservation advice (Table 3-10). However, benthic habitat within the OA is well represented in the wider surrounds and the OA is not recognised as a BIA for marine fauna.

Receptor	Consequence level
	Seabed disturbance is not expected to cause a decrease in local population size, area of occupancy of species, loss or disruption of critical habitat, or disruption to the breeding cycle of any threatened or migratory marine fauna. Therefore, the consequence level is considered to be I – Negligible.
Threatened ecological communities	Not applicable – no threatened ecological communities were identified in the area where seabed disturbance could occur.
Protected areas	Not applicable – no protected areas over which seabed disturbance could occur.
Socioeconomic receptors	Seabed disturbance is not expected to impact commercial fisheries based on the small size of disturbance compared with the total available fishing area. There are no known heritage sites or clear evidence of shipwrecks or aircraft wrecks within the OA. Given the distances of the category A and B sonar anomaly (e.g. maritime) sites from proposed subsea infrastructure, the sonar anomalies will not be impacted. The physical environment or habitat where seabed disturbance will occur may overlap cultural features. The seabed disturbance as a result of this activity is unavoidable and will be of a relatively small scale. The consequence of seabed disturbance on receptors is assessed as I – Negligible.
Cultural features	There are no sacred sites registered or recorded under the NTASS Act or protected under the ATSIHP Act, UCH Act, ALR Act or EPBC Act that overlap the OA. Of the culturally important sites (including underwater sites) identified by Tiwi People and First Nations people, all of the identified sites are outside the OA. Through consultation, Santos became aware of the presence of one registered sacred site and 3 recorded sacred sites which are located on the western coast of Bathurst Island that may potentially intersect the outer extent of the EMBA. Feedback provided during consultation on the Drilling EP raised concerns about some First Nations people cultural and spiritual beliefs, which were not linked to a specific location or place. For assessment of impacts to marine species of cultural significance, refer to the assessment for threatened, migratory or local fauna. In relation to seabed disturbance, Santos notes that almost 900 wells have been drilled previously in the region, and there is also significant historical and ongoing industrial shipping and fish trawling activities in the area that may be affected by the Activity in this EP. There is no evidence to support actual adverse effects from spiritual beings in response to impacts on people or the environment from these activities. Notwithstanding, in response to the concerns raised by some First Nations people during consultation for the Drilling EP, Santos has considered the adoption of control measures in the Drilling EP where practicable and appropriate.
Cumulative impacts	
The combined seabed footprint from concurrent activities represents an incidental proportion of similarly representative regional habitat, predominantly bare sediment with a low abundance and diversity of infauna. Hence, concurrent activities are expected to not substantially change or adversely impact on biodiversity or ecological integrity of benthic communities. When considering the absence of BIAs and significant regional habitats within the OA, and the short and intermittent duration of concurrent activities, additive and cumulative seabed and benthic disturbance effects are considered negligible, and no change to the overall consequence level has resulted.	

Receptor	Consequence level
Overall worst-case consequence	II – Minor

6.2.5 Demonstration of as low as reasonably practicable

There are no reasonably practicable better alternatives for installing subsea infrastructure. All reasonably practicable control measures were reviewed and those adopted are considered appropriate to manage the impacts such that the residual consequence is assessed to be II – Minor. The proposed control measures are in accordance with Santos' risk management criteria and are considered appropriate to manage the impacts to ALARP.

6.2.6 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 to validate the consequence assessment?	No – potential impacts and risks are well understood through the information available. Extensive marine studies have been completed within the OA to inform the assessment.
Are the risks and impacts consistent with the principles of ecologically sustainable development (ESD)?	Yes – activity evaluated in accordance with Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004), which considers principles of ESD.
Have the acceptable levels of impact and risks been informed by relevant species recovery plans, threat abatement plans and conservation advice and Australian marine park zoning objectives?	Yes – No plans identified seabed disturbance as a threat to marine fauna or habitats. The benthic environment within the OA contains no known seabed features (e.g. shoals, banks). The Marine Bioregional Plan for the North Marine Region (CoA, 2012a) includes consideration of the KEF (Shelf break and slope of the Arafura Shelf). The OA overlaps this KEF and survey data confirm that the OA avoids the high environmental values associated with the KEF. Impacts to the marine environment from seabed disturbance will be highly localised. The adoption of EPO-02 and the control measures outlined in Table 6-3 ensures the impacts of seabed disturbance are consistent with these objectives.
Are performance outcomes, control measures and associated performance standards consistent with legal and regulatory requirements?	Yes – through acceptance of this EP, legislative and regulatory requirements will be met as per Section 1.6.2.
Are performance outcomes, control measures and associated performance standards consistent with Santos' Environment, Health and Safety Policy?	Yes – aligns with Santos' Environment, Health and Safety Policy (Appendix A).
Are performance outcomes, control measures and associated performance standards consistent with industry standards?	Yes – the most recent and comparable EPs accepted by NOPSEMA were reviewed for consistency with the performance outcomes, control measures and associated performance standards proposed in this EP.
Have performance outcomes, control measures and associated performance standards taken into	Yes – no objections or claims were specifically raised for this Activity. However given the overlap of the SURF and Drilling activity OAs, feedback received during the Drilling EP has been

consideration Relevant Person feedback?	considered and where applicable additional EPOs, CMs and EPSs were adopted.
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – ALARP assessment conducted, with additional control measures adopted.

The consequence of seabed and benthic habitat disturbance is assessed as II – Minor. Based on an assessment of Santos' acceptability criteria and with the control measures in place, potential impacts are considered acceptable.

6.3 Noise emissions

6.3.1 Description of event

Event	Potential impacts from noise emissions may occur in the OA from the following sources: • vessel activities (e.g. vessel engines, thrusters and other machinery and equipment) • acoustic positioning system on the reel-lay and construction vessels • ROV activities • survey equipment • helicopter activities. Concurrent activities (Section 2.10) will generate noise emissions, such as the operation of the MODU, vessels, geophysical equipment and helicopters. Flaring will occur intermittently and short duration (~2–3 days per well) and the predicted underwater noise is not predicted to exceed MODU/vessel noise. Therefore, the cumulative impacts have been considered in this assessment. Cumulative effects from the Activity and other marine users (e.g. fishing) conducted in the vicinity are not expected, due to the short-term nature of the Activity, and the remote location of the OA.
Extent	Noise emissions will be concentrated around sources, with studies supporting the assessment of only localised effects, up to 12 km from vessel activities (NMFS, 2014; NOAA, 2019). The noise emissions from concurrent activities are predicted to be limited within 12 km from the noise sources.
Duration	Continuous vessel noise emissions for the duration of the activity, with intermittent emissions associated with discrete activities (e.g. helicopter movements, ROVs, acoustic positioning and survey equipment etc). Section 2.10 describes the temporal extent of concurrent activities.

6.3.1.1 Introduction

Santos commissioned a technical study into underwater noise impacts on marine fauna (JASCO, 2020) using contemporary criteria and has used the findings to inform the underwater noise emissions impact assessment. All noise sources involved in the activities described in this EP are non-impulsive. Non-impulsive sounds have a longer duration than impulsive ones, and they usually do not have the high peak sound pressure and rapid rise and decay time that impulsive sounds have. However, especially in respect to their auditory effects on marine fauna, the term ‘non-impulsive’ does not imply long duration signals (JASCO, 2020). The relevant terminology for underwater acoustic levels relevant to non-impulsive sources are sound pressure levels (SPL), and accumulated sound exposure levels (SEL).

Previous assessments in the Barossa Development OPP (ConocoPhillips, 2018) examined the noise from an FPSO facility and associated support vessels. The modelling scenarios include modelling an operational FPSO facility and an FPSO facility with an offloading tanker and a support vessel in attendance at the proposed FPSO facility site in the Barossa field. This modelling study is the only one conducted for non-impulsive sources within the OA. Anchor pile driving noise was assessed and included in the OPP. To reduce underwater noise, the design engineering process eliminated the option for pile driving installation by selecting the suction anchors (minimal noise impact).

Site- and operational-specific modelling was not conducted for the planned activities. The approach taken within this assessment was to contrast the noise associated with the Activity to relevant existing information and to estimate the range of potential effect. This process used Barossa Development modelling and other literature where relevant to assess modelled noise sources within

the OA. The proposed construction vessels have the highest sound generating thruster power of 12,800 kW within the activity vessel fleet. The MODU considered in McPherson et al. (2019) assessed noise generated as 30,400 kW. As the MODU (out of scope for this EP) has a higher thruster power, the construction vessel maximum noise output will be within the 20 km noise assessment boundary that has been applied for the MODU assessment.

Previous studies do not always contain the most relevant current criteria. For example, the assessment undertaken for the Barossa Development (ConocoPhillips, 2018) applied Southall et al. (2007) to assess potential hearing impairment in marine mammals as this was the best available information at the time. Southall et al. (2019) has improved the assessment approach for low-frequency cetaceans by determining the effect ranges and applying the unweighted SEL results and low-frequency hearing group specific thresholds. This approach is conservative because it does not account for the weighting of frequencies for fauna that do not hear as well. Note also that Southall et al. (2021) reports further research recommendations that are aiming to improve the assessment of the severity of marine mammal behavioural responses to human noise.

The Artisan-1 Exploration Well Drilling EP (Beach, 2020) contains an assessment of an anchored MODU and resupply operations (Appendix F in Koessler et al., 2020). This assessment did not predict a range to temporary threshold shift (TTS) in high-frequency cetaceans (using the terminology in Southall et al. [2019]) at ranges beyond 30 m for the most impactful activity—resupply operations. At very close range, the source levels of the vessels involved in the activities dominate over other environmental influences, therefore these results can be applied for this assessment as they conservatively represent anticipated noise levels from vessel operations.

Other criteria within ConocoPhillips (2018) relevant to the current assessment are:

- marine mammal behavioural response criteria threshold is 120 dB re 1 µPa (SPL) (National Oceanic and Atmospheric Administration [NOAA], 2019)
- sound exposure guidelines for fish, fish eggs, sea [marine] turtles and larvae from Popper et al. (2014), which will be applied for hearing impairment in marine turtles in the absence of the ability to assess the frequency-weighted thresholds presented in Finneran et al. (2017).

The Southall et al. (2021) paper on behavioural response criteria does not provide new numerical thresholds for onset of behavioural responses for marine mammals, and thus has not been applied in this assessment. This paper does provide significant context and guidance for future work to better determine such thresholds.

The modelling results within ConocoPhillips (2018) that pertain to this assessment are summarised below. The terminology used to refer to the distances to thresholds are:

- Rmax, the maximum range to the given sound level over all directions
- R95%, the range to the given sound level after the 5% farthest points were excluded.

Results summary from ConocoPhillips (2018):

- FPSO in isolation during normal operations:
    - For this scenario, the range to the 120 dB re 1 µPa National Marine Fisheries Service (NMFS, 2014) and NOAA (2019) criteria for behavioural responses in marine mammals was 1.33 km (R95%) and 1.42 km (Rmax).
- FPSO under DP during offload to a tanker, with both the FPSO and tanker represented using a conservative power level approximation for the thrusters of 50% load, attended by a support vessel, also under DP:
    - For this scenario, the range to the marine mammal behavioural response criteria of 120 dB re 1 µPa NMFS (2014) and NOAA (2019) was 8.9 km (R95%) and 11.4 km (Rmax).

- For both of these scenarios, neither permanent threshold shift (PTS) or TTS was predicted beyond the FPSO extents using the applied criteria in that assessment (Southall et al., 2007).
- Applying the Southall et al. (2019) criteria to the unweighted 24-hour SEL results indicates:
  - FPSO in isolation during normal operations: PTS and TTS in low-frequency cetaceans could occur within approximately 20 or 200 m respectively
  - FPSO, tanker and support vessel during offload operations: PTS and TTS in low-frequency cetaceans could occur within approximately 70 or 1,860 m respectively.
- Considering modelling assessments of other similar operations (such as the Artisan-1 Exploration Well) and applying a conservative approach, a range to TTS of 50 m for high-frequency cetaceans will be used to represent potential effects on odontocetes within this assessment.

6.3.1.2 Noise generated by vessels

Vessel operational noise includes machinery noise (e.g. engine noise), equipment noise (e.g. SBES) and hydrodynamic noise (e.g. water flowing past the hull, thruster use and propeller singing). The impacts associated with SBES (see Section 2.4) are considered negligible and hence not considered further. Machinery on a ship radiates sound through the hull into the water. During normal operations the activity vessels will generate continuous noise from propeller cavitation, thrusters, hydrodynamic flow around the hull, and machinery and equipment operations. The activity vessels and their activities are listed in Table 2-3. Typically, 3 types of vessel operations will occur, 2 of which involve DP:

- vessel steaming at low speed during activity operation e.g. reel-lay vessel
- manoeuvring during subsea infrastructure handling operations (vessels under DP)
- resupply activities to activity vessels (supply vessels under DP).

For activity vessels, the noisiest anticipated activity is when the vessel uses thrusters to maintain its position. McCauley et al. (1998) measured underwater SPLs equivalent to approximately 182 dB re 1 µPa @ 1 m with a frequency range of 20 Hz to 10 kHz from a support vessel holding station in the Timor Sea. The thruster noise dropped below 120 dB re 1 µPa within 3–4 km and was audible above ambient noise up to 20 km away (McCauley, 1998). This has been taken as the greatest noise-generating activity for assessment purposes, as other vessel activities will require the vessel to be idle or moving. McCauley et al. (1998) measured underwater sound levels from the *Pacific Ariki*, a 64 m long support vessel with 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.

6.3.1.3 Noise generated by a helicopter

Sound traveling from a source in the air (e.g. a helicopter) to a receiver underwater is affected by both in-air and underwater propagation processes, and processes occurring at the air/sea water surface interface (e.g. 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, with sound penetrating water at angles less than 13° (Richardson et al., 1995). The noise from the flyover of a Bell 214ST helicopter has been recorded underwater,(Richardson et al., 1995), with the maximum recorded sound level for the dominant 22 Hz tone was 109 dB re 1 µPa

(SPL) when the helicopter was 152 m from the surface and the hydrophone 3 and 18 m under the surface.

For context, the Bell 214ST uses a single powerful Lycoming LTC4B-8 engine of 2,185 kW (Frawley, 2003), while the modern Bell 412, often used as a rescue helicopter in Australia (Air Services Australia, 2020) uses twin 1,250 shp (930 kW) turboshaft engines (Bell Helicopter, 2012). Typical offshore crew change and medivac helicopters in Australia are Leonardo AW139s (Milne, 2019), which have been measured to be 2 dB(A) quieter than the Bell 412 helicopters (Air Services Australia, 2020).

Helicopter activities produce strong underwater sounds for brief periods when the helicopter takes off/lands on the vessel. Sound from helicopter activities is very localised and infrequent (e.g. approximately 3 times a week at the peak utilisation). Further helicopter operations are expected to result in received underwater noise levels lower than those associated with vessel operations.

6.3.1.4 Noise generated from survey equipment

Survey activities may be undertaken within the OA to identify debris, seabed features, buried assets and obstructions. Survey activities may also be undertaken to confirm the location of the infrastructure and supporting structures with a duration of ~0.5 days per survey dependent on the area being surveyed. Survey methods will primarily involve:

- MBES, such as the Reson SeaBat 7125 transmitting at 400 kHz. At 400 kHz, it has a 1° beamwidth along the track, and a source level of 220 dB re 1 µPa (Coastal Frontiers, 2017)
- SBP CHIRP with a chirp frequency range from 2 to 50 kHz, with three chirp transducers for three frequency ranges, 2 to 9 kHz, 10 to 20 kHz and 20 to 50 kHz. The in-beam estimated maximum source levels are about 200 to 205 dB re 1 µPa @ 1 m (DOC, 2016)
- SSS is generally considered a high acoustic density source and medium frequency generator. The frequency ranges from 75 to 900 kHz (Jiménez-Arranz et al., 2017). The sound pressure level ranges from 200–235 dB re 1µPa SPL.

6.3.1.5 Noise generated from acoustic positioning

Installing subsea infrastructure including flowlines, manifolds and FLET foundations requires accurate positioning and therefore long baseline (LBL) and/or ultra short baseline (USBL) acoustic positioning will be utilised. These systems provide accuracy up to one metre and are, therefore critical for the safe and accurate installation of subsea infrastructure. Transponders will active during calibration or positioning only. The operation duration is approximately 3 days for each array at approximately 7 locations. For USBL positioning, transponders are typically attached to subsea equipment and recovered once the equipment is correctly positioned on the seabed. For LBL, transponders are typically fixed to seabed frames and then fully recovered once subsea equipment is correctly positioned.

LBL and USBL systems work by emitting short pulses of medium- to high-frequency sound. Transmissions are not continuous but are short ‘chirps’ with a duration that ranges from 3–40 milliseconds.

The USBL system uses a vessel-mounted transceiver to detect the range and bearing to a target using acoustic signals. 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 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 transceiver head normally contains 3 or more transducers separated by 10 cm or less. A method called ‘phase-

differencing' within this transducer array is used to calculate the angle to the subsea transponder. The transducer will then send sound signals, typically at 19–33 kHz to a USBL transponder. Table 6-4 details the nominal specifications of likely acoustic positioning systems as detailed in McPherson (2020).

Table 6-4: Specifications of nominal acoustic positioning systems

Manufacturer	Model	Source frequency (kHz)	Source level (dB re 1 µPa @ 1 m)
Kongsberg	HiPAP 500	33	206
Sonardyne	Ranger USBL	18–36	204

6.3.1.6 Noise generated from ROV operations

ROVs may be launched from activity vessels to undertake the activities described in Section 2.4.4.2. Typically, the noise generated from an ROV will have a considerably lower intensity than vessel noise.

Underwater sound levels depend on the primary (noisiest) sound source rather than being strictly additive. ROV operations will be undertaken from a vessel, and thus will make little contribution to the overall noise emissions associated with vessel activities, as described above. ROVs are not risk assessed further for noise.

6.3.1.7 Summary of noise sources and rationale for assessment

Of the noise sources described in Sections 6.3.1.2 to 6.3.1.6, noise from helicopters, survey equipment, acoustic positioning systems, ROVs are expected to be intermittent during the activity and underwater received levels will not exceed that of activity vessels.

Therefore, the assessment focused on the operations of the activity vessels.

6.3.2 Nature and scale of environmental impacts

Potential receptors: threatened, migratory, or local marine fauna (marine mammals, marine turtles, sharks, rays, other fish and invertebrates); socioeconomic and cultural features. Some of these marine species have cultural significance to First Nations persons either as a traditional food source or for other cultural reasons (as to which, see sections 3.2.5.8 and 3.2.5.9).

A PMST search was undertaken for the 20 km noise assessment boundary around the OA as a conservative buffer. One threatened species—the reef manta ray—was identified in addition to those present in the OA (Table 3-8). The reef manta ray does not have any associated Conservation Advice or Recovery Plans. No known BIAs or habitat critical to the survival of the species intersect the 20 km noise assessment boundary.

Marine fauna use sound in a variety of functions, including social interactions, foraging, orientation, and response to predators. Underwater noise can affect marine fauna in these ways:

- attraction
- disturbance, leading to behavioural changes or displacement to fauna. The occurrence and intensity of disturbance is highly variable and depends on a range of factors relating to the animal and situation
- disruption to underwater acoustic cues
- increased stress levels
- indirectly by inducing behavioural and physiological changes in predator or prey species
- localised avoidance

- injury to hearing or other organs; hearing loss may be temporary (TTS) or permanent (PTS)
- masking or interfering with other biologically important sounds (including vocal communications, echolocation, signals and sounds produced by predators or prey).

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 vessel traffic. Wind speed and seabed conditions have a clear influence on the ambient noise level. Fish choruses are capable of reaching very high levels, in excess of 130 dB re 1 µPa (McCauley, 2012). Anthropogenic underwater noise sources in the region comprise shipping and small vessel traffic, petroleum production and exploration drilling activities and sporadic petroleum seismic surveys.

Marine fauna respond variably when exposed to underwater noise from anthropogenic sources, with effects depending on various factors, including 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 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 audibility is reduced for one sound (signal) that is 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—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 and 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.
- 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 temporary (TTS) from which an animal recovers within minutes or hours, or permanent (PTS) from which the animal does not recover.

The levels of acoustic exposure that may result in injury or behavioural changes in marine fauna is an area of increasing research. Because of differences in experimental design, methods and units of measure, comparing studies to determine likely sound exposure thresholds can be difficult. After assessing the available scientific information, thresholds were defined for informing the impact assessment and interpreting the estimated sound ranges. These are discussed for each receptor in JASCO (2020).

The assessment compared modelled received underwater sound levels to defined noise effect criteria, as determined by scientific research and academic papers (JASCO, 2020), for the identified environmental and social receptors.

Although the relationship between received sound levels and impacts to marine species is the subject of ongoing research, the science underlying noise modelling is well understood (Farcas et al., 2016).

6.3.2.1 Marine mammals

There are no known BIAs for marine mammals within the 20 km noise assessment boundary (Figure 3-6). Therefore, marine mammals are unlikely to aggregate within the noise assessment area, however, cetaceans may transit the area. The closest significant feature to the OA is the pygmy blue whale distribution and migration BIA, the nearest boundary of which is approximately 63 km and 179 km away respectively. Dugongs are not expected to occur within the OA.

The PMST report for the 20 km noise assessment boundary for the OA identified several threatened marine mammal species including the blue whale, fin whale and sei whale (Appendix D). Noise is listed as a threat in the Conservation Advice for *Balaenoptera physalus* (fin whale) (TSSC, 2015c) and Conservation Advice for *Balaenoptera borealis* (sei whale) (TSSC, 2015b).

The Conservation Management Plan for the Blue Whale 2015–2025 (CoA, 2015a) lists noise disturbance as a threat, specifically relating to impulsive sound sources and acute industrial noise such as pile driving. Anchor pile driving noise was assessed and included in the OPP, however this activity was eliminated by choosing an alternative anchor mooring system (i.e. suction anchors) to effectively reduce noise impact. Shipping noise in busy shipping channels is also identified as a potential source of noise emissions, although the risk assessment determines that consequences would be restricted to individuals, and no population-level effects are expected. The plan requires that anthropogenic noise in BIAs will be managed such that any blue whales may continue to use the area without injury. Because the noise assessment boundary does not impact any blue whale BIA, impacts will be managed in adherence with the Management Plan (CoA, 2015a).

Pygmy blue, Omura's and Bryde's whales were detected acoustically (using autonomous multichannel acoustic recorders deployed close to the seabed at 3 stations) in the Barossa area during a baseline acoustic environment characterisation program undertaken from July 2014 to July 2015 at and surrounding the Barossa field (JASCO, 2016). These whales were detected mostly during May–August, with no detections November–December. The pygmy blue whale detections were more than 400 km further east than the currently estimated northbound migration corridor. This detection was stated as being a significant regional scientific contribution. Omura's whales were detected from April–September with a peak in June–July. The whales seemed to enter the region from a south-west to north-east direction, then maintain a higher presence within the Barossa field area (compared to Evans Shoal and the Caldita field area). They appeared to leave the region reversing their entry path, leaving by the start of November. Pygmy blue whales were detected once during their northward migration in August 2014, over a few consecutive days in late May to early June 2015, on 16 June, 30 June, and 1 July 2015. No detections were logged from the southbound migration. The highest detection rate of the 3 sites was at the Barossa field. Bryde's whales were present in the region from January to October. Their location was detected mainly in shallower waters at Evans Shoal and the Caldita field area compared to the Barossa field area. In May 2022, Woodside contractors conducted a seismic survey for Woodside's Galactic Hybrid 2D MSS. This survey extent was approximately 21,000 km^2 and overlapped the proposed OA. Woodside reported that cetacean species were sighted including false killer whales and pygmy blue whales (personal communication, 1 June 2022).

Based on their hearing range, whale species have been classified as low-frequency cetaceans. Several odontocetes (including spotted bottlenose dolphin, killer whale and sperm whales) may also be present in the OA. Odontocetes have been classified as high-frequency cetaceans using the hearing group classification from Southall et al. (2019).

To better reflect the auditory similarities between closely related species, but also significant differences between species groups among the marine mammals, Southall et al. (2007) assigned the marine mammal species to functional hearing groups based on their hearing capabilities and sound production. This division into broad categories was intended to provide a realistic number of categories for which individual noise exposure criteria were developed. These groups were revised by NMFS (2018) and most recently by Southall et al. (2019). The categorisation has proven to be a

scientifically justified and useful approach in developing auditory weighting functions and deriving noise exposure criteria for marine mammals. These auditory weighting functions are referred to as frequency weighting.

For non-impulsive continuous noises, NMFS currently uses a step-function (all-or-none) threshold of 120 dB re 1 µPa SPL (unweighted) to assess and regulate noise-induced behavioural impacts for marine mammals (NOAA, 2019). The behavioural disturbance threshold criteria applied uses the most recent scientific literature on the impacts of sound on marine mammal hearing considered the most relevant to this activity. Table 6-5 details cetacean behavioural, TTS and PTS thresholds for continuous noise.

Table 6-5: Continuous noise: summary of cetacean impact thresholds

Hearing group	NOAA (2019)	Southall et al. (2019)	
	Behaviour	PTS onset thresholds (received level)	TTS onset thresholds (received level)
	SPL (dB re 1 µPa)	Weighted SEL_{24h} (dB re 1 μPa^2s)	Weighted SEL_{24h} (dB re 1 μPa^2s)
Low-frequency cetaceans	120	199	179
High-frequency cetaceans		198	178

Table 6-6: Impulsive noise: unweighted sound pressure level, SEL_{24h} and PK thresholds for acoustic effects on marine mammals

Hearing group	NOAA (2019)	NMFS (2018); Southall et al (2019)			
	Behaviour	PTS onset thresholds (received level)		TTS Onset Thresholds (Received Level)	
	SPL (dB re 1 µPa)	Weighted SEL24h (dB re 1 $\mu Pa^2 \cdot s$)	PK (Lpk; dB re 1 µPa)	Weighted SEL24h (LE,24h; dB re 1 µPa2·s)	PK (Lpk; dB re 1 µPa)
Low-frequency cetaceans	160	183	219	168	213
Mid-frequency cetaceans	160	185	230	170	224

Potential impacts from activity vessels

Using the predicted noise levels (as described in Section 6.3.1.2), the estimated distances from activity vessels to behavioural and physiological thresholds (as listed in Table 6-5) for cetaceans were calculated and are provided below.

The extent of thresholds associated with activity vessel operations can be estimated by considering those determined for the Barossa Development FPSO in isolation during normal operations which provides a conservative estimate (ConocoPhillips (2018):

- the range to the 120 dB re 1 µPa NOAA (2019) criterion for behavioural responses in marine mammals is approximated to be 1.42 km (Rmax)
- PTS and TTS in low-frequency cetaceans could occur within approximately 20 or 200 m respectively if the animal remains within that range for 24 hours

- PTS is not predicted in high-frequency cetaceans, although they could experience TTS within 50 m if the animal remains within that range for 24 hours.

The extent of thresholds associated with DP vessel operations are estimated considering the FPSO offload scenario, therefore:

- the range to the 120 dB re 1 µPa NOAA (2019) criterion for behavioural responses in marine mammals is approximated to be 11.4 km (Rmax)
- PTS and TTS in low-frequency cetaceans could occur within approximately 70 or 1,860 m respectively if the animal remains within that range for 24 hours
- PTS is not predicted in high-frequency cetaceans, although they could experience TTS within 50 m if the animal remains within that range for 24 hours.

These predictions are conservative for some vessel activities, as they considered 24-hour operations, whereas resupply activities typically take less time than this or the vessels are idle for some time during operations.

The extent of thresholds for a vessel in transit have been estimated using measurements of the *Pacific Ariki* (McCauley, 1998) and the FPSO operating in isolation:

- the range to the 120 dB re 1 µPa NOAA (2019) criterion for behavioural responses in marine mammals is approximated to be 1 km
- PTS and TTS in low-frequency cetaceans could occur within approximately 20 or 200 m respectively if the animal remains within that range for 24 hours
- PTS is not predicted in high-frequency cetaceans, although they could experience TTS within 50 m if the animal remains within that range for 24 hours.

Auditory masking impacts may occur when audibility is reduced for one sound (signal) that is 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 simultaneously. Therefore, the closer the marine mammal is to the vessel and the more overlap there is with their vocalisation frequencies, the higher the probability of auditory masking. Thus, the potential for masking and communication impacts is classified as high near the vessel (within tens of metres), moderate within hundreds of metres, and low within thousands of metres (Clark et al., 2009).

A qualitative assessment of masking was included in the OPP (ConocoPhillips, 2018), which considered the noise from the proposed FPSO facility operations (including offload) and the sound levels recorded during the baseline monitoring program (JASCO, 2015). The OPP FPSO assessment determined that pygmy blue whales, Omura's and Bryde's whales will experience masking when near the proposed FPSO facility and therefore masking may occur near the activity vessels within the OA. Given the lower vocalisation source levels for the latter 2 species, the area over which masking will occur will be larger than for pygmy blue whales. Masking from activity vessels is expected to be more relevant for Omura's and Bryde's whales because of their more regular presence within the region that encompasses the Barossa field from summer through to early spring, whereas the migratory pygmy blue whales will only be affected for a short time.

Generally, the spatial and temporal scale of behavioural (such as avoidance) response effects on marine mammals would be limited to the localised area surrounding the proposed activity vessels (thousands of metres) and periods of intensified activities. Because the operations will be focused on a static site, and thus only influence a small region that does not overlap any BIA, significant effects at the population level are not expected—impacts will be managed in accordance with the Conservation Management Plan for the Blue Whale 2015–2025 (CoA, 2015a), Conservation Advice for *Balaenoptera borealis* (sei whale) (TSSC, 2015b) and Conservation Advice for *Balaenoptera physalus* (fin whale) (TSSC, 2015c).

The Blue Whale Conservation Management Plan requires that "Anthropogenic noise in biologically important areas will be managed such that any blue whale continues to utilise the area without injury, and is not displaced from a foraging area". The potential for injury to blue whales associated with exceedance of PTS and TTS thresholds from vessel noise sources is limited to <2 km from Activity noise sources within the OA. The pygmy blue migration BIA is 179 km from the OA and the pygmy blue foraging BIA is approximately 975 km from the OA. As such the Activity is not inconsistent with the requirements of the Blue Whale Conservation Management Plan.

Potential impacts from acoustic surveying and positioning equipment

McPherson (2020) indicates that both peak and frequency-weighted SEL noise emissions from survey equipment such as MBES operating at 400 kHz or CHIRP SBP are typically below sound levels that could result in low and high-frequency marine mammal TTS or PTS from either PK or SEL criteria (Table 6-6) in a horizontal direction. The threshold for behavioural disturbance (Table 6-6) could be exceeded within 120 m (McPherson, 2020).

SSS impulses MBES sound levels are outside the auditory range of low frequency species / baleen whales (e.g. humpback and pygmy blue whales) but within the mid-frequency and high frequency cetacean marine fauna auditory range (e.g. sperm whales and dolphins). However, PTS and TTS thresholds for these species (Table 6-6) are only expected to be exceeded close to the source. Due to the lack of aggregating areas for these species, individuals are expected to be transitory only, displaying behavioural responses, and moving away from the source, before TTS and PTS thresholds are exceeded.

Measurements of vessel mounted CHIRP SBP indicated that the threshold for behavioural disturbance could be exceeded up to 141 m (NOAA, 2021).

The source levels for the positioning equipment are below those for the MBES. As the MBES will not cause the thresholds for physiological impact to be exceeded (Table 6-6), neither will the positioning equipment. However, threshold for behavioural disturbance (Table 6-6) could be exceeded within 40 m (McPherson, 2020).

Survey and positioning equipment could cause masking of vocalisations of cetaceans due to the overlap in frequency range between signals and vocalisations. Masking will primarily apply to high frequency cetaceans, with all signals above 2 kHz. Higher frequency sounds have limited propagation, and attenuate rapidly, resulting in a relatively small area of influence. Therefore, the range at which masking impacts could occur would be limited to within hundreds of metres from the sound source.

Given that marine mammal presence is likely to be transitory in nature, the likelihood of an individual remaining within the distances above for any length of time is highly unlikely.

Studies of baleen whales (e.g. humpback whales and blue whales) hearing apparatus suggest that their hearing is best adapted for low frequency sounds (Southall et al., 2019) with peak sensitivity range for humpback whales being <10 kHz. Behavioural avoidance of baleen whales may onset from 140 to 160 dB re 1 µPa (NOAA, 2019). Baleen whales display a gradation of behavioural responses to noise, suggesting that acoustic signals are audible to whales at considerable distances from the source, but indicate that whales are not disrupted from normal activities even during migration (Southall et al., 2007).

Given that survey equipment sound levels are typically below marine mammal TTS and PTS onset thresholds, and there are no significant feeding, breeding or aggregation areas for marine mammals within the OA, the likelihood of noise impacts associated with survey equipment are considered remote and limited to temporary behavioural impacts to individual fauna close to the sound source.

6.3.2.2 Marine turtles

The 20 km noise assessment boundary does not intersect any known marine turtle BIAs or habitat critical to the survival of species (Figure 3-7 to Figure 3-11). The closest turtle BIA within the EMBA is approximately 54 km from the OA.

The Recovery Plan for Marine Turtles in Australia 2017–2027 (CoA, 2017b) highlights noise interference from anthropogenic activities as a threat to marine turtles. The plan refers to vessel noise and the operation of some energy infrastructure as sources of chronic (continuous) noise in the marine environment, exposure to which may lead to avoidance of important turtle habitat. The recovery plan 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 that they have the highest hearing sensitivity in the frequency range 100–700 Hz (Bartol and Musick, 2003).

Finneran et al. (2017) presented revised thresholds for marine turtle injury and hearing impairment (TTS and PTS). Their rationale is that marine turtles have better auditory sensitivity at low frequencies and poor auditory sensitivity at other frequencies (Bartol and 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 fish than to marine mammals (Popper et al., 2014).

Studies show that marine turtle 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 activity vessels. Based on the limited data regarding noise levels that elicit a behavioural response in turtles, the lower level of 166 dB re 1 µPa from the 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 continuous sound sources for turtles are listed in Table 6-7.

Table 6-7: Continuous noise: criteria for vessel noise exposure for sea turtles

Potential marine fauna receptor	Popper et al., 2014		Finneran et al. (2017) Weighted SEL_{24h} (dB re 1 μPa^2s)	
	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 3 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 6-8: Criteria for impulsive noise exposure for turtles, adapted from Popper et al., 2014

Potential Marine Fauna Receptor	Masking	Behaviour	TTS	Recoverable Injury	Mortality and Potential Mortal Injury
Marine Turtle	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low	(N) High (I) Low (F) Low	(N) High (I) Low (F) Low	>210 dB SEL_{24h} or >207 dB PK

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. Sound Exposure Level (SEL). Zero to peak pressure level (PK).

Potential impacts from vessels

Based on the criteria listed in Table 6-7 there is a low risk of any acoustic injury to marine turtles from activity vessel noise. Behavioural changes, such as avoidance and diving, are only predicted for individuals near the activity vessels (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 marine turtles. Turtle 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.

Considering the open-ocean location of the OA, only individual turtles may be affected as they transit the area, and impacts are not considered significant because:

- the noise assessment boundary for the OA does not intersect any BIAs or habitat critical to turtle species
- individual species may infrequently traverse the OA
- vessel noise is expected to be below the thresholds for PTS and TTS given the typical size vessels used during the activity and the slow vessel speeds within the OA; the received levels may result in behavioural impacts, such as avoidance behaviours, but for a limited time and will not result in significant impacts
- helicopter noise will be intermittent during the activity, and below the thresholds for behavioural impacts (PTS and TTS)
- following the guidelines outlined in Popper et al. (2014), marine turtles are at low risk of mortality or permanent injury due to continuous noise sources, even near the source
- behavioural responses are expected to occur near the sources, but they will be limited to avoidance or a temporary change in swimming behaviour.

Potential impacts from acoustic surveying and positioning equipment

The sound levels of the acoustic survey and positing equipment (Sections 6.3.1.4 and 6.3.1.5) are below those associated with the PK criteria for injury (PTS and TTS) (Table 6-8) beyond a few metres, and are low enough that SEL criteria will not be reached (McPherson and Wood, 2017).

Recoverable injury and TTS could occur within tens of metres applying the relative risk criteria from Popper et al. (2014) (Table 6-8). Behavioural changes, such as avoidance and diving, are only

predicted for individuals in close proximity to the Activity vessels with acoustic sources on board (high risk of behavioural impacts within tens of metres of 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. This is in part because the sounds from survey and positioning equipment are all outside of the hearing frequency range for turtles (approximately 50 to 2000 Hz, with highest sensitivity to sounds between 200 and 400 Hz) (Bartol and Ketten, 2006; Yudhana et al., 2010; Lavender et al., 2012, 2014).

Impacts to marine turtles from underwater noise generated by survey and positioning equipment are unlikely to result in substantial impacts given that impacts are likely to be limited to physiological impacts in individuals located within tens of metres of the sound source. Behavioural impacts are extremely unlikely due to the signals all being outside the hearing range for turtles, however if they do occur, they will be limited in extent.

6.3.2.3 Sharks, rays and other fish

The PMST report for the noise assessment boundary identified a threatened species—reef manta ray—additional to the several sawfish, ray, shark and other fish species identified within the OA (Table 3-8; Appendix D).

There are no known fish spawning or aggregation areas in the noise assessment boundary for the OA; however, tuna and other mobile pelagic species may traverse the OA. No impacts to fish stocks are anticipated. The closest area considered likely to support site-attached fish is Lynedoch Bank, which is approximately 54 km from the OA. The closest fish BIA is approximately 510 km from the OA (whale sharks).

All fish species can detect noise sources, although hearing ranges and sensitivities vary substantially between species (Dale et al., 2015). Sensitivity to sound pressure in fish seems to be functionally correlated to the presence or absence of gas-filled chambers in the sound transduction system. These chambers enable fish 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 fish into 3 animal groups comprising:

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

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

Potential impacts from vessels

The criteria defined in Popper et al. (2014) for continuous noise sources were applied when assessing impacts to sharks, rays and other fish (Table 6-9).

Table 6-9: Continuous noise: criteria for noise exposure for fish

Potential marine fauna receptor	Mortality / potentially mortal injury	Impairment			Behaviour
		Recoverable injury	TTS	Masking	
Type 1 Fish: No swim bladder (particle motion	(N) Low (I) Low	(N) Low (I) Low	(N) Moderate (I) Low	(N) High (I) High	(N) Moderate (I) Moderate

Potential marine fauna receptor	Mortality / potentially mortal injury	Impairment			Behaviour
		Recoverable injury	TTS	Masking	
detection); includes sharks and rays	(F) Low	(F) Low	(F) Low	(F) Moderate	(F) Low
Type 2 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
Type 3 Fish: Swim bladder involved in hearing (primarily pressure detection)	(N) Low (I) Low (F) Low	170 dB SPL for 48 hours	158 dB SPL for 12 hours	(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

Source: Adapted from Popper et al., 2014

Note: Relative risk (high, moderate, low) is given for animals at 3 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.

Based on this study, vessel noise has a low risk of resulting in mortality for all fish types. The risk of recoverable injury to Type 1 and 2 fish is low, but is moderate for TTS and behavioural impacts when fish are within tens of metres of an activity vessel (Popper et al., 2014). For Type 3 fish, recoverable injury and TTS may occur within 60 m of the source (McPherson et al., 2019), with a high risk of behavioural impacts occurring within tens of metres of an activity vessel (Popper et al., 2014). Masking could occur within thousands of metres under a worst-case scenario of vessel operations, but typically any effect will be limited to within hundreds of metres.

Whale sharks are not considered to be particularly vulnerable to noise-related impacts and are categorised as 'fish with no swim bladder' when determining impact thresholds. Whale sharks would be expected to show avoidance to vessel noise, although they are likely to tolerate low-level noise—whale sharks have been observed swimming close to energy industry platforms on WA's North West Shelf.

Impacts to fish are not considered to have the potential to be significant because noise levels from helicopters and vessels that may cause behavioural responses are expected to be within a radius of a few hundred metres of the noise source.

Potential impacts from survey and positioning equipment

Potential impacts from survey equipment on fish have been assessed based on available criteria from Popper et al. (2014). Impulsive noises from acoustic positioning and survey equipment could result in physiological impacts to fish located within metres of the sound source, considering the results presented in Sections 6.3.1.4 and 6.3.1.5. The criteria defined in Popper et al. (2014) for impulsive noise sources have been adopted (Table 6-10).

Table 6-10: 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 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.

Behavioural impacts to fish from survey equipment noise may occur in individuals located within hundreds of metres of the source. None of the proposed equipment has energy below 19 kHz, and therefore it 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, as these signals are outside the hearing range of most fish in the region, the risk of impact is reduced.

Sharks are known to be highly sensitive to low frequency sounds between 40-800 Hz sensed solely through the particle-motion component of an acoustic field, Popper et al. (2014). Free ranging elasmobranchs (i.e. sharks) are attracted to sounds possessing specific characteristics – irregular pulse, broadband frequency and transmitted with a sudden increase in intensity (i.e. resembling struggling prey).

6.3.2.4 Invertebrates

Benthic invertebrates are unlikely to be negatively impacted from noise generated due to their distance from vessel activities (i.e. water depth is greater than 200 m) or from other SURF activity sources (such as ROVs). There are no thresholds or guidelines regulating the exposure of marine invertebrates to underwater noise.

Stress responses to non-impulsive sound exposure have been documented for marine invertebrates. The worst-case consequence for individual animals can be expected to be moderate to major, but

due to the limited spatial extent of the affected area, population consequences are considered to be minor.

There is no systematic information available if and to what extent marine invertebrates use acoustic cues to communicate with others of their species or their environment. Anecdotal information indicates no functional relevance of sound for these animals. However, vibration, such as ground-borne or near-field particle motion, can be assumed to have functional relevance—vibration can provide information about potential food availability or approaching predators. This information could potentially be masked by the noise/particle motion emitted by the vessels even though this effect would be limited to the direct vicinity of noise-generating sources. In the worst-case scenario, the consequence of acoustic/vibrational masking is considered to be moderate for individuals. A limited number of individuals are expected to experience this masking, thus it would have a negligible effect at a population level.

Limited and inconclusive data are available on the potential for behavioural responses and noise-induced physical effects on marine invertebrates. Theoretically, behavioural responses as well as significant sensory impairment or injury can have moderate consequences for an individual. However, in the absence of conclusive scientific information on the scope of these effects and the animals' ability to compensate for them, it is impossible to assess the consequences of behavioural responses and noise-induced impairment or injury.

Plankton and pelagic invertebrates could drift close to high-energy noise sources (e.g. bow thrusters). However, any negative impacts that could occur would be restricted to within metres of the sound source, apart from physical damage at that close range. At such a localised extent, noise impacts would be negligible at an ecosystem or population level.

Potential impacts from survey and positioning equipment

For impulsive noise and benthic invertebrates, the source is an important consideration in the assessment.

Any negative impacts on plankton and invertebrates 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 MBES/SBES 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.

6.3.2.5 Socioeconomic

No effects to benthic invertebrates are expected, including those of commercial value (e.g. scampi which are targeted in waters deeper than 250 m).

6.3.2.6 Cultural features

During consultation meetings with Tiwi Clans for the Drilling EP concerns were raised about the impact of drilling on their dreaming totems (including turtle totems).

Tiwi clients of the EDO also raised concerns about the potential impacts to marine life by noise and lights from the drilling activity; and the potential impacts of loud noises and vibrations that could harm imunga (spiritual places that are often connected to other sites) and marine species, which could in turn harm Tiwi people. Other concerns were raised by Tiwi clients of the EDO in relation to potential impacts to the health of land and sea country which could in turn impact access to food through traditional hunting and fishing, and that if totemic species (e.g. turtles) are impacted by the drilling activity this can impact Tiwi people and make them sick.

As SURF activities are proposed to occur in a similar geographical location to that of the Barossa drilling activities, Santos has considered those concerns and where appliable additional EPOs, Eps and CMs have been adopted. considers that similar concerns may exist, despite there being no specific feedback or concerns raised during SURF consultation.

Santos notes that almost 900 wells have been drilled previously in the region, and there is also significant historical and ongoing industrial shipping and fish trawling activities in the area that may be affected by the Activity in this EP. There is no evidence to support actual adverse effects from the actions of spiritual beings in response to impacts on the environment from those activities.

Santos understands the spiritual protection believed to be afforded to the Tiwi people is broadly maintained by protecting the features of the natural environment and through ceremonial practices alerting the spiritual beings to the presence of people travelling through country and the like.

6.3.2.7 Potential cumulative impacts from concurrent activities

On the basis that concurrent activities (see Section 2.10) will occur within the OA, the potential for cumulative noise impacts are acknowledged.

The Barossa GEP Installation EP, Drilling EP and this EP assessed potential noise impacts to a range of sensitive marine fauna. The overall worst-case consequence of noise for each EP was assessed as negligible, given there are no significant feeding, breeding or aggregation areas in the vicinity of the noise assessment boundary. The closest BIAs are located outside the area predicted to exceed thresholds for behavioural, masking or physiological impacts.

Additive effects will vary depending on environmental factors such as water depth, substrate, and position of the sound source within the water column. Cumulative effects from multiple sources are likely to produce increased impacts on individuals within a confined or shallow water environment (e.g. a bay or harbour) compared to the deep ocean environment (Nienke et. al., 2022). In the event that concurrent activities with multiple noise sources operate within the noise assessment area (20km assessment boundary around the SURF OA), the generated overlapping sound exposure area from aggregate sound effects are considered likely to remain below thresholds for injury to marine fauna.

It is considered that it is highly unlikely that there are any concurrent activities that have the capacity to materially change the location of the impact threshold boundaries.

The marine sound generated from vessel activities has the potential to cause behavioural responses, such as avoidance, to threatened or migratory marine fauna—marine mammals within 12 km of operating noise sources. Whilst it is considered unlikely that transiting individuals would remain in close proximity to the sound source due to a lack of BIAs and suitable habitat to support biologically important behaviours, PTS may occur in low frequency cetaceans within close proximity (<110 m) of a vessel. TTS may occur up to 1.9 km away for low-frequency cetaceans and within close proximity (<120 m) for high frequency cetaceans and dugongs. Vessel and MODU noise is expected to be below the thresholds (PTS and TTS) for turtles, however the received levels may result in behavioural impacts, such as avoidance behaviours, but for a limited time and will not result in significant impacts.

Marine fauna behavioural responses to noise from drilling operations are predicted to be confined to the OA and concentrated within a few hundred metres of the noise source, depending upon the noise sources and operations.

The risk of impact from GEP pipelay activities is further reduced as the pipelay vessel will slowly travel along the GEP route at approximately 2–3 km per day, and the MODU operations are limited to the drill centre locations. The likelihood of an individual remaining within the distances above behavioural thresholds is considered highly unlikely.

Notwithstanding the potential for overlap of the extent of noise effects from concurrent activities, due to the absence of significant feeding, breeding or aggregations areas and marine fauna BIAs within the noise assessment boundary (and up to 54 km from the Activity OA), and the short and intermittent duration of the concurrent activities (approximately 5 weeks), negligible additive and cumulative noise effects are considered likely only to transiting individuals.

6.3.2.8 Summary

The marine fauna impacts will be limited due to the short-term nature of the Activity and the low sound levels generated by activity vessels and other support noise. Noise levels from activity vessels and other support may cause marine fauna behavioural responses, such as avoidance, that are expected to be confined to the OA and concentrated within a radius of approximately 12 km to a few hundred metres of the noise source, depending upon the noise sources and operations.

No known BIAs occur within the noise assessment boundary, and migratory and threatened fauna are considered likely to be limited to transiting individuals.

Noise effects to fish of potential commercial value would be restricted to within hundreds of metres of the noise source.

No effects to benthic invertebrates are expected, including those of commercial value (e.g. scampi which are targeted in waters deeper than 250 m).

6.3.3 Environmental performance outcomes and control measures

The EPOs relating to this event include:

- No significant impacts to marine fauna from noise emissions [EPO-03].
- No significant impacts to cultural features from the Activity [EPO-14].

An assessment of the environmental benefits and the potential costs or issues associated with control measures for this activity are described in Table 6-11 to demonstrate the potential impacts from this aspect are ALARP. Control measures that are adopted have associated EPSs and measurement criteria, and are presented in Table 8-2. Rejected control measures have an ALARP evaluation provided to justify their rejection.

Table 6-11: Control measure evaluation for noise emissions

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
Standard control measures				
C6.3.1	Avoid activities near cetaceans and turtles (isolation control)	Santos implements EPBC Regulations– Part 8 Division 8.1 Interacting with cetaceans (and applied for marine turtles) to reduce the risk of a collision with marine fauna (Section 7.3). This control may result in a minor ancillary reduction in the potential for vessel noise impacts. However, it effectively reduces helicopter noise	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 accepted.	**Adopted** – Note, control measure is aligned with EPBC Regulations (Part 8).

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
		levels received at the sea surface.		
C6.1.1	Activity vessels equipped and crewed in accordance with Australian maritime requirements (administrative control)	Reduces noise emissions by ensuring contracted vessels are operated, maintained and crewed in accordance with industry standards and regulatory requirements.	Costs are expected as part of standard procedure.	**Adopted**
C6.2.1	Vessel planned maintenance system (administrative control)	Ensures equipment that generates noise is operating optimally and sound source levels are appropriately verified and within desired operating range.	Costs are expected as part of vessel maintenance requirements.	**Adopted**
Additional control measures				
C6.3.2	No pile driving activities (elimination control)	Pile driving is a significant noise source, and thereby eliminating its use will reduce underwater noise by a considerable degree.	Potential to reduce costs as alternatives such as suction anchors are relatively quick to install. Geotechnical conditions may make alternative options unfeasible.	**Adopted** – eliminated anchor pile driving for mooring systems by selecting an alternative anchor mooring system (i.e. suction anchors). Suction anchors provide a suitable alternative due to the suitable geological profile.
C6.3.3	Helicopter planned maintenance system (administrative control)	Ensures helicopter engine and equipment that generates noise is operating optimally and sound source levels are appropriately verified and within desired operating range.	Costs are expected as part of helicopter maintenance requirements.	**Adopted**
C6.3.4	Pre-deployment function testing of subsea acoustic positioning system (administrative control)	Ensures that subsea acoustic position systems are functioning correctly and operating optimally and sound source levels are appropriately verified and within desired operating range.	Costs are expected as part of standard procedure.	**Adopted**
C6.1.7	HSE inductions will include environmental	Ensures that crew are aware of the stringent EP, Santos and legislative requirements.	Administrative costs to update existing Santos procedure and	**Adopted**

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
	requirements (administrative control)		induction materials and train personnel.	
C6.2.6	Cultural Heritage (administrative control)	Shows respect for beliefs and culture of First Nations people.	Time and cost to work with First Nations communities.	**Adopted**
N/A	Manage the timing of the activity to avoid sensitive periods such as migration (whales), spawning (fish) or nesting (turtles) (administrative control)	Reduces potential impacts to fauna during key life stages.	Reduces the window of opportunity for undertaking the activity.	**Rejected** – not considered necessary or feasible. The OA does not overlap with any BIAs and therefore seasonal presence of species is not expected to be higher at certain times of the year. It is recognised that the Omura's whale has seasonal variability in the region, but this is not an EPBC Act listed species. Additionally, given the low potential impacts to individual fauna, significant impacts to migratory or nesting behaviours are not expected, therefore, no impacts at population level are predicted.
N/A	Dedicated marine mammal observer (MMO) (administrative control)	Improved ability to spot and identify marine fauna.	Additional cost of contracting several specialist MMOs. Even if marine fauna are identified, noise sources cannot be shut down if marine fauna are detected, since these sources are integral to safe operation of vessels.	**Rejected** – cost disproportionate to increase in environmental benefit given there are no seismic surveys (as per EPBC Policy Statement 2.1 Part B.1), activity noise generated is considered negligible and no known BIAs overlap (or are close to) the OA.
N/A	Concurrent activity noise management plan (administrative control)	Additive and cumulative impacts are predicted to be negligible (e.g. potential temporary behavioural changes), remain within the noise assessment boundary and short term;	No additional cost other than negligible personnel costs of preparing and reviewing the management plan.	**Rejected** – the noise assessment boundary does not occur in any resting, foraging, calving or confined migratory pathway for protected cetacean species, therefore the

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
		therefore, a noise management plan, and associated management controls, will have little or no benefit in terms of outcomes (i.e. reducing impacts further).		cost associated with developing a management plan outweighs the little or no benefit for a short duration activity that has a negligible impact (e.g. potential temporary behavioural changes).
N/A	Verification of noise levels (administrative control)	Allow adaptive management controls to be implemented if impact is greater than expected. May help verify estimated potential noise impact zones.	Costs of deploying noise monitoring equipment and processing data. Field monitoring program not warranted where potential impacts are low risk.	**Rejected** – negligible sources of noise and the OA does not occur in any resting, foraging, calving or confined migratory pathway for protected cetacean species. Short-term presence of vessels (approx. 9 months) would prevent noise verification being completed before the activity is finished. Cost disproportionate to the increase in environmental benefit given the rapid reduction in noise levels from vessels and the low-level behavioural response expected.
N/A	Helicopters will not land or take off if marine megafauna are present in the vicinity of an activity vessel (elimination control)	Reduces potential impacts to megafauna.	May impact safety during landing or take off.	**Rejected** – increased exposure risk to passengers. Risk of exhausting fuel supplies.

6.3.4 Environmental impact assessment

Receptor	Consequence level
Noise emissions	
Threatened, migratory or local fauna	The noise assessment boundary (20 km buffer from OA) does not intersect any BIA or habitat critical to the survival of any marine fauna species or in close proximity to the OA. Potential impacts due to underwater noise are limited to within 12 km of operating activity vessels.

Receptor	Consequence level
	While the level of noise expected from temporary and intermittent operational activities has the potential to cause physical injury to marine fauna, most species that may transit through the OA are expected to demonstrate avoidance behaviour if noise levels approach those that could cause pathological effects. Avoidance behaviour is likely to be localised (less than 1 km) within the area of the activity vessels (due to small spatial extent of elevated noise) and temporary (i.e. for the duration of the activity vessels only). Several cetacean species transit through the OA. Behavioural impacts may include increased swimming speed, changes in dive behaviour and/or avoidance of the area. Such impacts would be temporary with no significant impacts predicted to individuals or populations and considered not inconsistent with the Conservation Management Plan for the Blue Whale 2015–2025 (CoA, 2015a). The activity that potentially has the greatest effect is when vessels are under DP, which is either during resupply or while maintaining location when placing subsea infrastructure. During these activities, there is potential for TTS to occur within 50 m and 1,860 m from the source for high-frequency and low-frequency cetaceans, respectively. The potential for PTS in low-frequency cetaceans is estimated to be within 70 m of the source. However, it is anticipated that individuals will show avoidance behaviour in response to the continuous noise sources before respective TTS and PTS thresholds are exceeded. Impulsive noise generated from survey and positioning equipment would be limited to individual marine turtles located within tens of metres of the sound source, noting that the closest marine turtle BIA is >54 km from the OA. Behavioural impacts to fish from survey equipment noise may occur in individuals located within hundreds of metres of the source. Survey equipment could cause masking of vocalisations of cetaceans, but would be limited to within hundreds of metres from the sound source. PTS and TTS thresholds for marine mammals are only expected to be exceeded close to the source. Due to the lack of aggregating areas for these species and significant distances to the nearest marine mammal BIA, individuals are expected to be transitory only, displaying behavioural responses, and moving away from the source, before TTS and PTS thresholds are exceeded In the Recovery Plan for Marine Turtles in Australia (CoA, 2917b), noise interference to marine turtles depends on whether the exposure is short (acute) or long-term (chronic). The noise generated by the Activity is acute with impacts restricted to localised changes in behaviour within hundreds of metres of the source. The OA is more than 54 km from the nearest BIA for marine turtles, and no aggregations are expected. Therefore, potential behavioural impacts to marine turtles are expected to be localised and not significant at the individual and population level. Potential impacts to threatened or migratory shark or ray species are limited to the potential for avoidance behavioural responses within hundreds of metres of the source. Although there is the potential for TTS within this range, this is not expected due to noise avoidance behaviour. Impacts to fish are not considered to have the potential to be significant because noise levels from helicopters and vessels that may cause avoidance behavioural responses are expected to be within a radius of a few hundred metres of the noise source. Site attached fish are not expected within approximately 38 km of the OA. Potentially present demersal and pelagic fish are expected to move away from noise at levels that could cause PTS and TTS.

Receptor	Consequence level
Physical environment or habitat	Not applicable – noise will not impact the physical environment (including the KEF that overlaps the OA—Shelf break and slope of the Arafura Shelf). Species associated with the continental slope and patch reefs that characterise this KEF (such as demersal fish, whale sharks, sharks and turtles) are unlikely to aggregate within the OA due to the lack of sea floor features. The closest sea floor features are 2 scarps approximately 10 km and 13 km south of the OA (Figure 7-3). Potential impacts to these species are described in Section 6.3.2.
Threatened ecological communities	Not applicable – no threatened ecological communities have been identified in the area over which noise emissions are expected.
Protected areas	Not applicable – no protected areas have been identified in the area over which noise emissions are expected.
Socioeconomic receptors	The consequence of noise emissions on receptors is assessed as I – Negligible. Impacts to fauna, including fish and other marine species is likely to be limited to temporary behavioural impacts within a 12 km radius around activities, and is unlikely to result in significant impacts to marine species at the individual or population level. There is limited activity by Australian commercial fishers that overlaps the OA, and activity by Indonesian commercial fishers is not expected in Perth Treaty waters (outside the OA). Given the negligible consequence to marine species, subsequent impacts to commercial fish stock are not anticipated.
Cultural features	For assessment of impacts to marine species that are of cultural significance and/or represent a traditional food source for First Nations groups, refer to the assessment for threatened, migratory or local fauna. Feedback provided by Tiwi clients of the EDO during consultation raised concerns about their cultural and spiritual beliefs, which were not linked to a specific location or place. It was observed that other Tiwi Islands Relevant Persons did not identify similar concerns. Feedback provided by Croker Island clients of the EDO during consultation also raised concerns about cultural and spiritual beliefs, which were also not linked to a specific location or place. However consultation meetings with Croker Island people in Darwin did not identify any sacred sites or songlines identified as occurring within the operational area or the EMBA, and no objections or claims were raised. Santos notes that almost 900 wells have been drilled previously in the region, and there is also significant historical and ongoing industrial shipping and fish trawling activities in the area that may be affected by the Activity in this EP. There is no evidence to support actual adverse effects from spiritual beings in response to impacts on people or the environment from these activities. Notwithstanding, in response to the concerns raised by some First Nations people during consultation for the Drilling EP, Santos acknowledges the recommendations by Tiwi people as suggested to Dr Corrigan and has considered them for adoption where practicable and appropriate.
Cumulative impacts	
On the basis that concurrent activities (see Section 2.10) will occur within the OA, the potential for cumulative sound emissions is acknowledged. However, given the short and duration of concurrent activities and absence of significant feeding, breeding or aggregations areas and marine fauna BIAs within the noise assessment boundary, negligible additive and cumulative noise effects are expected to be limited to transiting individuals. It is considered that it is highly unlikely that there are any concurrent activities that have the capacity to materially change the location of the impact threshold boundaries. Therefore, cumulative noise effects are considered to be negligible, and no change to the overall consequence level is expected to result. The remoteness of the OA means that it is unlikely that there will be a cumulative impact above impact	

Receptor	Consequence level
thresholds with other marine users. Therefore, cumulative noise emission impacts are not predicted with other marine users.	
Overall worst-case consequence	I – Negligible

6.3.5 Demonstration of as low as reasonably practicable

The use of vessels on DP, survey equipment, acoustic positioning and ROVs for the Activity are unavoidable as there are no other options for safe installation methods. The activity vessels are expected to produce similar noise emissions to other marine vessels that frequent or transit through the vicinity of the OA. The proposed management controls verify that the activity vessels and subsea acoustic position systems are operating optimally; hence sound levels are expected to be within the normal operating range. Using helicopters to transfer personnel to and from activity vessels is necessary to allow operational activities to occur safely and effectively. Some personnel also need to be rotated to and from other locations, and a rapid method to transfer personnel is required in an emergency. A performance standard prohibiting helicopters from landing or taking off in the presence of marine megafauna would introduce an unacceptable risk to human life. Lastly, the use of additional vessels for crew transfer would also prolong the presence of noise generating sources (i.e. vessel engines and thrusters) within the OA.

All reasonably practicable control measures were reviewed and those adopted are considered appropriate to manage the impacts such that the residual consequence is assessed to be I – Negligible. The most significant noise-generating activity assessed in the accepted Barossa Development OPP (ConocoPhillips, 2018) was anchor pile driving. This activity has been eliminated by selecting an alternative anchor mooring system (i.e. suction anchors) which reduces the noise emitted substantially.

The proposed management controls are in accordance with Santos' risk management criteria and are considered appropriate to reduce impacts to ALARP.

6.3.6 Acceptability evaluation

Is the consequence ranked as I or II?	Yes – maximum consequence from noise emissions is I – Negligible.
Is further information required to validate the consequence assessment?	No – potential impacts and risks are well understood through the information available.
Are the risks and impacts consistent with the principles of ecologically sustainable development (ESD)?	Yes – activity evaluated in accordance with Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004), which considers principles of ESD.
Have the acceptable levels of impact and risks been informed by relevant species recovery plans, threat abatement plans and conservation advice and Australian marine park zoning objectives?	Yes – Consistent with relevant species recovery plans, conservation management plans and management actions set out in Table 3-10, including: **Conservation Advice:** • Conservation Advice for *Balaenoptera physalus* (fin whale) (TSSC, 2015c) • Conservation Advice for *Balaenoptera borealis* (sei whale) (TSSC, 2015b) **Recovery Plans:** • Conservation Management Plan for the Blue Whale 2015–2025 (CoA, 2015a) identifies noise interference as a threat to blue

	whales. No known BIAs for the pygmy blue whale occur within the noise assessment boundary. • Recovery Plan for Marine Turtles in Australia 2017–2027 (CoA, 2017b) identifies noise interference as a threat to marine turtles. No known BIAs or habitat critical to the survival of marine turtle species overlap the noise assessment boundary. Recovery plans / conservation advice for other species that may occur in the noise assessment boundary do not identify noise emissions as a key threat or have explicit relevant objectives or management actions related to noise emissions. The Marine Bioregional Plan for the North-West Marine Region (CoA, 2012b) indicates that noise pollution is not a concern for the one KEF (Shelf break and slope of the Arafura Shelf) that is within the noise assessment boundary. The noise assessment boundary does not overlap any AMP. The objectives and actions of these publications were considered during impact and risk assessments. The controls outlined in Table 6-11 are consistent with the objectives of the material listed above and Santos considers the impacts of noise emissions to be not inconsistent with these objectives.
Are performance outcomes, control measures and associated performance standards consistent with legal and regulatory requirements?	Yes – management measures are consistent with EPBC Regulations Part 8. Through acceptance of this EP, legislative and regulatory requirements will be met as per Section 1.6.2.
Are performance outcomes, control measures and associated performance standards consistent with Santos' Environment, Health and Safety Policy?	Yes – aligns with Santos' Environment, Health and Safety Policy (Appendix A).
Are performance outcomes, control measures and associated performance standards consistent with industry standards?	Yes – the most recent and comparable EPs accepted by NOPSEMA were reviewed for consistency with the performance outcomes, control measures and associated performance standards proposed in this EP.
Have performance outcomes, control measures and associated performance standards taken into consideration Relevant Person feedback?	Yes – no objections or claims were specifically raised for this Activity. However given the overlap of the SURF and Drilling activity OAs, feedback received during the Drilling EP has been considered and where applicable additional EPOs, CMs and EPSs were adopted.
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – ALARP assessment conducted, with no additional control measures adopted.

The Activity will be conducted over a short time period in a remote offshore location where there is a relatively low probability of encountering significant numbers of noise-sensitive fauna. Minimal behavioural changes are expected from all marine fauna in the noise assessment boundary, and therefore the negligible impacts expected from these noise sources are considered environmentally acceptable. No long-term harm is expected to result to EPBC Act listed marine fauna during operational activities. Through adherence to Santos' Protected Marine Fauna Interaction and Sighting Procedure (EA-91-II-00003), which drives compliance with EPBC Policy Statement Part 8, the Activity is considered acceptable to undertake in the area. The noise generated from vessels and helicopters and the potential impacts are well documented. With the controls proposed including EPBC Regulations Part 8 (Vessels and Aircraft), aligned with the applicable management actions outlined in relevant recovery plans and approved conservation advice, the potential consequences of impacts to noise-sensitive receptors in the area are assessed to be I – Negligible and ALARP.

6.4 Light emissions

6.4.1 Description of event

Event	Light emissions will occur from activity vessels and other support. Activity vessels and other support will routinely use external lighting to facilitate navigation and safe operations at night. Lighting typically comprises bright white (i.e. metal halide, halogen, fluorescent) lights, and is similar to that used in other offshore activities in the region, including fishing and shipping. Lighting levels will be determined primarily by operational safety and navigational requirements under relevant legislation, specifically the *Navigation Act 2012* (Cth). Activity vessels will be required to generate and use navigational lighting at night to indicate their position and they must indicate their limited ability to manoeuvre during operations under the *Navigation Act 2012*. Spot lighting may be used on an as-needed basis, such as when deploying or retrieving equipment. The ROV will be used during the activity and spot lighting will be used when it is working underwater. Lighting will typically comprise bright white (i.e. metal halide, halogen, fluorescent) lights. Lighting will be limited to that required for safety and navigational purposes on the activity vessels. Concurrent activities (Section 2.10) will generate light emissions due to the operation the MODU (including intermittent and short duration flaring [2–3 days for each well]) and vessels. Therefore, the cumulative impacts have been considered in this assessment.
Extent	The light assessment boundary of 20 km from the source will be used as the extent of light exposure, in accordance with National Light Pollution Guidelines for Wildlife (DCCEEW, 2023b). This additional 20 km buffer around the OA is the extent relevant to the impact assessment for planned light emissions. Cumulative modelling of two vessels working together indicates that light is predicted to reduce to below ambient levels at approximately 21.6 km and potential behavioural impacts to turtles is limited to 4.5 km (Pendoley, 2022). The light emissions from concurrent activities are predicted to be limited within the light assessment area. Direct line of sight may be visible up to 52.4 km from the MODU for a short duration flaring (2–3 days per well; up to 9 days total).
Duration	Navigational, safety and task lighting is required on a 24-hour basis for the duration of the activity described in Section 2. Section 2.10 describes the temporal extent of concurrent activities.

6.4.2 Nature and scale of environmental impacts

Potential receptors: threatened, migratory or local fauna (marine mammals, marine turtles, sharks, rays, other fish and seabirds); socioeconomic and cultural features.

To humans, light is visible between wavelengths of approximately 380–780 nanometres between the violet and red regions of the electromagnetic spectrum. In fauna it is visible between 300 and more than 700 nanometres, depending on the species. Some fauna do not see long wavelength red light at all, while others see light beyond the blue-violet end of the spectrum and into the ultraviolet (CoA, 2023). Therefore, the source of impact from light not only relates to the amount of artificial light, but also the types of light and the wavelengths that the different light types emit.

Activity vessels will have external lighting to provide a safe working environment and to comply with relevant maritime navigation requirements at night. Light from the larger construction vessels will be the most visible and therefore was used to determine the worst-case distance that light may be visible for activity vessels.

Lights include:

- regular halogen light bulbs (60–75 watt) and fluorescent lights (18–36 watt) that illuminate various gangways throughout the vessel and will be on all night for safety reasons
- floodlights of various power ratings (250–500 watt) that illuminate working areas
- helideck lights including floodlights (35 watt) and LEDs (3 watt) that provide lighting for the helicopter platform during night-time operations. Such lighting is obligatory but the platform will only be lit for safe helicopter landing and take off activities (e.g. medivacs or inspections). This lighting will be turned off during normal operations at night that do not involve helicopters
- navigation LEDs, which are installed at various locations around the vessel and are obligatory
- search lights, which are very bright but used only in emergency situations; these are turned off under normal operation.

Light modelling was undertaken for construction vessels to predict the extent of biologically relevant light spill. Specifics of the respective vessels' lighting design and luminaire specifications were applied to the Illumina Artificial Light At Night (ALAN) model (Aubé et al., 2005). The Illumina model is a 3D model that accounts for both line of sight and atmospheric scattering, allowing the attenuation of light over distance and extent of light glow to be modelled.

Since light sources (i.e. individual luminaires) can be placed individually within the area of interest, the model can replicate specific lighting designs in terms of light type, spectral distribution, height and orientation of individual luminaires, including any shielding, thus increasing model accuracy. This information was extracted from lighting layout drawings and light manufacturer data sheets for a typical construction vessel (130 m *Allseas Oceanic*, which is a similar size to the construction vessels proposed). The model assumed that all lights on the vessels were turned on (apart from search lights, which are only used in an emergency) with no additional shielding other than that provided by the vessel structures. It also assumed vessels were orientated north–south and that cloud cover was zero (no contribution of light from cloud reflectance). Model outputs are provided in radiance (W/m²/sr, where W = watts, m² = metres squared and sr = steradian).

In the absence of any published or generally accepted units of measure, or scale, for measuring the impact of artificial light at night on turtle hatchlings, moonlight was used as a proxy. Output from the light model (radiance, units of watts/m²/sr) was converted to units of full moon equivalents to provide biological relevance to the radiance output.

Table 6-12 presents potential impact criteria for marine turtles related to the proportion of radiance of a full moon. This was derived by Pendoley (2020) using their extensive experience observing marine turtles and how they respond to light in field settings. The range of moon brightness across a whole lunar cycle provides a realistic scale representative of ambient light levels to which turtle eyes are adapted. The scale is logarithmic to represent the nature of light decay with distance (a function of the inverse square law). At the lower end of the scale the radiant output is equivalent to no light in the sky (a new moon) while the upper limit is equivalent to the brightness of 10 full moons. The upper limit was selected to try to account for the increase in radiance levels that can be caused when light is reflected from clouds. Extending the scale beyond this limit was deemed unnecessary.

Table 6-12: Artificial light impact potential criteria (marine turtles)

Proportion of radiance of a full moon*	Impact potential to marine turtles
1 to 10	Light or light glow visible and impact likely
0.1 to 1	Light or light glow visible and behavioural impact possible, depending on moon phase
0.01 to 0.1	Light or light glow visible but behavioural impact unlikely (i.e. not biologically relevant)
<0.01	Light or light glow is considered ambient and no impact expected

Source: Pendoley (2020)

** Where 10 equals the radiance of 10 full moons and 0.01 equals 100th the radiance of one full moon.*

The Pendoley (2022) report provides ILLUMINA light modelling for an offshore pipelay vessel (327 m length) and construction vessel (130 m long) as well as a cumulative assessment (combined light spill) of both vessels side-by-side. It should be noted that both the reel-lay and construction vessels are significantly smaller vessels (both being approximately 157 m long) compared to the offshore pipelay vessel.

Light emissions were predicted to reduce to below ambient levels (0.01 orientation field of view full moon equivalents [OFOV FME], or 1%, radiance of a full moon) at 14.8 km from the offshore pipelay vessel, 10.9 km from the construction vessel and 21.6 km when both vessels are together. There is a potential for behavioural impacts to turtles (0.01–0.1 OFOV FME, or 10%, radiance of a full moon) within 3.3 km of the offshore pipelay vessel, 2.5 km of the construction vessel and 4.5 km when both vessels are together. Therefore, the reel-lay and construction vessels are predicted to reduce to below ambient levels at approximately 10.9 km and have the potential for behavioural impacts to turtles within 2.5 km. However, no nesting habitat or BIAs occur within these vessels' distance. The closest turtle BIA (an internesting buffer for flatback turtles) is approximately 54 km from the OA.

Results for the construction vessel are summarised in Table 6-13 (Pendoley, 2022).

Table 6-13: Distance of equivalent moon radiances for the construction vessel

OFOV FME*	Distance from source (m)
10–100	<126
1–10	126
0.1–1	557
0.01–0.1	2,469
<0.01	>10,949

Source: Pendoley (2022)

** Where 10 equals the radiance of 10 full moons and 0.01 equals 100th the radiance of one full moon.*

Continuous lighting may result in localised alterations to normal marine fauna behaviours for fish, sharks, marine turtles and seabirds that can alter foraging and breeding activity in marine turtles, seabirds, fish and sharks. Marine turtle and seabird species have the greatest sensitivity to light. The combinations of colour, intensity, closeness, direction and persistence of a light source are key factors in determining the magnitude of environmental impact (Environmental Protection Authority [EPA], 2010).

A PMST search was undertaken for the 20 km light assessment boundary around the OA, recommended in the National Light Pollution Guidelines for Wildlife (DCCEEW, 2023b). One threatened species—the reef manta ray—was identified in addition to those present in the OA (Table 3-8). The reef manta ray does not have any associated Conservation Advice or Recovery Plans. No

known BIAs or habitat critical to the survival of any marine fauna species intersect the 20 km light assessment boundary.

6.4.2.1 Marine mammals

Although no marine mammal BIAs occur within the 20 km light assessment boundary, cetaceans may travel through the area. The pygmy blue, Omura's and Bryde's whales have been sighted in and around the vicinity of the OA during surveys (see Table 3-8 for a comprehensive list of marine mammals).

The PMST report for the 20 km light assessment boundary for the OA identified several threatened marine mammal species including blue, fin and sei whales (Appendix D). Light is not listed as a threat in the conservation advice or recovery plans, nor in the Conservation Management Plan for the Blue Whale 2015–2025 (CoA, 2015a)

Marine mammals are not known to be attracted to light sources at sea. Cetaceans predominantly use acoustic senses to monitor their environment rather than visual cues (Simmonds et al., 2004). Therefore, impact from light is not anticipated.

6.4.2.2 Marine turtles

The National Light Pollution Guidelines for Wildlife (DCCEEW, 2023b) state that a 20 km buffer (based on sky glow) to important habitats for turtles should be applied when considering possible impacts. However, the demonstrated impacts on which this buffer is based were in response to light emissions associated with a liquefied natural gas (LNG) plant. Three relevant light modelling studies found that the spatial extent of a measurable change in ambient light was 10.9 km from a construction vessel, 12.6 km from a drilling rig, and 17.4 km from an FPSO (ERM, 2010; Pendoley, 2020; Pendoley, 2022). Hence, the expected light emissions associated with activity vessels will be notably lower than those of an LNG plant. Therefore, light emitted from activity vessels will have a lesser spatial extent than an FPSO. The reel-lay and construction vessels are predicted to reduce to below ambient levels at approximately 10.9 km and have the potential for behavioural impacts to turtles within 2.5 km. These studies indicate that the spatial extent of a change to ambient light is less than the 20 km light assessment boundary used for the purposes of impact assessment, based on the National Light Pollution Guidelines for Wildlife (DCCEEW, 2023b).

The 20 km light assessment boundary does not intersect any marine turtle BIAs or habitat critical to the survival of marine turtle species and therefore it is considered unlikely that artificial light will affect foraging, nesting and mating, and this is not assessed further in this EP. The closest turtle BIA (an internesting buffer for flatback turtles) is approximately 54 km from the OA. Individual species may infrequently traverse the OA.

The Recovery Plan for Marine Turtles in Australia 2017–2027 (CoA, 2017b) highlights artificial light as a threat to marine turtles. Specifically, the 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
- creating pools of light that attract swimming hatchlings and increase their risk of predation.

The most significant risk posed to marine turtles from artificial lighting is the potential disorientation of hatchlings following their emergence from nests by light spill on beaches, although breeding adult turtles can also be disoriented (Longcore and Rich, 2016). The nearest turtle nesting beach is approximately 140 km from the OA.

6.4.2.3 Sharks, rays and other fish

Fish at the surface of the water have the potential to be impacted by artificial light. 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 energy industry 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.

Sharks and rays are not known to be significantly attracted to light sources at sea. However, they may be attracted to the fish that are attracted to the light.

6.4.2.4 Seabirds

The National Light Pollution Guidelines for Wildlife (DCCEEW, 2023b) recommended using a 20 km threshold, which provides a precautionary limit based on observed effects of sky glow on fledgling seabirds grounded in response to artificial light 15 km away (CoA, 2023). The reel-lay and construction vessels are predicted to reduce to below ambient levels at approximately 10.9 km and have the potential for behavioural impacts to turtles within approximately 2.5 km (Pendoley, 2022). Light emitted from activity vessels will have a lesser spatial extent than an FPSO. Both studies indicate that the spatial extent of a change to ambient light is less than the 20 km light assessment boundary used for the purposes of impact assessment, based on the National Light Pollution Guidelines for Wildlife (DCCEEW, 2023b). Light pollution is listed as a threat in the Wildlife Conservation Plan for Seabirds (COA, 2020). The 20 km light assessment boundary does not intersect any bird BIAs and closest land is Seagull Island (off the north coast of the Tiwi Islands)—from which seabirds may fledge is being approximately 140 km distant. There are 3 threatened shorebird (migratory) species that may occur within the light assessment boundary—eastern curlew, red knot and curlew sandpiper. These species have conservation advice that does not list light as a threat. There are 5 seabirds (migratory) species that may or likely occur in the light assessment boundary—common noddy, great frigatebird, lesser frigatebird, streaked shearwater and white-tailed tropicbird.

Seabirds may either be directly attracted by the light source or indirectly—structures in offshore environments tend to attract marine life at all trophic levels, creating food sources and providing artificial shelter for seabirds (Surman, 2002). Offshore light sources may also provide enhanced capability for seabirds to forage at night. Artificial light can disorient seabirds, disrupt natural foraging and migratory behaviours, and potentially cause injury through interaction with infrastructure. Species with a nocturnal component to their life history, such as fledging shearwaters, are most vulnerable to negative effects of artificial light, however the nearest wedge-tailed shearwater BIA is approximately 718 km from the OA (Table 3-9), and the nearest breeding colony further still. At these distances, fledglings are not expected to occur in the OA. Cannell et al. (2019) reported mean foraging trip distances for wedge-tailed shearwaters, during different stages of the breeding cycle, as ranging from 183 to 5,113 km. As such, activity vessels within the OA should not significantly impact foraging behaviour, given the large distances typically covered by breeding individuals.

6.4.2.5 Protected and significant areas; socioeconomic receptors and cultural features

The First Nations people maintain a continuing spiritual connection with sea country, including marine fauna species with cultural significance, such as totems or as a cultural food source and AMPs. The OA is approximately 44 km from the nearest protected area (Oceanic Shoals AMP), which is a submerged receptor, therefore outside the light assessment boundary. Impacts to fauna, including fish and other marine species, is likely to be limited to localised, temporary behavioural

impacts and is unlikely to result in significant impacts to marine species at the individual or population level. In considering the distance to the nearest marine turtle BIA (>50 km), impacts to turtles from the Activity lighting are expected to be restricted to localised attraction and temporary disorientation, but with no long-term or residual impact. Given the negligible consequence to species and sea country, subsequent impacts to socioeconomic receptors including cultural features (e.g. culturally significant marine fauna) are not anticipated.

Information provided by some Tiwi people during consultation for the Drilling EP, raised concerns about the potential impacts of lights on marine turtles from drilling, and potential impacts to marine life generally, and that if totemic species (e.g. turtles) are impacted by the drilling activity this can impact Tiwi people and make them sick. As SURF activities are proposed to occur in a similar geographical location to that of the Barossa drilling activities, Santos considers that similar concerns may exist, despite there being no specific feedback or concerns raised during SURF consultation.

The distance from the OA to the Northern Prawn Fishery's medium- and high-intensity fishing areas is approximately 113 km and 121 km, respectively. Lighting from activity vessels will not impact these areas.

6.4.2.6 Potential cumulative impacts from concurrent activities

On the basis that concurrent activities (see Section 2.10) will occur within the OA, the potential for cumulative light impacts is acknowledged.

The Barossa GEP Installation EP, Drilling EP and this EP assessed potential light impacts. Light modelling predicted a potential for behavioural impacts, such as potential disorientation of hatchlings, to turtles within 3.3 km of the pipelay vessel (largest vessel within concurrent activities), 2.5 km of the construction vessel and 4.5 km cumulative impact (both vessels working together). Direct line of sight may be visible up to 52.4 km from the MODU for a short duration flaring (2–3 days per well; up to 9 days total).

In accordance with the National Light Pollution Guidelines for Wildlife (DCCEEW, 2023b) sensitive receptors within 20 km of the light source should be considered. There are no known BIAs within the light assessment boundary, with the closest bird and turtle BIA being ~54 km from the OA. The cumulative impacts of multiple vessels, MODU and flaring light sources are considered not to result in substantial adverse impacts to birds or turtles due to the short and intermittent nature of the concurrent activities and the closest land—Seagull Island (off the north coast of the Tiwi Islands)—from which seabirds may fledge or turtles may hatch being approximately 140 km distant. Therefore, no change to the overall consequence level due to cumulative light impacts is anticipated.

6.4.3 Environmental performance outcomes and control measures

The EPOs relating to this event include:

- No significant impacts to marine fauna from lighting emissions [EPO-04].
- No significant impacts to cultural features from the Activity [EPO-14].

An assessment of the environmental benefits and the potential costs or issues associated with control measures for this activity are described in Table 6-14 to demonstrate the potential impacts from this aspect are ALARP. Control measures that are adopted have associated EPSs and measurement criteria, and are presented in Table 8-2. Rejected control measures have an ALARP evaluation provided to justify their rejection.

Table 6-14: Control measures evaluation for light emissions

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
Standard control measures				
C6.1.1	Activity vessels equipped and crewed in accordance with Australian maritime requirements (administrative control)	Light spill from unnecessary lighting reduced when vessel meet the minimum lighting requirements, further lowering potential additional light pollution to the environment, thus reducing the potential impacts to fauna.	Lighting is required to ensure safe working conditions, and to alert other users of the sea to the vessel presence.	**Adopted**
Additional control measures				
N/A	Manage the timing of the activity to avoid sensitive periods (administrative control)	Negligible due to the remote offshore location, absence of receptors in vulnerable life stages, and nature and scale of potential light impacts (i.e. temporary and short duration).	As the activity's duration will be approximately 9 months there would be a high cost to demobilise and remobilise vessels.	**Rejected** – the high financial cost would be grossly disproportionate to negligible environmental benefits. The OA is not located in an area that is likely to cause impact to turtle nesting or hatching, or seabird breeding, and therefore timing the activity to avoid this would not change the potential environmental impacts. Therefore, impacts are not expected on a population level or to impact turtle habitat.
N/A	Implement light management actions recommended in the National Light Pollution Guidelines for Wildlife (DCCEEW, 2023b), including: • switch off outdoor/deck lights when not in use • use existing block-out blinds on portholes and windows that are not	Would result in reduced light spill from internal lighting onto the sea surface, potential to reduce overall light emissions, and reduce the consequence of any impact to any seabird interactions.	Potential re-engineering of vessel (lighting management systems and blackout blinds).	**Rejected** – control considered unwarranted given the OA is not located in an area that is likely to cause impact to turtle nesting or hatching, or seabird breeding, and therefore would not change the potential environmental impacts. 24-hour per day activities require a safe standard of lighting.

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
	necessary for safety or navigation at night • shielding/shrouding on external lights (administrative control)			
C6.2.6	Cultural Heritage (administrative control)	Shows respect for beliefs and culture of First Nations people.	Time and cost to work with First Nations communities.	**Adopted**
N/A	Change the wavelength of outdoor lights to avoid wavelengths within the peak sensitivity of turtles and seabirds (substitution control)	Negligible due to the absence of turtle and seabirds in vulnerable life stages within the OA.	High cost to change vessel lights. Navigational lighting colours are stipulated by law. Working and egress areas must be lit for health and safety reasons.	**Rejected** – the high financial cost would be grossly disproportionate to negligible environmental benefits. Health and safety reasons, and maritime regulations, dictate lighting requirements.
N/A	Limit or exclude night-time operations (elimination control)	Would reduce light emissions to the marine environment.	Would double the duration of activity; increase impacts or potential impacts in other areas, including increase in waste, air emissions, risk of vessel collision etc. A minimal level of artificial lighting will still be required on the vessels on a 24-hour basis for safety reasons.	**Rejected** – given the minimal risk of impacts to turtles and seabirds occurring, the financial and environmental costs of requiring all works to be undertaken during daylight hours only are not considered appropriate.
N/A	Use dark, matte surfaces on vessels (substitution control)	Would reduce reflection and scattering of light resulting in skyglow.	Additional cost to repaint surfaces. Some areas may require lighter surfaces to manage heat conduction for health and safety. Unlikely to result in a material light reduction.	**Rejected** – given the short duration of activities, the cost would be grossly disproportionate to negligible environmental benefits. May compromise health and safety in some circumstances.

6.4.4 Environmental impact assessment

Receptor	Consequence level
Light emissions	
Threatened, migratory or local fauna	Sensitive receptors that may be impacted by light emissions in the same location for an extended period include fish at the surface, marine turtles and seabirds. The National Light Pollution Guidelines for Wildlife (DCCEEW, 2023b) recommends a 20 km threshold as a precautionary limit based on observed effects of sky glow on marine turtle hatchlings and fledgling seabirds. The closest turtle BIA is approximately 54 km from the OA. The closest land—Seagull Island (off the north coast of the Tiwi Islands)—from which seabirds may fledge is approximately 140 km distant (Figure 7-3). There are no breeding colonies of wedge-tailed shearwaters on the Tiwi Islands, the species most vulnerable to impacts to artificial light. Therefore, night-time lighting from the activity is expected to have a negligible impact on breeding or hatchling turtles, and seabirds. Considering the distance from the nearest nesting beach and wedge-tailed shearwater breeding colony, the density of post-dispersal turtle hatchlings and wedge-tailed shearwater fledglings in the OA is also considered low. In considering the distance to the nearest marine turtle BIA (approximately 54 km), impacts to turtles from operational activity lighting are expected to be restricted to localised attraction and temporary disorientation, but with no long-term or residual impact. It is considered that the activity will not compromise the objectives set out in the Recovery Plan for Marine Turtles in Australia 2017–2027 (CoA, 2017b). Fish (including sharks) have been shown to be attracted to artificial light sources, but the activity is unlikely to lead to large-scale changes in species abundance or distribution. Overall, a short-term localised increase in fish activity is expected to occur as a result of lighting from the activity vessels, but with negligible impacts to the local fish population. Therefore, impacts to transient fish will 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. Therefore, the consequence level for threatened, migratory or local fauna is considered to be I – Negligible.
Physical environment or habitat	Not applicable – no impacts to physical environments and/or habitats from light emissions are expected. Impacts from light are not predicted at the seabed and the Marine Bioregional Plan for the North-West Marine Region (CoA, 2012b) identifies light pollution as not of concern for the KEF (Shelf break and slope of the Arafura Shelf).
Threatened ecological communities	Not applicable – no threatened ecological communities identified in the area over which light emissions are expected.
Protected areas	Not applicable – the light assessment boundary does not intersect any protected areas.
Socioeconomic receptors	Impacts to fish stock, is likely to be limited to localised, temporary behavioural impacts and will not result in significant impacts to fish at the individual or population level. Given the negligible consequence to fish species, subsequent impacts to commercial fishing (Section 3.2.4.1) is not anticipated. Lighting from activity vessels is not expected to cause an impact to other socioeconomic receptors other than to act as a visual cue for avoidance of the area (for safety purposes) by other marine users, including commercial fishers. The consequence level for socioeconomic receptors is considered to be I – Negligible.

Receptor	Consequence level
Cultural features	For assessment of impacts to marine species that are of cultural significance and/or represent a traditional food source for First Nations groups, refer to the assessment for threatened, migratory or local fauna.
Cumulative impacts	
On the basis that concurrent activities (see Section 2.10) will occur within the OA, the potential for cumulative light emissions is acknowledged. Notwithstanding the potential for overlap of the extent of light effects from concurrent activities, due to the absence of significant feeding, breeding or aggregations areas within the Activity light assessment area (and up to 54 km from the Activity OA) and the short and intermittent duration of the concurrent activities, additive and cumulative light effects can reasonably be expected to be negligible. The lighting control measures identified reduce the potential for impacts to sensitive marine fauna.	
Overall worst-case consequence	I – Negligible

6.4.5 Demonstration of as low as reasonably practicable

Artificial lighting is required 24 hours a day for operational and navigational safety during the activity. All reasonably practicable control measures were reviewed and those adopted are considered appropriate to manage the impacts such that the residual consequence is assessed to be I – Negligible. The proposed management controls are in accordance with Santos' risk management criteria and are considered appropriate to reduce impacts to ALARP.

6.4.6 Acceptability evaluation

Is the consequence ranked as I or II?	Yes – maximum consequence from light emissions is I – Negligible.
Is further information required to validate the consequence assessment?	No – potential impacts and risks are well understood through the information available.
Are the risks and impacts consistent with the principles of ecologically sustainable development (ESD)?	Yes – activity was evaluated in accordance with Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004), which considers principles of ESD.
Have the acceptable levels of impact and risks been informed by relevant species recovery plans, threat abatement plans and conservation advice and Australian marine park zoning objectives?	Yes – consistent with relevant species recovery plans, conservation management plans and management actions set out in Table 3-10, including: • National Light Pollution Guidelines for Wildlife (DCCEEW, 2023b). These Guidelines classify light emissions as a threat. Managing artificial light emissions from vessels is not inconsistent with the objectives of this plan through the adoption of EPO-04 and C6.1.1. • Recovery Plan for Marine Turtles in Australia 2017–2027 (CoA, 2017b). The OA, with a recommended 20 km light assessment boundary, does not impact turtle nesting habitat, turtle BIAs or habitat critical to the survival of marine turtle species. Therefore, biologically important behaviours of nesting adults and emerging/dispersing hatchlings can continue given the distance of the OA from the nearest nesting beaches. • Wildlife Conservation Plan for Seabirds (COA, 2020). This plan identifies light pollution as a minor threat to seabirds. The OA, with a 20 km light assessment boundary, does not impact seabird BIAs (closest BIA is approximately 140 km south of the OA). Therefore, biologically important

	behaviours of breeding and roosting can continue given the distance of the closest bird BIA is approximately 140 km south of the OA. • For all the plans identified above, the objectives are achieved by adopting EPO-04 and C6.1.1, and Santos considers the impacts of light emissions to be not inconsistent with these recovery plans. Recovery plans / conservation advice for other species that may occur in the light assessment boundary do not identify light emissions as a key threat or have explicit relevant objectives or management actions related to light emissions. The Marine Bioregional Plan for the North-West Marine Region (CoA, 2012b) identifies light pollution as not of concern for the KEF that overlaps the OA—the Shelf break and slope of the Arafura Shelf. The OA light assessment boundary does not overlap any AMP. The objectives and actions of these publications were considered during impact and risk assessments. The controls outlined in Table 6-14 are not inconsistent with the objectives of the material listed above.
Are performance outcomes, control measures and associated performance standards consistent with legal and regulatory requirements?	Yes – management measures are consistent with SOLAS and the *Navigation Act 2012* (Cth). Through acceptance of this EP, legislative and regulatory requirements will be met as per Section 1.6.2.
Are performance outcomes, control measures and associated performance standards consistent with Santos' Environment, Health and Safety Policy?	Yes – aligns with Santos' Environment, Health and Safety Policy (Appendix A).
Are performance outcomes, control measures and associated performance standards consistent with industry standards?	Yes – the most recent and comparable EPs accepted by NOPSEMA were reviewed for consistency with the performance outcomes, control measures and associated performance standards proposed in this EP.
Have performance outcomes, control measures and associated performance standards taken into consideration Relevant Person feedback?	Yes – objections or claims raised by Relevant Persons relating specifically to lighting from ROV operations have been considered. The existing control measures are considered sufficient.
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – see ALARP assessment conducted, with no additional control measures adopted.

Lighting on activity vessels is industry standard and is required to meet relevant maritime and safety regulations. The potential consequences of the anthropogenic light sources in the OA are considered to be negligible and restricted to short-term behavioural impacts on individual fauna that may be present in the OA during the Activity. The 20 km light assessment boundary does not intersect any BIA or habitat critical for the survival of any marine fauna species. Light emissions from the activity vessels are unlikely to attract and/or affect the behaviour of large numbers of seabirds and the impact of lighting associated with the activity to seabirds is considered negligible. The potential consequence of light emissions on receptors is assessed as I – Negligible. 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 acceptable.

6.5 Atmospheric emissions

6.5.1 Description of event

Event	Atmospheric emissions may occur from: • hydrocarbon combustion to operate the activity vessels and helicopters • operation of vessel incinerators. Activity vessels may use ozone-depleting substances (ODS), but in a closed rechargeable refrigeration system—there is no plan to release ODS to the atmosphere. Concurrent activities (Section 2.10) will also generate atmospheric emissions, such as the operation of a MODU (under normal operations), ~3 support vessels, pipelay vessel and construction vessels and intermittent and short duration flaring activities. Therefore, the cumulative impacts have been considered in this assessment.
Extent	Localised: small quantities of vessel-generated gaseous emissions will, under normal circumstances, quickly dissipate into the surrounding atmosphere. The atmospheric emissions from concurrent activities are likely to dissipate quickly in the open water environment; however, given the proximity, there may be a spatial overlap.
Duration	For the activity duration, with intermittent emissions associated with discrete activities, e.g. incinerators. Section 2.10 describes the temporal extent of concurrent activities.

6.5.2 Nature and scale of environmental impacts

Potential receptors: physical environment (air quality); threatened, migratory or local fauna (seabirds); socioeconomic receptors and cultural features.

The potential impacts from air emissions identified above include:

- deterioration of local air quality
- contribution to national GHG levels.

These impacts may in turn have indirect impacts on marine species and the environment to which First Nations people are connected.

Hydrocarbon combustion emissions may result in a temporary, localised reduction of air quality. A reduction in local air quality could affect threatened, migratory or local fauna (seabirds), and the workforce. Atmospheric emissions may be harmful, odoriferous or aesthetically unpleasing.

Table 6-15 lists the direct GHG emissions associated with activity vessels during the Activity. Emissions were calculated based on forecast fuel usage using the National Greenhouse and Energy Reporting (NGER) Emissions and Energy Threshold Calculator 2022–2023[27]. The total estimated direct GHG emissions for these petroleum activities is approximately 21,210 t CO_2-e. The total annual Australian GHG emissions for the year from December 2021 to December 2022 are estimated by the Commonwealth Government to be 463.9 Mt CO_2-e (DCCEEW, 2022). The direct emissions from the Activity are estimated to be approximately 0.0046% of the total annual Australian GHG emissions.

[27] https://www.cleanenergyregulator.gov.au/NGER/Forms-and-resources/Calculators

Table 6-15: Estimated direct GHG emissions in tonnes of carbon dioxide equivalent (~t CO_2-e)

Vessel type	Approximate fuel usage (tonnes)	Conversion to kilolitres (kL)	GHGs			Total scope 1 emissions (~t CO_2-e)
			CO_2	CH_4	N_2O	
Reel-lay	773	899	2,426	3	14	2,443
Construction	3,480	4,046	10,917	16	62	10,995
Support	2,460	2,860	7,717	11	44	7,772
TOTAL	**6,712**	**7,805**	**21,060**	**30**	**120**	**21,210**

In consideration of EPBC Act Section 527E (Appendix B.1), Santos considers that no material indirect GHG emissions are associated with the petroleum activities limited to the Activity. Refer to Appendix B.1 for additional information.

In the future Barossa Production Operations EP (BAA-200 0637), Santos will present a GHG emissions (scopes 1 to 3) analysis for the 25-year lifecycle of the Barossa Development, which will inform the environmental assessment of greenhouse gas emissions.

The OA is in a remote offshore environment where there are no other permanent sources of air pollution—the air quality is expected to be nearly pristine. Atmospheric emissions from combustion engines could result in deterioration of local air quality, while direct GHG emissions may cause an incremental increase in global GHG concentrations.

GHG emissions refers to gases that trap heat within the atmosphere through the absorption of long-wave radiation reflected from the Earth's surface. The emissions of carbon dioxide (CO_2), nitrous oxide (N_2O) and methane (CH_4), as relevant to this petroleum activity, are recognised as GHG emissions. GHG emissions are linked to global warming and climate change.

Santos recognises the science of climate change and supports the objective of limiting global temperature rise to less than 2°C and pursuing efforts to limit the temperature rise to 1.5°C. In recognition of the global need to reduce GHG emissions, Santos has had a published Climate Change Policy since 2008, guiding emissions management and climate change risks. The *Climate Change Act 2022* (Cth) legislates Australia's emissions reduction targets, including reducing Australia's net GHG emissions to 43% below 2005 levels by 2030 and to a net zero by 2050.

Santos' emission reduction targets include a new long-term target of achieving net–zero scope 1 and 2 absolute emissions by 2040. Santos' strategy focuses on natural gas as a reliable transition fuel source and on developing technologies such as carbon capture and storage and alternative fuels, such as hydrogen, as foundations for its decarbonisation pathway.

Potential impacts as a result of climate change have been modelled by the Commonwealth Scientific and Industrial Research Organisation (CSIRO). The modelling indicates that temperatures will increase across Australia; rainfall patterns will change significantly; and extreme events, such as droughts, floods and wildfires, will become more common. These changes are likely to impact individual species, ecosystems and ecosystem services, such as food and water availability. Within decades, environments across Australia may be substantially different (CSIRO and Bureau of Meteorology, 2015).

To date, the currently observed global warming and associated anthropogenic climate changes cannot be directly attributed to any one development or activity—they are the result of net global GHG emissions and GHG sinks that have accumulated in the atmosphere since the industrial revolution began in the 1700s.

Therefore, it is not possible to directly attribute any one project or activity, such as the Activity, to climate change impacts globally or upon potential Australian receptors due to the spatial (global) and

temporal (since the industrial revolution) extent of GHG emissions. Therefore, consideration for the purpose of this EP is framed by the contribution that this petroleum activity will make to national and global atmospheric emissions of GHG. This contribution is small—approximately 0.0046% of the annual Australian GHG emissions (2021–2022 data).

Further, the Barossa Development will be a designated large facility under the NGER Act and as such will be subject to the Safeguard Mechanism. This means that Santos, among other things, will have an obligation to ensure that the net covered emissions of GHGs from the operation of the Barossa Development do not exceed the applicable baseline.

ODSs are used in closed refrigeration systems. ODSs have the potential to contribute to ozone-layer depletion if accidentally released to the atmosphere. ODS air emissions would only occur in the event of damaged or faulty refrigeration equipment, or due to human error.

6.5.2.1 Potential cumulative impacts from concurrent activities

On the basis that concurrent activities (see Section 2.10) will occur within the OA, the potential for cumulative impacts of atmospheric emissions is acknowledged.

The Barossa GEP Installation EP, Drilling EP and this EP assessed potential atmospheric emission impacts to be negligible given the remote location and the relatively short duration of each activity. The direct emissions from concurrent activities within the Activity OA (including the Activity) are estimated to be approximately 0.0446% of the total annual Australian GHG emissions compared to 0.0046% for the Activity. As a result, negligible additive and cumulative atmospheric emissions effects from concurrent activities are predicted.

6.5.3 Environmental performance outcomes and control measures

The EPOs relating to this event include:

- Reduce impacts to air quality (GHG and non-GHG emissions) from combustion engines and incinerators by maintaining atmospheric emissions in accordance with standard maritime practices [EPO-05].

An assessment of the environmental benefits and the potential costs or issues associated with control measures for this activity are described in Table 6-16 to demonstrate the potential impacts from this aspect are ALARP. Control measures that are adopted have associated EPSs and measurement criteria, and are presented in Table 8-2. Rejected control measures have an ALARP evaluation provided to justify their rejection.

Table 6-16: Control measures evaluation for atmospheric emissions

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
Standard control measures				
C6.5.1	Atmospheric (GHG and non-GHG) emissions from combustion managed in accordance with standard maritime practice (administrative control)	Vessels, as required by vessel class, will comply with the *Navigation Act 2012* (Cth) and Marine Order 97 (MARPOL Annex VI) to meet the following requirements: • use low-sulfur fuel to reduce emissions • hold a valid International Air	No additional costs, as this is an industry standard requirement.	**Adopted**

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
		Pollution Prevention Certificate (or equivalent) • minimise the risk of accidentally releasing ODSs • minimise incinerator emissions.		
C6.1.1	Activity vessels equipped and crewed in accordance with Australian maritime requirements (administrative control)	Reduces emissions by ensuring contracted vessels are operated, maintained and crewed in accordance with industry standards and regulatory requirements.	No additional costs, as this is an industry standard requirement.	**Adopted**
C6.2.1	Vessel planned maintenance system (administrative control)	Reduces emissions by ensuring vessels are operating within desired operating range.	No additional costs, as this is an industry standard requirement.	**Adopted**
Additional control measures				
C6.1.7	HSE inductions will include environmental requirements (administrative control)	Ensures that crew are aware of the stringent EP, Santos and legislative requirements.	Administrative costs to update existing Santos procedure and induction materials and train personnel.	**Adopted**
N/A	No incineration during activities (all waste transported to shore for disposal) (elimination control)	Eliminates waste incineration emissions.	Increase in health risk from storage of some wastes. Energy/emissions impacts to transfer waste for onshore disposal. Cost of waste disposal.	**Rejected** – avoiding incineration will increase cost and environmental impacts (emissions, energy and landfill) of onshore disposal.
N/A	Use incinerators and engines with higher environmental efficiency (administrative control)	Improves air quality by more efficient burning or fuel combustion.	Significant cost in changing vessel equipment.	**Rejected** – cost grossly disproportionate to low environmental benefit (impact rated Negligible).
N/A	Removal of all ODS-containing	Eliminates potential of ODS emissions occurring.	ODS is rarely found on vessels and there is a low	**Rejected** – based on cost to replace all

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
	equipment (elimination control)		potential for ODS releases. If there is ODS-containing equipment (such as refrigerators), it will be managed as per Marine Order 97: Marine Pollution Prevention – Air Pollution.	equipment and the low potential for ODS releases.
N/A	Alternative fuel type selected for vessels (substitution control)	Could reduce pollutants associated with MDO combustion.	Not practically feasible at present. Practical and reliable alternative fuel types (and power sources) have not been identified for the contracted vessels required for this activity.	**Rejected** – not practically feasible at present.
N/A	Using lower emissions vessels (substitution control)	Reduces total emissions associated with engines.	Not practically feasible at present. The contracted vessels required are specialised and have limited availability. The vessels selected will comply with Santos' vessel vetting process.	**Rejected** – not practically feasible at present. The contracted vessels are specialised and have limited availability. The vessels selected will comply with Santos' vessel vetting process.
N/A	Santos vessel vetting process to include evaluation of vessel emissions and alternative fuels (administrative control)	Potential to reduce emissions associated with vessels by selecting more efficient vessels.	The emissions profile of activity vessels is unlikely to be a factor for selection, given the limited vessel availability and emission variability between activity vessels currently available for hire. The vessels selected will comply with Santos' vessel vetting process.	**Rejected** – not feasible.
N/A	Reporting of GHG emissions as per the NGER Scheme	This is a regulatory requirement under the NGER Act with which	Cost associated with implementing.	**Adopted** – NGER reporting is a Commonwealth regulatory

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
	(administrative control)	Santos and its contractors must comply.		requirement, hence no control measure has been developed for this requirement.

6.5.4 Environment impact assessment

Receptor	Consequence level
Atmospheric emissions	
Threatened, migratory or local fauna	Short-term behavioural impacts (e.g. avoidance) to seabirds could be expected if they fly in the vicinity of the location. No decrease in local population size or area of occupancy of species, loss or disruption of critical habitat or disruption to the breeding cycle. The consequence level for threatened migratory or local fauna (seabirds) is considered to be I – Negligible.
Physical environment or habitat	The activity vessels and other supports will generate atmospheric emissions in the open ocean and offshore waters, enabling emissions to dissipate into the surrounding atmosphere quickly. GHG emissions released during the Activity will account for approximately 0.0046% of annual Australian GHG emissions. Given the relatively small quantity, detectable environmental impacts are not predicted. No impacts will occur to sensitive subsea features including within the KEF (Shelf break and slope of the Arafura Shelf) and its values that overlap the OA. The consequence level for physical environment/habitat is assessed as I – Negligible.
Threatened ecological communities	Not applicable – no threatened ecological communities were identified in the area over which air emissions are expected.
Protected areas	Not applicable – no protected areas over which air emissions are expected.
Socioeconomic receptors	Given the negligible consequence to species, subsequent impacts to socioeconomic receptors are not anticipated. As the Activity occurs in offshore waters, the air quality in coastal towns or settlements will not be affected. The consequence level for socioeconomic receptors is considered to be I – Negligible.
Cultural features	For assessment of impacts to marine species of cultural significance, refer to the assessment for threatened, migratory or local fauna. For assessment of impacts to the physical environment to which First Nations people are connected and have raised concerns, refer to the assessment for the physical environment/threatened ecological communities /protected areas.
Cumulative impacts	
Cumulative atmospheric emissions from either concurrent activities or in conjunction with other marine users are unlikely to be significant. This is based on the following:	

• atmospheric emissions from concurrent activities may result in a localised reduction in air quality in the immediate vicinity of the source and hence are unlikely to overlap with other marine users due to the cautionary zone and PSZs around sources of emissions, and the remoteness of the OA. • the addition of atmospheric emissions from the activities will be a negligible contribution to overall Australian GHG emissions. Therefore, no change to the overall consequence level due to cumulative impacts is reasonably expected.	
Overall worst-case consequence	I – Negligible

6.5.5 Demonstration of as low as reasonably practicable

Atmospheric emissions are largely unavoidable due to operational and health and safety considerations. All reasonably practicable control measures were reviewed and those adopted are considered consistent with maritime/petroleum industry standards and appropriate to manage the impacts such that the residual consequence is assessed to be I – Negligible. The proposed management controls are in accordance with Santos' risk management criteria and are considered appropriate to reduce impacts to ALARP.

6.5.6 Acceptability evaluation

Is the consequence ranked as I or II?	Yes – maximum consequence from atmospheric emissions is I – Negligible.
Is further information required to validate the consequence assessment?	No – potential impacts and risks are well understood through the information available.
Are the risks and impacts consistent with the principles of ecologically sustainable development (ESD)?	Yes – activity evaluated in accordance with Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004), which considers principles of ESD. Santos concludes that the activity-related impacts of atmospheric emissions will not compromise the health, diversity or productivity of the environment.
Have the acceptable levels of impact and risks been informed by relevant species recovery plans, threat abatement plans and conservation advice and Australian marine park zoning objectives?	Yes – maximum consequence from atmospheric emissions is I – Negligible. The Marine Bioregional Plan for the North Marine Region (CoA, 2012a) includes consideration of the effects of air quality on species and KEFs. The implementation of EPO-05 and the control measures outlined in Table 6-16 will ensure the atmospheric emissions from the Activity (vessel emissions) will not compromise this conservation effort.
Are performance outcomes, control measures and associated performance standards consistent with legal and regulatory requirements?	Yes – management measures are consistent with the *Climate Change Act 2022* (Cth), *Ozone Protection and Synthetic Greenhouse Gas Management Act 1989* (Cth) (and associated regulations), *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth) (and associated regulations), and MARPOL VI/Marine Order 97. Through acceptance of this EP, legislative and regulatory requirements will be met as per Section 1.6.2.
Are performance outcomes, control measures and associated performance standards consistent with Santos' Environment, Health and Safety Policy?	Yes – aligns with Santos' Environment, Health and Safety Policy (Appendix A).

Are performance outcomes, control measures and associated performance standards consistent with industry standards?	Yes – the most recent and comparable EPs accepted by NOPSEMA were reviewed for consistency with the performance outcomes, control measures and associated performance standards proposed in this EP.
Have performance outcomes, control measures and associated performance standards taken into consideration Relevant Person feedback?	Yes – no objections or claims were specifically raised for this Activity. However given the overlap of the SURF and Drilling activity OAs, feedback received during the Drilling EP has been considered and where applicable additional EPOs, CMs and EPSs were adopted.
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – ALARP assessment conducted, with additional control measures adopted.

Atmospheric emissions from vessels are permissible under the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth), 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 Australian Marine Order standards is considered to be an appropriate management measure.

The consequence of atmospheric emissions on receptors is assessed as I – Negligible. Based on an assessment of Santos' acceptability criteria and with the control measures in place, there is expected to be no substantial change in air quality that may adversely impact the environment and the potential impacts are considered acceptable.

6.6 Vessel discharges

6.6.1 Description of event

Event	Potential impacts may occur in the OA from vessel discharges of: • deck drainage/run-off • sewage and greywater • food waste • cooling water • bilge water • brine (if a reverse osmosis unit is used for water treatment) • ballast water. **Deck drainage** Drainage water from activity vessels includes rainwater, sea water and washdown water. Such discharge may potentially contain small residual quantities of oil, grease and detergents if present or used on the decks. Assessment of the unplanned spillage of hydrocarbons and other environmentally hazardous liquids is discussed in Section 7. **Sewage and greywater** The volume of sewage and greywater is directly proportional to the POB number. Up to 30–40 L of sewage/greywater may be generated per person per day. Approximate POB numbers for each vessel are: 120 on the reel-lay vessel, 140 on the construction vessel, up to 40 on each support vessel. With up to 3 support vessels at any one time within the OA, the estimated sewage and greywater discharged per day would be 15,200 L. **Food waste** Putrescible waste potential discharge to sea is estimated to be approximately 1 L of food waste per person per day. For the vessels within the OA at any one time this results in an estimated 380 L/day, using the POB numbers in 'sewage and greywater' above. **Cooling water** Sea water will be used as a heat exchange medium for cooling machinery engines. Sea water is drawn from the ocean and flows counter current through closed-circuit heat exchangers, transferring heat from engines and machinery to the sea water. The sea water is then discharged to the ocean (i.e. it is a once-through system). Cooling water temperatures may vary depending on engine workload and activity. **Bilge water** While in the OA, the vessels may discharge oily bilge water after treatment to 15 mg/L oil in water via an approved oily water filter system. **Brine** Brine generated from the water supply systems on each vessel will be discharged to the ocean at a salinity of approximately 10% higher than sea water. The volume of the discharge depends on the requirement for fresh (or potable) water and will vary between vessels and the POB number. The effluent may contain scale inhibitors to control inorganic scale formation, such as the formation of calcium carbonate and magnesium hydroxide, in water-making plants. Other water purification and plant cleaning chemicals may be used and discharged to sea after the cleaning process is completed. **Ballast water** Ballast water could potentially be discharged to the marine environment from vessel ballast tanks. Refer to Section 7.2 for the ballast water risk assessment. Note: Firefighting foam will not be discharged to sea when testing the firefighting system on vessels within the OA.

	Concurrent activities (Section 2.10) will generate MODU and vessel discharges. The maximum POB for the MODU is 140 and the largest vessel (pipelay) is 270.
Extent	The small volumes of vessel discharges may cause localised nutrient enrichment, organic and particulate loading, ecotoxicological effects, and increased water temperature and salinity around discharge points and in the direction of the prevailing current. The environment that may be affected by vessel discharges will likely be within approximately 50 m of the activity vessel and is likely to be contained the OA, based on dispersion modelling. Concurrent activities will result in small volume (incremental increase) and very short duration vessel (including MODU) discharges. Any overlapping plume may result in a highly localised and temporary decrease in water quality, considering the rapid dispersion predicted to occur in the open ocean within the OA.
Duration	During the period of the activity, localised changes to water quality will occur, but water quality conditions will return to normal within minutes to hours after ceasing discharges. Routine vessel (including MODU) discharges may occur throughout the concurrent activities; however an overlapping plume is considered unlikely due to the infrequent and very short duration (hours) of vessel discharges.

6.6.2 Nature and scale of environmental impacts

Potential receptors: physical environment (water quality, benthic habitats including KEF), threatened, migratory or local fauna (marine mammals, marine turtles, rays, sharks and other pelagic fish, and seabirds); socioeconomic and cultural features.

6.6.2.1 Physical environment

Small volumes of vessel discharges will be released to the marine environment and result in a localised negligible reduction in water quality. Discharges will be temporary (minutes to hours), localised and limited to surface waters. The discharges are expected to disperse and dilute rapidly.

The OA overlaps one KEF—Shelf break and slope of the Arafura Shelf. The sea floor features associated with this KEF (i.e. the shelf break and patch reefs, hard substrate pinnacles and submerged reefs on the shelf slope) were not observed within the OA during the Barossa marine studies program, nor are these topographically distinct features evident from the bathymetry data derived from multiple surveys undertaken across this area. Hence, vessel discharges are unlikely to impact the KEF. Species associated with the continental slope and patch reefs that characterise this KEF (e.g. demersal fish, whale sharks, sharks and turtles) are unlikely to aggregate within the OA due to the lack of sea floor features. However, potential impacts to these species are described below.

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

Eutrophication impacts from sewage, greywater and putrescible wastes

Discharges of macerated food waste, treated sewage and greywater can result in localised increases in nutrient concentrations (e.g. ammonia, nitrite, nitrate and orthophosphate), organics (e.g. volatile and semi-volatile organic compounds, oil and grease, phenols and endocrine-disrupting compounds) and inorganics (e.g. hydrogen sulfide, metals and metalloids, surfactants, phthalates and residual chlorine). Increased biochemical oxygen demand on the receiving waters may promote localised elevated levels of phytoplankton due to nutrient inputs and bacterial activity due to organic carbon inputs. This could subsequently impact higher order predators.

However, the discharges are low volume so their dispersion and dilution is expected to be rapid. The organic components discharged are subject to biodegradation through bacterial action, oxidation and evaporation. The OA is located in deep offshore waters dominated by high currents and strong wave action—short-term changes to surface water quality may occur within the OA. Modelling of wastewater discharges from the FPSO was undertaken for the Barossa Development

(ConocoPhillips, 2018) and indicated that discharges would be mixed to very low levels (1:5,000 dilution with regard to oil/grease, total suspended solids and coliform bacteria) within a maximum distance of 53 m (based on higher flow rates expected during commissioning). The volumes and discharge rates expected during the Activity would be much less and therefore likely to result in dilution within a smaller radius.

In a study of sewage discharge in deep ocean waters, Parnell (2003) reported no appreciable differences in the inorganic nutrient levels between the outfall area and background concentrations, suggesting rapid uptake of nutrients and/or rapid dispersion and dilution within hours of discharge.

Salinity increases

The desalination of sea water results in a discharge of brine with a slightly elevated salinity (around 10% higher than sea water). On discharge to the sea, the desalination brine, being of greater density than sea water, is expected to sink and disperse in the currents. The volume of the discharge depends on the requirement for fresh (or potable) water and the POB number.

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

Changes in temperature

Cooling water will be discharged at a temperature above ambient sea water temperature. Upon discharge it will be subjected to turbulent mixing and transfer of heat to the surrounding waters. Cooling water discharge to the marine environment could result in a localised and temporary increase in the ambient water temperature, which may cause alteration of the physiological processes (particularly enzyme-mediated processes) in marine biota.

Cooling water discharge points vary for each vessel. However, they all adopt the same discharge design, which permits cooling water to be discharged above the water line to help cool and oxygenate this wastewater stream before it mixes with the surrounding marine environment.

Temperature dispersion modelling undertaken for the Barossa Development (RPS APASA, 2017) for an FPSO shows that the temperature of discharged water will decrease rapidly as the discharge mixes with the receiving waters, returning to within 3°C of ambient water temperature within approximately 12 m of the discharge location (horizontally) and less than 70 m below the sea surface. The discharge volumes from an FPSO would be expected to be at much higher rates than the activity vessels due to the difference in size and equipment type used—discharges from the activity vessels are considered unlikely to extend beyond the area described by this modelling.

Contamination from releases of bilge water

Discharges of oily bilge water could result in a localised reduction in water quality with impacts on protected marine fauna and plankton. If not properly managed, the discharge of oily water has the potential to create an oil sheen on surface waters and a temporary localised decline in water quality and toxic effects to marine fauna. Toxicity to marine organisms would be from small amounts of dissolved hydrocarbons in the oily water drainage after treatment. Given that oil and grease residues in oily water drainage will be in low concentrations, the potential for impact is considered low and would be further reduced due to the strong tidal movements experienced in the region and the naturally turbid environment.

Toxicity

Discharges from vessels may include typical chemicals used within standard maritime sewage systems, desalination systems and residues of those used for cleaning decks. Discharges are expected to be intermittent and similar to other permitted discharges from vessels.

On discharge to the marine environment, the low volumes of these types of chemicals are expected to rapidly disperse in the offshore marine environment. There may be a localised and temporary (hours) reduction in water quality in the immediate vicinity of the release.

Therefore, toxic environmental effects on environmental receptors along the food chain (plankton, fish, marine reptiles, birds and cetaceans) are not expected in these deep open waters.

6.6.2.2 Threatened, migratory or local fauna

As discussed in the sections above, the extent of impact for planned discharges is localised, and rapid dilution is predicted to occur within the offshore waters. Marine fauna within the OA, some of which may have cultural significance as totems of cultural food sources, are likely to be transient. If contact does occur with marine fauna, it will be for a short duration likely not of sufficient duration to cause a toxic effect.

Discharges may cause changes to behaviour in marine fauna (avoidance or attraction). Fish and oceanic seabirds may be attracted to macerated food scrap discharges. However, such discharges would be isolated occurrences, so no prolonged influence on fauna behaviour is expected.

There are no known BIAs, breeding grounds or sensitive habitats (including habitat critical to the survival of any marine fauna species) for EPBC Act listed species near the OA.

6.6.2.3 Cultural features

No First Nations people feedback was provided about potential impacts from vessel discharges to cultural features during consultations for SURF activities.

Feedback provided during consultation on the Drilling EP raised concerns regarding potential impacts from the Drilling Activity on totemic species and marine species that provide a food source for traditional fishing and hunting.

Other Tiwi people also provided information to Santos that impacts to totemic species could also affect Tiwi people by making them sick. Section 6.6.2.2 describes the potential impacts to marine species of cultural significance.

6.6.2.4 Potential cumulative impacts from concurrent activities

On the basis that concurrent activities (see Section 2.10) will occur within the OA, potential cumulative impacts from vessel discharges are acknowledged.

The Drilling EP and this EP assessed potential vessel discharge impacts as minor, while the Barossa GEP Installation EP assessed the impacts as negligible. The activity vessels (covered under this EP) will not be permitted within the 500 m cautionary zone for the GEP pipelay vessel or MODU 500 m PSZ. Safe level separation distances may occur between activity vessels and up to 2 GEP vessels during pipelay and pre-commissioning activities (e.g. construction and/or support vessel) for short intermittent periods. One activity vessel (covered under this EP) may be adjacent to or nearby the MODU and up to 2 Drilling activity vessels.

Multiple vessels (including the MODU) may conduct routine discharges (e.g. sewage and bilge water) during concurrent activities. Vessel discharges will be in accordance with standard maritime practices (e.g. MARPOL) to minimise potential environmental impacts (refer to Table 6-17). Vessel discharges resulting in overlapping plumes is considered unlikely due to the infrequent nature of these discharges and the limited duration of vessels working in close proximity to each other. A relatively small volume (incremental increase) over a very short duration (hours) is expected if concurrent discharges occur. Any overlapping plume may result in a highly localised and temporary decrease in water quality, considering the high levels of dilution in open water and the nature of the marine environment near the OA. As a result, the additive and cumulative effects of vessel (including MODU) discharges are considered negligible.

Therefore, no change to the overall consequence level due to cumulative vessel discharge impacts is expected.

6.6.3 Environmental performance outcomes and control measures

The EPOs relating to this event include:

- Reduce impacts to water quality from activity vessel discharges by maintaining discharge streams in accordance with standard maritime practices [EPO-06].
- No significant impacts to cultural features from the Activity [EPO-14].

An assessment of the environmental benefits and the potential costs or issues associated with control measures for this activity are described in Table 6-17 to demonstrate the potential impacts from this aspect are ALARP. Control measures that are adopted have associated EPSs and measurement criteria, and are presented in Table 8-2. Rejected control measures have an ALARP evaluation provided to justify their rejection.

Table 6-17: Control measures evaluation for activity discharges – vessels

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
Standard control measures				
C6.6.1	Routine discharges of treated bilge and deck water will comply with the *Navigation Act 2012* (Cth), *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth) and Marine Order 91 (administrative control)	Managing bilge and deck drainage discharges to Commonwealth and marine requirements ensures no substantial change in water quality will occur. Ensures vessel oily water is treated and discharged in accordance with MARPOL Annex I (and Marine Order 91: Marine pollution prevention – oil).	MARPOL requirement.	**Adopted**
C6.6.2	Routine discharges of treated sewage and grey water, in accordance with the *Navigation Act 2012* (Cth), *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth) and Marine Order 96 (Marine Pollution Prevention – Sewage) (administrative control)	Managing treated sewage and grey water discharges to Commonwealth and marine requirements ensures no substantial change in water quality will occur.	MARPOL requirement.	**Adopted**

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
C6.6.3	Routine discharges of putrescible waste, in accordance with standard maritime practice and Marine Order 95 (Marine Pollution Prevention – Garbage) (administrative control)	Reduces probability of garbage being discharged to sea thus reducing potential impacts to marine fauna and ensures compliance with MARPOL Annex V (and Marine Order 95: Marine pollution prevention – garbage).	MARPOL requirement.	**Adopted**
Additional control measures				
C6.2.6	Cultural Heritage (administrative control)	Shows respect for beliefs and culture of First Nations people.	Time and cost to work with First Nations communities.	**Adopted**
C6.1.7	HSE inductions will include environmental requirements (administrative control)	Ensures that crew are aware of the stringent EP, Santos and legislative requirements.	Administrative costs to update existing Santos procedure and induction materials and train personnel.	**Adopted**
N/A	Zero discharge of deck water (elimination control)	Would eliminate potential contaminants being discharged to sea.	Increased 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 environmental benefit for a remote offshore location. It is a permissible maritime discharge.
N/A	Zero discharge of bilge water (elimination control)	Would eliminate treated oily water from being discharged to sea.	Issues include vessel stability comprised, potential fire hazard and flooding risk.	**Rejected** – safety and environmental considerations outweigh the environmental benefit for a remote offshore location. It is a permissible maritime discharge.
N/A	Restrict use of desalination plant; or zero discharge of brine water (elimination control)	Would eliminate or reduce brine from being discharged to sea.	Cost associated with transporting freshwater offshore. Health risks associated with limited supply of freshwater. Storage of brine would create an additional hazard	**Rejected** – health and safety considerations outweigh the environmental benefit for a remote offshore location; use of 'water making' system and discharge of waste brine is a

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
			for working on deck.	permissible maritime discharge
N/A	Zero discharge of putrescible waste (elimination control)	Would eliminate putrescible waste from being discharged to sea.	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 (e.g. incineration, treatment etc.) of the wastes.	**Rejected** – cost outweighs the benefit given the low impact expected from planned discharges; discharge of food waste is a permissible maritime discharge.
N/A	Mandatory closed drain system on vessels (administrative control)	Would eliminate untreated deck drainage from being discharged to sea.	Increased cost due to treatment system and vessel modification requirements.	**Rejected** – costs significantly outweigh the environmental benefit given the minor impacts expected from planned discharges.

6.6.4 Environmental impact assessment

Receptor	Consequence level
Vessel discharges	
Threatened, migratory or local fauna	Sensitive receptors that may be impacted include plankton, fish at sea surface, marine turtles and mammals, and seabirds. Impacts to water quality will be localised and will occur only when the discharges occur (i.e. no sustained impacts), therefore recovery will be measured in hours to days. Consequently, only short-term behavioural impacts are expected with no decrease in local population size, area of occupancy of species, loss or disruption of critical habitat or disruption to the breeding cycle. Given the nature of the planned vessel discharges, the limited volumes that could be released to the marine environment, the high levels of dilution and the

Receptor	Consequence level
	nature of the marine environment near the OA, the consequence level for threatened, migratory or local fauna is considered to be II – Minor.
Physical environment or habitat	Vessel discharges are predicted to quickly dilute and disperse in the offshore environment. Water quality changes will be negligible, localised and of short duration. Any effects on water quality are expected to be within the surface waters only and have no effect on seabed receptors (including the KEF that overlaps the OA—Shelf break and slope of the Arafura Shelf). Species associated with the continental slope and patch reefs that characterise this KEF (e.g. demersal fish, whale sharks, sharks and turtles) are unlikely to aggregate within the OA due to the lack of sea floor features. Given the nature of the planned vessel discharges, the limited volumes that could be released to the marine environment, the high levels of dilution and the nature of the marine environment near the OA, the consequence level for physical environment or habitat is considered to be II – Minor.
Threatened ecological communities	Not applicable – no threatened ecological communities identified in the area over which vessel discharges are expected.
Protected areas	Not applicable – no protected areas were identified in the area over which vessel discharges are expected.
Socioeconomic receptors	Given the controls in place to manage the vessel discharges in accordance with regulatory requirements, impacts to marine species (including targeted fishery species) are not expected. Indonesian commercial fishers are not expected as the Perth Treaty waters are outside of the OA. Vessel discharges will be of a relatively small scale and will be highly diluted. Therefore, the consequence to socioeconomic receptors (e.g. commercial fishing) is assessed as Negligible (I).
Cultural Features	For potential impacts to marine species of cultural significance or that provide a traditional food source, refer to the assessment for threatened, migratory or local fauna.
Cumulative impacts	
Although overlapping plumes from MODU and vessel operations discharges may occur during concurrent activities (Section 2.10), it is considered unlikely. Vessel (including the MODU) interactions will be managed under the Barossa Interface Management Plan. A relatively small volume (incremental increase) over a very short duration (hours) is expected if concurrent discharges occur. Any overlapping plume may result in a highly localised and temporary decrease in water quality, considering the high dilution levels in open water and the nature of the marine environment near the OA. As a result, the additive and cumulative effects of vessel (including MODU) discharges are considered negligible. The remoteness of the OA means that it is unlikely that there will be a cumulative impact with other marine users. Therefore, no change to the overall consequence level due to cumulative vessel discharge impacts can reasonably be expected.	
Overall worst-case consequence	II – Minor

6.6.5 Demonstration of as low as reasonably practicable

Activity vessels are required to undertake the activity.

Onboard treatment of most wastes and their subsequent discharge to the marine environment is consistent with legislative requirements (such as MARPOL) and considered environmentally acceptable.

All reasonably practicable control measures were reviewed and those adopted are considered appropriate to manage the impacts such that the residual consequence is assessed to be II – Minor. The proposed control measures are in accordance with Santos' risk management criteria and are considered appropriate to reduce impacts to ALARP.

6.6.6 Acceptability evaluation

Is the consequence ranked as I or II?	Yes – maximum planned vessel discharge consequence is rated II – Minor.
Is further information required to validate the consequence assessment?	No – potential impacts and risks are well understood through the information available.
Are the risks and impacts consistent with the principles of ecologically sustainable development (ESD)?	Yes – activity evaluated in accordance with Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004), which considers principles of ESD.
Have the acceptable levels of impact and risks been informed by relevant species recovery plans, threat abatement plans and conservation advice and Australian marine park zoning objectives?	Yes – the following material published in relation to threatened and migratory species within the OA identifies pollution as a threat (Table 3-10): **Conservation Advice:** • Conservation Advice for *Balaenoptera physalus* (fin whale) (TSSC, 2015c) • Approved Conservation Advice for *Calidris ferruginea* (Curlew Sandpiper) (TSSC, 2015e) • Approved Conservation Advice for *Numenius madagascariensis* (Eastern Curlew) (TSSC, 2015f). **Recovery Plans:** • Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) (DoE, 2014a) • Recovery Plan for Marine Turtles in Australia 2017–2027 (CoA, 2017b) • Wildlife Conservation Plan for Seabirds (COA, 2020). Recovery plans / conservation advice for other species that may occur in the OA do not identify pollution as a key threat or have explicit relevant objectives or management actions. The implementation of EPO-6 and the control measures outlined in Table 6-17 will ensure that no contact with banks and shoals or nearby AMPs are expected. The objectives of these publications were considered during impact and risk assessments. The activity is not inconsistent with these objectives. The controls outlined in Table 6-17 are consistent with the objectives of the material listed above. Santos considers the impacts of activity discharges – vessels to be not inconsistent with these objectives.
Are performance outcomes, control measures and associated performance standards consistent with legal and regulatory requirements?	Vessel discharges comply with the requirements of the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth), which in Australian waters reflects MARPOL, and is enacted by: • Marine Order 91 (Marine pollution prevention – oil) • Marine Order 95 (Marine pollution prevention – garbage) • Marine Order 96 (Marine pollution prevention – sewage).
Are performance outcomes, control measures and associated	Yes – aligns with Santos' Environment, Health and Safety Policy (Appendix A).

performance standards consistent with Santos' Environment, Health and Safety Policy?	
Are performance outcomes, control measures and associated performance standards consistent with industry standards?	Yes – the most recent and comparable EPs accepted by NOPSEMA were reviewed for consistency with the performance outcomes, control measures and associated performance standards proposed in this EP.
Have performance outcomes, control measures and associated performance standards taken into consideration Relevant Person feedback?	Yes – no objections or claims were specifically raised for this Activity. However given the overlap of the SURF and Drilling activity OAs, feedback received during the Drilling EP has been considered and where applicable additional EPOs, CMs and EPSs were adopted.
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – ALARP assessment conducted, with additional control measures adopted.

The consequence of operational discharges on receptors is assessed as II – Minor. Based on an assessment of Santos' acceptability criteria and with the control measures in place, potential impacts are considered acceptable.

6.7 Activity discharges

6.7.1 Description of event

Event	Potential impacts may occur in the OA from activity discharges (excluding vessel operations) from:
	• FCGT, dewatering, flushing and leak testing:
	  ○ planned discharge of treated freshwater or sea water from flowlines, manifolds, spools and well jumpers
	  ○ planned discharge of MEG from flowlines, risers, umbilicals, manifolds, spools and well jumpers
	  ○ planned discharge of hydraulic control fluid from the umbilicals
	• treated sea water from the STP buoy deballasting
	• grout from the grout downline flushing (grout bag continency option).
	These discharges are collectively referred to as 'activity discharges' throughout this section.
	Table 2-9 summarises the discharge volumes and Section 2.6, Section 2.5.3.4 and Section 2.5.4.2.1 describe the activities leading to the discharges.
	Concurrent activities (Section 2.10) will generate activity discharges including pre-commissioning discharges (GEP and this Activity) and drilling and completions discharges (Drilling). Therefore, the cumulative impacts have been considered in this assessment.

Extent	Activity discharges are predicted to disperse rapidly and be diluted within the OA. If used, grout discharges will disperse as a fine sediment on the seabed within a few metres of the post-filled grout bags. The discharges from concurrent activities are expected to disperse or diluted rapidly within the OA.
Duration	Following an activity discharge, water quality changes are predicted to recover within hours to days following cessation of discharges for the Activity. Section 2.10 describes the temporal extent of concurrent activities.

6.7.1.1 Treatment chemicals

As detailed in Section 2.12, all chemicals that are planned for discharge to the environment will be selected in accordance with Santos' Offshore Division Operations Chemical Approval Procedure (EA-91-II-10001) to ensure that environmentally acceptable products are used or the risks can be demonstrated to be ALARP from the use of other chemicals.

The chemically treated sea water and freshwater is typically a mixture of biocides (to prevent biofouling on the internal surfaces), an oxygen scavenger and corrosion inhibitor (to control corrosion of the pipeline), and a dye (allows for leaks to be detected through visual inspections). The typical dosage concentration is between 400 and 600 mg/L using products (similar to Roemex Hydro 4 or Hydrosure) that will be added to freshwater or sea water for FCGT, dewatering, flushing and leak testing and STP buoy ballasting activities. An assessment determined that Roemex Hydro 4 and Hydrosure can be used interchangeably as their chemical composition and concentration profile is similar (Section 2.12). For the purposes of this risk assessment, Australian marine species toxicity data for Hydrosure components were used (see Table 6-18).

Biocide

The biocide is an alkyl dimethyl benzyl ammonium chloride (ADBAC), which is a mixture of alkylbenzyl dimethylammonium chlorides of various alkyl chain lengths. It is a nitrogenous cationic surface-acting agent belonging to the quaternary ammonium group. The mechanism of microbicidal action is thought to be due to disruption of intermolecular interactions that cause dissociation of

cellular membrane bilayers. This compromises cellular permeability controls and induces leakage of cellular contents.

ADBAC is reported to have a half-life of between eight and 15 days in sea water and is considered highly biodegradable, which indicates that its potential persistence in marine water and sediments is unlikely.

Bioconcentration factor testing reported values for fish of 79 L/kg (CEFAS, 2017). Substances with a bioconcentration factor below 1,000 L/kg are considered to not bioconcentrate (Champion Technologies, 2013).

Industry alternatives to ADBAC are glutaraldehyde and tetrakis (hydroxymethyl) phosphonium sulfate. These alternatives were evaluated as more toxic to the marine environment and rejected.

Oxygen scavenger

The oxygen scavenger is ammonium bisulfite (NH_4HSO_3), a pale-yellow liquid with a pungent sulfur smell. It is soluble in water and readily reacts with oxygen to form sulfate salts and acids:

$2NH_4HSO_3 + O_2 = (NH_4)2SO_4 + H_2SO_4$

Neither the product component nor its by-products are classified as hazardous. It is listed in the OSPAR PLONOR list and therefore is considered safe to discharge to the marine environment.

Solvents

Dipropylene glycol methyl ether and ethylene glycol (see also MEG below) are organic compounds used in various industrial products, including paints, pastes, dyes, resins, brake fluids, inks, and cosmetics.

Fluorescein dye

Fluorescein dye is a dark greenish liquid, a 60–90% aqueous solution of xanthene. Despite its significant visual effect in the water, it is not hazardous to the environment. The ecological information in the Fluorescein Safety Data Sheet (SDS) states the product is not expected to be hazardous to the environment (Champion Technologies, 2011).

Monoethylene glycol

Monoethylene glycol (MEG) is a colourless, odourless, non-volatile, hygroscopic liquid. It is characterised by 2 hydroxyl groups, which contribute to its high water solubility, hygroscopicity and reactivity with many organic compounds. MEG is on the OSPAR PLONOR list and therefore is deemed safe to discharge to the marine environment.

MEG is soluble in water, does not volatilise or undergo photodegradation, and is not adsorbed on to soil particles (Hook and Revill, 2016). Studies on a green alga (*Chlorella fusca*), a freshwater crayfish (*Procambarus* sp.) and a golden orfe carp (*Leuciscus idus melanotus*) revealed low potential for bioaccumulation in the marine environment (International Programme on Chemical Safety, 2000). Ethylene glycols biodegrade readily when released to the environment, and several strains of microorganisms can use them as an energy source.

Small volumes of MEG will be discharged neat or at near neat concentrations from flowlines, risers, and manifolds and spools at various locations and times (see Section 2.6). Table 2-9 provides the estimated total MEG discharge with the largest single discharge of 31 m^3 from a service flowline FLET.

The World Health Organization (WHO) has reported a no observed effect concentration (NOEC) of 24,000 mg/L for MEG. In accordance with the Organisation for Economic Co-operation and Development (OECD), because 3 NOECs are described for 3 separate taxonomic groups a safety factor of 10 was adopted for the protection of marine fauna and benthic habitats. Based on the NOEC provided by WHO a predicted no effect concentration of 2,400 mg/L was used to inform the

concentration level above which there is potential to result in an environmental impact (see Section 6.7.2.1; Chevron, 2020).

The Barossa Development modelled an 85,000 m³ subsea discharge of treated sea water at the proposed FPSO PLET location over 7 days from a 4″ orifice orientated vertically upwards 3.5 m above the seabed, with approximately 1,000 m³ MEG discharged over less than one day. There was a median (50th percentile) concentration dilution of approximately 10,000 within 100 m of the discharge, equivalent to approximately 100 mg/L MEG concentration, which meets the environmental criterion concentration of 2,400 mg/L (RPS, 2021). Given the smaller volumes (see Table 2-9) and duration of the activity activities compared to the modelled scenario, using a 100 m buffer is conservative.

Grout

Post-filled grout bags may be used in the unlikely event that a higher span rectification is required. The empty grout bags are filled from the surface using a liquid slurry of grout via a downline. After each operation, the downlines are flushed to subsea to ensure the grout does not set in the downline between filling operations. The grouting operations may release up to 1.5 m^3 of grout per line with a maximum total volume 6 m^3. Grout is composed of cement, sand and water and is on the OSPAR PLONOR list. The fate of any grout released is unlikely to impact the seabed biota. As filling grout bags is a contingency activity and grout is deemed safe to discharge to the marine environment, grout will not be discussed further in this assessment.

6.7.2 Nature and scale of environmental impacts

Potential receptors: physical environment (water quality, benthic habitat, KEF); threatened, migratory or local fauna; socioeconomic receptors; and cultural features.

6.7.2.1 Ecotoxicity

Table 6-18 lists whole effluent testing results for Hydrosure, or its equivalent, that may be used to treat sea water or freshwater for pre-commissioning and STP buoy ballast activities. Testing was undertaken according to protocols recommended by the Australian and New Zealand Guidelines (ANZG) (2000) and included 5 locally relevant species from a range of trophic levels (primary producer, herbivore and carnivore). Note that the ANZG are now able to be accessed online and a ‘conceptual model’ process has been introduced so that community and local government thresholds are also included when selecting ‘default guideline values’; this new process is unlikely to change the guideline values for Commonwealth Waters offshore marine water quality. Results show that NOECs ranged from 0.13 mg/L for the crustacean to 12.5 mg/L for the fish. In general, simpler life forms (algae and species in their larval stage) exhibited higher sensitivity compared to more complex life forms such as fish.

Table 6-19 lists species protection levels calculated from statistical distribution of the NOECs. For long-term continuous discharges (e.g. sewage outfalls), ANZG (2018) recommend that the 99% species protection concentrations should be applied to develop environmental criterion for high-conservation ecosystems. For chemicals with negligible potential for bioaccumulation, the 95% level of species protection may also be applied.

The chemical concentration in the receiving environment does not exceed a median (50th percentile) concentration of 0.06 mg/L with a discharge concentration of 550 mg/L, 100 m from the discharge point. This is the modelled, approximate 10,000 dilution, described for MEG above, a conservative analysis given the larger volume actually modelled, that shows the environmental criterion can be met with this type of discharge in this location.

Table 6-18: Ecotoxicological testing results for Hydrosure

Species	Test	Type	EC_{10} mg/L	EC_{50} mg/L	LOEC mg/L	NOEC mg/L
Nitzschia closterium (algae)	72-hour growth inhibition	Chronic	1.5 *	3.3 (3.0–3.58)	2.50	1.30
Saccostrea echinata (mollusc)	48-hour larval abnormality	Chronic	0.29 (0.24–0.33)	0.54 (0.52–0.56)	0.50	0.250
Heliocidaris tuberculata (echinoderm)	72-hour larval development	Chronic	1.30 (1.27–1.32)	1.71 (1.70–1.74)	2.50	1.25
Melita plumulosa (crustacean)#	96-hour acute toxicity	Acute	0.08 (0.04–0.11)	0.14 (0.10–0.16)	0.25	0.13
Lates calcarifer (fish)#	96-hour acute toxicity	Acute	13.5 (12.3–18.0)	17.5 (17.1–18.0)	25.0	12.5

Source: Chevron (2015)

** 95% confidence limits are not reliable; numbers in brackets represent the 95% fiducial limits.*

 # Toxicity test is defined as an acute test.

Table 6-19: Species protection concentrations for Hydrosure based on the NOEC from whole effluent toxicity testing

	PC99% mg/L	PC95% mg/L	PC90% mg/L	PC80% mg/L
Hydrosure (based on NOEC)	0.06	0.10	0.15	0.23

Source: Chevron (2015)

6.7.2.2 Water quality

Predictive modelling at the proposed FPSO PLET location demonstrates that dilution in the receiving environment is high and the area is well flushed. Chemical concentrations reduce rapidly, with the median concentrations predicted to reduce below the 99% species protection concentration near the discharge point.

The release of treated sea water and freshwater will result in negligible, localised and temporary (within hours) reduction in water quality around the discharge location. Chemicals that will be used are inherently biodegradable with low potential for bioaccumulation. For the above reasons, no substantial change in water quality is expected from activity discharges and therefore the impact is assessed as acceptable.

6.7.2.3 Plankton

Plankton drifting past the outlet at the time of discharge may be exposed to concentrations above those that could elicit an effect. However, dilution of the plumes is rapid and the exposure concentration travelling with the organism will continually reduce. Plankton are widely distributed in the ocean and regenerate rapidly.

6.7.2.4 Sediment quality

Sediments are unlikely to be impacted as activity discharges (excluding grout) will be through a diffuser at least 3 m above the seabed.

If used, grout discharges will disperse as a fine sediment on the seabed within a few metres of the post-filled grout bags.

6.7.2.5 Other communities – benthic communities

No protected or sensitive benthic habitats were identified that have the potential to be exposed to the dewatering plumes. The seabed within the OA is bare sediment and contains low abundance and diversity of infauna. Marine invertebrates may inhabit soft sediments and can contribute to the diet of some fauna. The area of soft sediment habitat that is potentially impacted is small compared with the amount of similar habitat available across the bioregion. Therefore, the disturbance is not expected to affect prey availability, and protected fauna species, significantly. Large sensitive banks and shoals are too far away to be impacted. There is no sediment in the discharges except from the initial flush of construction and welding material from pigging flowlines and contingency grout discharges.

6.7.2.6 Marine mammals, marine turtles, sharks and rays, other pelagic and demersal fish

Marine fauna within the OA, some of which have cultural significance as totems of cultural food sources, are likely to be transient. If present, marine fauna could pass through the plumes. Exposure will be at low concentration and for a short duration. The biocide chemical in the discharged treated sea water shows toxicity to marine life, with the effects greater on simpler life forms. This is illustrated in the ecotoxicological data in which the NOEC for a fish species is 12.5 mg/L (time-weighted average) compared to 1.3 mg/L for algae (Table 6-18). Modelling demonstrated that concentrations within the plume vary both temporally and spatially, rarely exceeding instantaneous concentrations of 10 mg/L, noting that the total volumes discharged will be minimal compared to the volume modelled.

There are no known BIAs, breeding grounds or sensitive habitats (including habitat critical to the survival of any marine fauna species) for EPBC Act listed species near the OA. Mobile marine species are expected to either avoid turbid stretches of water or pass through with no significant impacts. No aggregation areas for marine mammals, sharks, rays or other pelagic or demersal fish were identified near the OA.

6.7.2.7 Key Ecological Features

Discharges will occur within the KEF (Shelf break and slope of the Arafura Shelf), but the OA is devoid of any of the KEF's values.

It is considered that no substantial change that may modify, destroy, fragment, isolate or disturb the values of the KEF. Therefore, the impact is assessed as acceptable.

6.7.2.8 Cultural features

No First Nations people feedback was provided about potential impacts from vessel discharges to cultural features during consultations for SURF.

During consultation with Tiwi Clans, concerns were raised about potential impacts from the drilling Activity on totemic species and marine species that provide a food source for traditional fishing and hunting.

Other Tiwi people also provided information to Santos that impacts to totemic species could also affect Tiwi people by making them sick.

Section 6.7.2.6 describes the potential impacts to marine species of cultural significance.

6.7.2.9 Potential cumulative impacts from concurrent activities

On the basis that concurrent activities (see Section 2.10) will occur within the OA, the potential impacts from cumulative activity discharges are acknowledged.

Section 2.10 describes the GEP pre-commissioning discharges that will occur at the FPSO PLET and the drilling discharges that will occur at the drill centres. Section 2.6 describes the Activity pre-commissioning activities and discharges. The Barossa GEP Installation EP, Drilling EP and this EP assessed the consequences of the pre-commissioning activities as minor. The Activity pre-commissioning discharges will likely occur at the FLET for FCGT and the drill centres for dewatering. The GEP discharges will occur at the FPSO PLET, and the drilling discharges at the drill centres. The FPSO PLET is approximately 6.5 km from the drill centres and over 250 m from the closest FLET.

The median concentration of the hydrotest mixture (Section 2.6) reduces to below the 99% species protection level of 0.06 mg/L within 100 m of the discharge location during FCGT and dewatering for both the Activity and the GEP. As the distance of separation between the GEP (FPSO PLET) and the Activity (closest FLET) is greater than 250 m, impacts are predicted to be localised and consist of a temporary reduction in water quality around the discharge location. Hence, it is expected that the consequence of any impact is considered negligible. Chemicals that will be used are inherently biodegradable with low potential for bioaccumulation. For the above reasons and the fact that any concurrent activities will be limited to a very short term, no substantial change in water quality is expected from activity discharges and therefore the impact is assessed as acceptable.

The drilling discharges and the Activity pre-commissioning discharges may occur at the drill centres. The drilling EP concluded that the toxicity of various substances planned for discharge (such as water-based mud, non-aqueous fluids, formation water, control fluid and cement) is considered low and the potential for bioaccumulation of any toxic compounds is considered negligible. Santos will select chemicals planned for discharge that have a low aquatic toxicity (for example, EC50/LC50 >100 mg/L), low bioaccumulation potential (for example, Log Pow <3) and are readily biodegradable (for example, more than 60% in 28 days OECD 306), hence reducing the likelihood of any significant impacts. Concurrent discharges from Drilling and the Activity may occur. The concurrent activities will be limited to a very short duration (days) and overlapping plumes will be temporary and localised cumulative impacts within 100 m of the drill centre.

Due to the low sensitivity and widespread presence of benthic communities in the open ocean environment near the drill centres and the very short duration of concurrent activities, potential impacts from drilling and the Activity discharge activities are considered highly localised and temporary. Cumulative impacts on local receptors (e.g. benthic communities and water quality) are expected to be temporary, with no significant changes anticipated.

Therefore, cumulative activity discharges effects are considered negligible, and no change to the overall consequence level has resulted.

6.7.3 Environmental performance outcomes and control measures

The EPOs relating to this event include:

- No impacts to the marine environment from subsea infrastructure installation discharges resulting in a consequence severity greater than Minor [EPO-07]
- No significant impacts to cultural features from the Activity [EPO-14].

An assessment of the environmental benefits and the potential costs or issues associated with control measures for this activity are described in Table 6-20 to demonstrate the potential impacts from this aspect are ALARP. Control measures that are adopted have associated EPSs and measurement criteria, and are presented in Table 8-2. Rejected control measures have an ALARP evaluation provided to justify their rejection.

Table 6-20: Control measures evaluation for activity discharges (excluding vessel operations)

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
Standard control measures				
C6.7.1	Apply the Offshore Division Operations Chemical Selection Procedure (EA-91-II-10001) for chemicals planned to be discharged (administrative control)	Under the procedure, CHARM-rated gold/silver and non-CHARM Group E/D chemicals managed under the OCNS, or OSPAR PLONOR list, or chemicals risk assessed by Santos and deemed environmentally acceptable, will be selected (Section 2.12). Therefore, pre-commissioning and STP buoy ballast fluids will pose little or no risk to the environment.	Cost of implementing procedures. Range of chemicals reduced with potentially higher costs for alternative products.	**Adopted**
C6.7.2	Contractor FCGT procedure (administrative control)	This would limit the concentration of the hydrotest mixture within the treated sea water from the FCGT activities.	Cost of implementing procedures.	**Adopted**
Additional control measures				
C6.2.6	Cultural Heritage (administrative control)	Shows respect for beliefs and culture of First Nations people.	Time and cost to work with First Nations communities.	**Adopted**
N/A	Omission of FCGT activities (elimination control)	This would eliminate any potential impacts from the FCGT activities.	FCGT activities are required to control the potential for corrosion of the flowlines and to determine if any unacceptable restrictions and/or obstructions exist in the line. In addition, potential loss of subsea infrastructure integrity could possibly lead to a larger environmental incident after commissioning.	**Rejected** – omission of FCGT operations was assessed but is not considered acceptable from a technical and risk perspective.
N/A	Use raw sea water without any chemical treatment for FCGT activities (elimination control)	This would eliminate any potential impacts from the FCGT activities but increases the likelihood of loss of integrity during operation and has potentially greater environmental impacts.	Pre-commissioning fluids are required to verify the structural integrity of the subsea infrastructure. The FCGT volumes selected are the minimum amounts required to achieve verification. In addition,	**Rejected** – not feasible as required to prevent internal corrosion and ensure pipe integrity. Corrosion by oxidation and

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
			potential loss of subsea infrastructure integrity could possibly lead to an environmental incident after commissioning.	microbial action will occur without using sea water treatment resulting in wall thickness loss.
N/A	Use raw sea water without any chemical treatment for STP buoy ballasting activities (elimination control)	This would eliminate any potential impacts from the STP buoy deballasting activity but increases the likelihood of loss of integrity during operation and has potentially greater environmental impacts.	Chemical treatment of sea water with a hydrotest mixture is required to maintain the structural integrity of the subsea infrastructure. The STP buoy will be gradually deballasted to a pre-determined water depth with small volumes (see Table 2-9) and gradually released to maintain the required water depth. In addition, the potential loss of subsea infrastructure integrity could lead to an environmental incident after commissioning.	**Rejected** – not feasible as required to prevent internal corrosion and ensure STP buoy integrity. Corrosion by oxidation and microbial action will occur without using sea water treatment resulting in tank wall thickness loss.
N/A	Sea water treated with oxygen scavenger and exposed to ultraviolet (UV) light for FCGT activities (substitution control)	Would reduce chemical discharges to sea, reducing potential impacts to marine environment.	Pre-commissioning fluids are required to verify the structural integrity of the subsea infrastructure. The FCGT volumes selected are the minimum amounts required to achieve verification over the preservation period. In addition, potential loss of subsea infrastructure integrity could possibly lead to a larger environmental incident after commissioning. The effectiveness of UV sterilisation to kill bacteria species is affected by particulate shadowing, therefore it cannot provide an absolute sterilisation solution. Furthermore, UV sterilisation provides no 'residual' treatment and as a result corrosion-causing bacteria colonies can	**Rejected** – option of sea water treated with oxygen scavenger and exposed to UV light for bacterial sterilisation is not considered acceptable to prevent internal corrosion and ensure pipeline integrity.

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
			grow during the preservation period and in the dewatered state before hydrocarbons are introduced.	

6.7.4 Environmental impact assessment

Receptor	Consequence level
Activity discharges	
Threatened, migratory or local fauna	There are no known BIAs, breeding grounds or sensitive habitats (including habitat critical to the survival of any marine fauna species) for EPBC Act listed species near the OA. Internesting turtles remain close to the nesting beach (CoA, 2017b) and the closest internesting BIA boundary is approximately 54 km from the OA. No aggregation areas for marine mammals, sharks, rays or other pelagic or demersal fish were identified near the OA. The seabed within the OA is predominantly bare sediment and contains low abundance and diversity of infauna. Activity discharges are not predicted to impact any known protected or sensitive benthic habitats. Mobile marine species are expected to pass through the small discharge plumes with no significant impacts. The toxicity of treated freshwater and sea water and MEG is considered low and the potential for bioaccumulation of any toxic compounds is considered negligible given the low volumes discharged. As with all chemicals selected for use in offshore activities by Santos, the chemicals chosen will be low aquatic toxicity (e.g. EC_{50}/LC_{50} >100 mg/L), low bioaccumulation potential (e.g. Log Pow <3) and readily biodegradable (e.g. more than 60% in 28 days, OECD 306), thus reducing the likelihood of any significant impacts. Marine fauna species within the OA are likely to be transient. If discharge contact does occur with any marine fauna, it will be for a short duration due to the rapid dispersion of the small plumes and the transient fauna movement—exposure time may not be long enough to cause a toxic effect. Impacts will be temporary, and the area potentially impacted is small compared with the size of the areas used by the species. Therefore, no long-term impacts to the 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 the protected matters species is expected. Fish (including some sharks and rays) may forage in the soft sediments for marine invertebrates. If discharge contact does occur with fish, it will be for a short duration due to the rapid dispersion of the small plumes and the transient fauna movement—exposure time may not be long enough to cause a toxic effect. Given the low toxicity of the activity discharges there are no significant impacts expected to threatened and migratory fauna, and the consequence level for threatened, migratory or local fauna is considered to be II – Minor.
Physical environment or habitat	The seabed within the OA is largely bare sediment and contains low abundance and diversity of infauna. It is predicted that there is likely to be no to negligible impacts to the seabed from activity discharges as no significant toxicological impacts on the water quality is expected for an extended period. Given the water depth ranging from approximately 227 m to 269 m in OA and the minor volumes of treated water discharges for a short duration (approximately 6 hours), it is reasonable to conclude that the discharges will not have a significant environmental impact. The consequence level for physical environment or habitat is considered to be I – Negligible.

Receptor	Consequence level
Threatened ecological communities	Not applicable – no threatened ecological communities were identified in the area over which discharges are expected.
Protected areas	The OA occurs within the 'Shelf break and slope of the Arafura Shelf' KEF which is considered a component of the Commonwealth marine area MNES. Species associated with the continental slope and patch reefs that characterise this KEF (such as demersal fish, whale sharks, sharks and turtles) are unlikely to aggregate within the OA due to the lack of seafloor features. Given the low toxicity of the activity discharges and the lack of seafloor features representative of Shelf break and slope of the Arafura Shelf KEF species aggregation habitats the consequence level for protected areas is considered to be II – Minor.
Socioeconomic receptors	There is limited activity by Australian commercial fishers that overlap the OA, and activity by Indonesian commercial fishers is not expected as the Perth Treaty waters is outside of the OA. Activity discharges will be for a short period and have small volumes with rapid dispersion. Contact to discharges will also be limited to transient fauna individuals where exposure time will unlikely cause a toxic effect. Given the negligible consequence to species, subsequent impacts to socio-economic receptors including commercial fishing are not anticipated. The consequence level for the socioeconomic receptors is considered to be II – Minor.
Cultural features	For potential impacts to marine species of cultural significance or that provide a traditional food source, and concerns that any harm to totemic species may bring sickness to Tiwi people, refer to the assessment for threatened, migratory or local fauna.
Cumulative impacts	
On the basis that concurrent activities (see Section 2.10) will occur within the OA, the potential for cumulative activity discharges is acknowledged. These concurrent activities will be limited to a very short duration (days). The overlapping plumes will be temporary and localised (within hundreds of metres) of the discharge location. Therefore, cumulative activity discharges effects are considered negligible, and no change to the overall consequence level has resulted.	
Overall worst-case consequence	II – Minor

6.7.5 Demonstration of as low as reasonably practicable

Using pre-commissioning and STP buoy ballast fluids and resultant activity discharges is an unavoidable and planned part of the Activity. It is accepted industry practice to discharge these fluids to sea.

The small volumes of discharges will occur in a deep-water location with rapid dispersion. Applying the Offshore Division Operations Chemical Selection Procedure (EA-91-II-10001) is an important control measure for reducing the toxicity of discharges to the marine environment. Under the procedure, CHARM-rated gold/silver and non-CHARM Group E/D chemicals managed under the OCNS, or OSPAR PLONOR list, or chemicals risk assessed by Santos and deemed environmentally acceptable, will be selected (Section 2.12). The pre-commissioning and STP buoy ballast fluids will pose little or no risk to the environment. The consequence was assessed as II – Minor 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 6.7.3. Therefore, the impact of activity discharges are considered ALARP.

6.7.6 Acceptability evaluation

Is the consequence ranked as I or II?	Yes – maximum consequence from activity discharges is II – Minor.
Is further information required to validate the consequence assessment?	No – potential impacts and risks are well understood through the information available.
Are the risks and impacts consistent with the principles of ecologically sustainable development (ESD)?	Yes – activity evaluated in accordance with Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004), which considers principles of ESD.
Have the acceptable levels of impact and risks been informed by relevant species recovery plans, threat abatement plans and conservation advice and Australian marine park zoning objectives?	Yes – The following material published in relation to threatened and migratory species within the OA identifies pollution as a threat (Table 3-10): **Conservation Advice:** • Conservation Advice for *Balaenoptera physalus* (fin whale) (TSSC, 2015c) **Recovery Plans:** • Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) (DoE, 2014a) • Recovery Plan for Marine Turtles in Australia 2017–2027 (CoA, 2017b). Recovery plans / conservation advice for other species that may occur in the OA do not identify pollution as a key threat or have explicit relevant objectives or management actions. The implementation of EPO-7 and the control measures outlined in Table 6-20 will ensure that no contact with banks and shoals or nearby AMPs are predicted. The objectives of these publications were considered during impact and risk assessments. The activity is consistent with these objectives. The controls outlined in Table 6-20 and the impacts of activity discharges are not inconsistent with the objectives of the material listed above.
Are performance outcomes, control measures and associated performance standards consistent with legal and regulatory requirements?	Through acceptance of this EP, legislative and regulatory requirements will be met as per Section 1.6.2.
Are performance outcomes, control measures and associated performance standards consistent with Santos' Environment, Health and Safety Policy?	Yes – aligns with Santos' Environment, Health and Safety Policy (Appendix A).
Are performance outcomes, control measures and associated performance standards consistent with industry standards?	Yes – the most recent and comparable EPs accepted by NOPSEMA were reviewed for consistency with the performance outcomes, control measures and associated performance standards proposed in this EP.
Have performance outcomes, control measures and associated performance standards taken into consideration Relevant Person feedback?	Yes – no objections or claims were specifically raised for this Activity. However given the overlap of the SURF and Drilling activity OAs, feedback received during the Drilling EP has been considered and where applicable additional EPOs, CMs and EPSs were adopted.

Are performance standards such that the impact or risk is considered to be ALARP?	Yes – ALARP assessment conducted, with additional control measures adopted.

The minor impacts expected from activity discharges are considered to be environmentally acceptable.

7 Unplanned events 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.

An ENVID workshop (as described in Section 3.2.5.10) for unplanned events was held in April 2022. Santos' environmental assessment identified 7 environmental risks associated with unplanned events for this activity. A second ENVID workshop was held in August 2023 to revalidate the risk assessment based on new information regarding receptors (including values and sensitivities) (as described in Section 5.2.3). New requirements (such as changes to legislation, other requirements and guidelines) were also considered. The results of the environmental and socioeconomic risk assessments are summarised in Table 7-1. A comprehensive risk and impact assessment for each unplanned event and subsequent control measures proposed by Santos to reduce the risk and impacts to ALARP are detailed in the following subsections.

Table 7-1: Environmental risk assessment summary

EP section	Unplanned event	Likelihood	Consequence	Residual risk level
7.1	Release of solid objects	D – Occasional	I – Negligible	Low
7.2	Introduction of invasive marine species	B – Unlikely	III – Moderate	Low
7.3	Marine fauna interaction	C – Possible	I – Negligible	Very Low
7.4	Non-hydrocarbon chemical release	C – Possible	II – Minor	Low
7.5	Hydrocarbon release – minor	C – Possible	I – Negligible	Very Low

EP section	Unplanned event	Likelihood	Consequence	Residual risk level
7.6	Hydrocarbon release – refuelling and vessel collision	B – Unlikely	III – Moderate	Low
7.7	Contingency spill response operations	C – Possible	II – Minor	Low

7.1 Release of solid objects

7.1.1 Description of event

Event	Solid objects and particles (solids) can be accidentally released to the marine environment from vessels or during installation activities. These solids may include: • non-hazardous solid wastes, such as paper, plastics and packaging – incidental • hazardous solid wastes, such as batteries, fluorescent tubes, medical wastes and aerosol cans – incidental • equipment and materials, such as supplies, hard hats, tools, infrastructure parts installation aids – incidental • microplastics and plastic pieces from PP particles – up to 0.12 m^3. Release of these solids may occur as a result of: • overfull and/or uncovered bins • incorrectly disposed items • incidents during transfers of waste or supplies • accidentally dropped objects/lost equipment • particles detaching or dislodging from the flowline's PP topcoat.
Extent	The event will only occur within the OA, and all non-buoyant waste material or dropped objects are expected to sink to the seabed and remain within the OA. Buoyant objects could potentially move beyond the OA.
Duration	An unplanned release of solids may occur during operational activities and impacts may occur until the solid degrades.

7.1.2 Nature and scale of environmental impacts

Potential receptors: physical environment (water quality, benthic habitats, KEF); threatened, migratory fauna or local fauna (marine reptiles, whales, fish [including sharks and rays]); and socioeconomic and cultural features.

7.1.2.1 Physical environment

Release of hazardous solids (e.g. wastes such as batteries) may pollute the immediate receiving environment, leading to detrimental health impacts to marine fauna. Physiological damage can occur through ingestion; or absorption in individual fish, marine mammals, marine reptiles or seabirds.

The release of microplastic particles (<5 mm) may occur as unbonded particles on the surface (PP topcoat) of the flowlines detach during transportation to the OA, and the release of plastic pieces (>1 cm) may occur during installation activities—vessel deck activities (from large-diameter storage reel to tensioners) or subsea (flowline placement).

PP is a polymer and that ranks as the second most widely produced commodity plastic worldwide, surpassed only by polyethylene. It is commonly used in municipal potable water supply and storage due to its established safety profile. PP is synthesised from titanium dioxide (non-toxic material), and it exhibits notable tensile strength, as well as resistance to chemical corrosion and heat. The release of microplastics has the potential to contribute to the overall amount of marine microplastics in the ocean, which can have various impacts on marine fauna as they are absorbed by plants and animals and accumulate in the food chain. However, given the very small volume of PP particles that could potentially be released, the consequence of any impacts is considered to be negligible.

The area of potential seabed disturbance due to release of a heavier solids would be restricted to the OA (e.g. accidentally dropped equipment). Damage to substrates within the OA and associated

infauna and epifauna may occur, but such impact is expected to be restricted to the size of the dropped object.

The seabed within the OA comprises soft substrates and is devoid of significant bathymetric features, and sediments are predominantly unconsolidated silty sand (Jacobs, 2016).

The habitat type in the OA is widely distributed and well represented in northern Australia. Soft sediment benthic habits will not be destroyed, but the communities on and within them (such as epifauna and infauna) will be disturbed by a dropped object; and depressions may remain on the seabed for some time after removal of the dropped object (depressions will gradually infill over time). The sea floor of this bioregion is strongly affected by long-period swells and large internal tides, which can resuspend sediments within the water column and move sediment across the sea floor.

The OA overlaps one KEF—Shelf break and slope of the Arafura Shelf. The sea floor features associated with this KEF (i.e. the shelf break and patch reefs, hard substrate pinnacles and submerged reefs on the shelf slope) were not observed within the OA during the Barossa marine studies program, nor are these topographically distinct features evident from the bathymetry data derived from multiple surveys undertaken across this area.

7.1.2.2 Marine fauna – marine mammals, marine turtles, seabirds, fish and sharks

Solids such as plastics have the potential to affect benthic environments and to harm marine fauna through entanglement or ingestion. Marine fauna within the OA, some of which have cultural significance as totems of cultural food sources, are likely to be transient. Floating, non-biodegradable marine debris has been highlighted as a threat to marine turtles, sharks, seabirds, whales and whale sharks in the relevant recovery plans and approved conservation advice (see Table 3-10). Marine turtles and seabirds are particularly at risk from entanglement and ingestion. The recognition of the problem of plastic and microplastic debris in the marine environment is a key aspect of the National Plastics Plan (DAWE, 2021). The National Plastics Plan also includes supporting global action to address marine plastic debris, including the implementation of the Threat Abatement Plan for the Impacts of Marine Debris on the Vertebrate Wildlife of Australia's Coasts and Oceans (DoEE, 2018). The Threat Abatement Plan for the Impacts of Marine Debris on the Vertebrate Wildlife of Australia's Coasts and Oceans (DoEE, 2018) and Wildlife Conservation Plan for Seabirds (COA, 2020) have specified various recovery actions to help combat this threat. Floating non-biodegradable marine debris has been highlighted as a threat to marine turtles within the Recovery Plan for Marine Turtles in Australia 2017–2027 (CoA, 2017b). Marine turtles may mistake plastics for food—once ingested, plastics can damage internal tissues and inhibit physiological processes, both of which can potentially result in fauna mortality.

The Conservation Management Plan for the Blue Whale 2015–2025 (CoA, 2015a) identified marine debris as a threat to cetaceans. The pygmy blue whale may be present within the OA, but they will most likely be transient and/or migratory through the area. Plastics such as microplastics, plastic bags or bottles can cause problems by ingestion or as entanglement in small cetaceans. Entanglement and ingestion of plastics may result in the loss of reproductive fitness or mortality for cetaceans (CoA, 2015a).

Of relevance to the Activity is legislation for preventing garbage disposal from vessels, which Santos implements in accordance with MARPOL Annex V through the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983,* the *Navigation Act 2012* and Marine Order 95.

7.1.3 Environmental performance outcomes and control measures

The EPOs relating to this event are:

- No loss of equipment/cargo overboard from vessels resulting in a consequence severity greater than Minor [EPO-08]

- No significant impacts to cultural features from the Activity [EPO-14].

An assessment of the environmental benefits and the potential costs or issues associated with control measures for this activity are described in Table 7-2 to demonstrate the potential risks are ALARP. Control measures that are adopted have associated EPSs and measurement criteria, and are presented in Table 8-2. The rejected control measure has an ALARP evaluation provided to justify its rejection.

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

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
Standard control measures				
C7.1.1	Implement standards and procedures for lifting equipment (administrative control)	Impacts to the environment are reduced by preventing dropped objects and dragged objects during lifting operations. Administrative costs to update induction materials and train personnel.	Cost of implementing procedures.	**Adopted**
C7.1.2	Dropped objects recovered where safe and practicable to do so (administrative control)	Impacts to the environment are reduced by preventing dropped objects and by retrieving dropped objects unless the environmental consequences of the dropped object are negligible or there are risks to safety.	Cost of implementing procedures.	**Adopted**
C6.6.3	Routine discharges of putrescible waste, in accordance with standard maritime practice and Marine Order 95 (Marine Pollution Prevention – Garbage) (administrative control)	Reduces probability of garbage being discharged to sea thus reducing potential impacts to marine fauna and ensures compliance with MARPOL Annex V (and Marine Order 95: Marine pollution prevention – garbage).	Cost of implementing procedures.	**Adopted**
Additional control measures				
C6.1.7	HSE inductions will include environmental requirements (administrative control)	Ensures that crew are aware of the stringent EP, Santos and legislative requirements.	Administrative costs to update existing Santos procedure and induction materials and train personnel.	**Adopted**

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
N/A	Eliminate lifting in field (elimination control)	Reduces the risk of dropped objects.	Eliminating lifting would require vessels storing more equipment and supplies on board, and/or additional trips to shore. Vessels will not have enough deck space to store all required equipment, materials and supplies needed for the duration of the activity.	**Rejected** – not feasible to eliminate lifting in the field.
C7.1.3	Contractor reel-lay vessel Environmental Installation Plan (administrative control)	Mitigates the risk of PP particles and debris release through HSE inspections, documentation, and proper disposal methods.	Cost of implementing procedures.	**Adopted.**
C7.1.4	Vessel standard operating procedure (administrative control)	Vessel standard operating procedures to include a vessel sweep/inspection to reduce the risk of unplanned objects being released to the sea by ensuring that objects on the deck are secured.	Cost of implementing procedures.	**Adopted.**
C7.1.5	International Maritime Dangerous Goods Code (administrative control)	Regulatory requirement that reduces the risk of an environmental incident, such as an accidental container release to sea or unintended chemical reaction.	Cost of implementing procedures.	**Adopted**
N/A	Eliminate use of the PP corrosion coating on flowlines (elimination control)	Reduces potential for microplastics to be released to the environment.	3-layer PP prevents external corrosion and ensures flowline integrity by preventing wall thickness loss due to oxidation	Rejected - not feasible due to the role of the 3-layer PP to prevent external corrosion and maintain flowline integrity over the life of the flowline.

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
			and microbial action.	
N/A	Eliminate use of PP topcoat on flowlines (elimination control)	Reduces potential for microplastics or flakes to be released to the environment.	PP topcoat provides necessary friction and stability for pipe installation, mitigates the risk of unplanned events (e.g. lateral buckling), and extends flowline lifespan in various environmental conditions.	Rejected – no feasible alternative product was identified that had similar characteristics suitable for the subsea environment that that mitigate small volumes of plastic release. The PP topcoat product mitigates the risk of unplanned events, and extending the flowline's lifespan.
C6.2.2	Subsea infrastructure inventory (administrative control)	Enables Santos to monitor and maintain flowlines to mitigate PP coating degradation and 3-layer PP. This will facilitate future maintenance and decommissioning (removal and disposal) activities.	Cost of surveys, maintaining equipment and records.	Adopted.

7.1.4 Environmental impact assessment

Receptors	• Physical environment (benthic habitats) • Threatened, migratory or local fauna (marine mammals, marine reptiles, fish [including sharks and rays]) • Socioeconomic
Consequence	I – Negligible

Physical environment (benthic habitats)

An object dropped into the sea can result in localised and short-term damage to the seabed. The extent of the impact to the seabed is limited to the size of the dropped object (e.g. tools, containers and installation equipment); given the size of the equipment used on the activity vessel.

The release of microplastics from the PP topcoat has the potential to contribute to the overall amount of marine microplastics in the ocean, which can have various impacts on marine fauna as they are absorbed by plants and animals and accumulate in the food chain. However, given the small maximum volume released, the overall impact marine microplastic pollution is relatively limited.

Marine invertebrates that may inhabit disturbed soft sediment benthic habitats are expected to occur elsewhere within the OA and surrounds and therefore the disturbance is not expected to affect prey availability, or protected fauna species.

The OA overlaps one KEF—Shelf break and slope of the Arafura Shelf. The sea floor features associated with this KEF (i.e. the shelf break and patch reefs, hard substrate pinnacles and submerged reefs on the shelf slope) were not observed within the OA during the Barossa marine studies program, nor are these topographically distinct features evident from the bathymetry data derived from multiple surveys undertaken across this area. Therefore, it is unlikely that the accidental loss of solids overboard would result in any impact to this seabed feature. Furthermore, the seabed footprint that would be impacted by the release of solid objects would represent a minimal portion of this KEF and would not be expected to impact the values of the KEF. No significant seabed features or biota have been found in the OA. Therefore, it is highly unlikely that any objects dropped during the activity would cause a significant impact to the ecological values associated with the seabed or benthic habitats. Therefore, the consequence level is considered I – Negligible.
Marine fauna – marine mammals, marine reptiles, seabirds, fish and sharks Marine debris (including plastics and microplastics) is identified as a potential threat to several marine fauna species in relevant recovery plans and conservation advice (Table 3-10). The types of solids and plastics accidentally dropped into the sea are limited by the type of activities planned. If the solid object can be ingested by marine fauna, impacts would be restricted to a small number of individuals, if any. Microplastics within the ocean come from many sources, and the bioaccumulation potential is high within marine fauna if ingested. Filter feeders ingest substantial amounts of microplastics by directly swallowing ocean water or indirectly by consuming prey (that have microplastics within the body cavity). Given that the very small volume of unplanned microplastics and plastics that could potentially be released to the marine environment is relatively small and the distance of the OA to shorelines and sensitive turtle habitats, it is considered that the consequence of any impacts is considered to be slight. The controls implemented demonstrate that the activity will be conducted to reduce the release of marine debris and plastic particles; therefore, potential impacts are reduced to ALARP and an acceptable level. The limited quantities of accidental hazardous/non-hazardous solid releases indicate that, in a worst-case release, fatalities would be limited to individuals and such a release is not expected to decrease the local population size. Therefore, the consequence level is considered I – Negligible.
Socioeconomic and cultural features Given the negligible consequence on species, subsequent risks or significant impacts to socioeconomic receptors (including commercial fish stocks) and cultural features (relating to species with cultural significance) are not anticipated.
Likelihood — D – Occasional
The proposed control measures will ensure that the risks of dropped solids (including plastics), lost equipment or release of hazardous/non-hazardous solid waste to the environment has been reduced. These control measures will also ensure that legislation for preventing garbage disposal from vessels is adhered to, as recommended by the Threat Abatement Plan for the Impacts of Marine Debris on the Vertebrate Wildlife of Australia's Coasts and Oceans (DoEE, 2018) and supported by the National Plastics Plan (DAWE, 2021). The likelihood of the release of solid objects occurring over the duration of the Activity is considered 'Occasional' as it has occurred before during other Santos projects. The risk to socioeconomic receptors and cultural features is considered to be low.
Residual Risk — The residual risk is considered Low.

7.1.5 Demonstration of as low as reasonably practicable

All reasonably practicable control measures were reviewed and those adopted are considered appropriate to manage the residual risk to a Low level. The proposed management controls are in accordance with Santos' risk management criteria and are considered appropriate to manage the risk to ALARP.

7.1.6 Acceptability evaluation

Is the risk ranked between Very Low and Medium?	Yes – residual risk ranking is Low.
Is further information required to validate the consequence assessment?	No – potential impacts and risks well understood through the information available.
Are the risks and impacts consistent with the principles of ecologically sustainable development (ESD)?	Yes – activity evaluated in accordance with Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004), which considers principles of ESD.
Have the acceptable levels of impact and risks been informed by relevant species recovery plans, threat abatement plans and conservation advice and Australian marine park zoning objectives?	Yes – controls implemented will minimise the potential impacts from the activity to species identified in recovery plans and approved conservation advices as having the potential to be impacted by solid objects. The following material published in relation to threatened and migratory species within the OA identifies marine debris as a threat Table 3-10: • Management Plans: • National Plastics Plan (DAWE, 2021) **Conservation Advice:** • Approved Conservation Advice for *Glyphis garricki* (northern river shark) (TSSC, 2014a) • Approved Conservation Advice for *Glyphis glyphis* (speartooth shark) (DoE, 2014). • Conservation Advice for *Rhincodon typus* (whale shark) (TSSC, 2015g) • Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle) (DEWHA, 2008b) **Recovery Plans:** • Threat Abatement Plan for impacts of marine debris on vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018) • Conservation Management Plan for the Blue Whale 2015–2025 (CoA, 2015a) • Recovery Plan for Marine Turtles in Australia 2017–2027 (CoA, 2017b) • Wildlife Conservation Plan for Seabirds (COA, 2020). Recovery plans / conservation advice for other species that may occur in the OA do not identify marine debris as a key threat or have explicit relevant objectives or management actions related to marine debris. The OA does not intersect any AMP. The objectives of these publications were considered during impact and risk assessments. The activity is not inconsistent with these objectives. The controls outlined in Table 7-2 are consistent with the objectives of the material listed above. Santos considers the impacts of hydrocarbon release from vessel collision to be not inconsistent with these objectives.
Are performance outcomes, control measures and associated performance standards consistent with legal and regulatory requirements?	Yes – management measures are consistent with MARPOL Annex V (through the *Protection of the Sea (Prevention of Pollution from Ship) Act 1983* (Cth), the *Navigation Act 2012* (Cth) and Marine Order 95: Marine pollution prevention – garbage),

	Annex X (IMO Marine Litter Action Plan) and International Maritime Dangerous Goods Code. Through acceptance of this EP, legislative and regulatory requirements will be met as per Section 1.6.2.
Are performance outcomes, control measures and associated performance standards consistent with Santos' Environment, Health and Safety Policy?	Yes – aligns with Santos' Environment, Health and Safety Policy (Appendix A).
Are performance outcomes, control measures and associated performance standards consistent with industry standards?	Yes – the most recent and comparable EPs accepted by NOPSEMA were reviewed for consistency with the performance outcomes, control measures and associated performance standards proposed in this EP.
Have performance outcomes, control measures and associated performance standards taken into consideration Relevant Person feedback?	Yes – no objections or claims raised by Relevant Persons during consultation of this EP or the Drilling EP relating specifically to unplanned release of solid objects/waste within the OAs.
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – ALARP assessment conducted, with additional control measures adopted.

Accidental solid object releases from vessels are expected to have negligible impacts. The control measures proposed are consistent with applicable actions described in the relevant fauna recovery plans and conservation advice and management plans. No Relevant Persons concerns have been raised regarding this event. With the control measures in place to prevent accidental solid object releases, impacts are considered ALARP and environmentally acceptable.

7.2 Introduction of invasive marine species

7.2.1 Description of event

Event	Introduction of invasive marine species (IMS) may occur due to: • biofouling on activity vessels • biofouling on equipment that is routinely submerged in water • discharge of STP buoy ballast water • discharge of high-risk ballast water. Once established, IMS have the potential to outcompete indigenous species and affect overall native ecosystem function.
Extent	Localised (seabed and water column within the OA) to widespread if successfully translocated to new areas via ocean currents or equipment transit.
Duration	Temporary to long-term (if successfully translocated).

7.2.2 Nature and scale of environmental impacts

Potential receptors: physical environment (benthic habitat); threatened, migratory, or local fauna (marine mammals, marine turtles, sharks, rays and other fish); socioeconomic (commercial fisheries, other marine users, tourism); and cultural features.

IMS are non-native marine plants or animals that harm Australia's marine environment, social amenity or industries that use the marine environment, or have the potential to do so if they were to be introduced, established or spread in Australia's marine environment (DAWE, 2018). Most climatically compatible IMS to northern Australia are found in Southeast Asian countries.

Some IMS pose a major threat to economy and social amenity by disrupting ecological processes (DAWE, 2018; Wells et al., 2009). When IMS achieve pest status, they are commonly referred to as introduced marine pests (IMPs). IMPs can cause various adverse effects in a receiving environment, including:

- over-predation of native flora and fauna
- outcompeting native flora and fauna for food
- human illness through released toxins
- depleting viable fishing areas and aquaculture stock
- reducing coastal aesthetics
- damage to marine and industrial equipment and subsea infrastructure.

The above impacts can result in flow on detrimental effects to marine parks, tourism, recreation and cultural features, noting that some native fauna may have cultural significance as dreaming totems or as a traditional food source.

Species of concern are those that are not native to the region, are likely to survive and establish in the region, and that can 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.

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 with other tropical regions (such as the Caribbean).

Once IMS populations have established, they are difficult to eradicate, 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 various Australian regulatory agencies.

If an IMS is introduced, species have been known to colonise areas outside the areas where they were introduced but this depends on the diversity and extent of suitable habitat for colonisation.

Potential sources for introducing IMS into the OA include biofouling on vessels, including external niches (e.g. propulsion units, steering gear and thruster tunnels) and internal niches (e.g. sea chests, strainers, sea water pipework, anchor cable lockers and bilge spaces). Ballast water is responsible for up to 30% of all marine pest incursions into Australia, while biofouling (the accumulation of aquatic microorganisms, algae, plants and animals on vessel hulls and submerged surfaces) is also considered a significant pathway for the potential introduction and spread of marine pests (DAWE, 2018).

Equipment that is submerged in water for periods of time (such as ROVs and STP buoy) may acquire marine pest species, which can be spread if the equipment is not cleaned before being used in pest-free areas. In addition, the water-winning location for pre-flooded equipment (such as STP buoy) may inadvertently introduce marine pest species unless a location is known to be clear of known IMS. There is minimal risk of biofouling from the STP buoy as the STP buoy will arrive dry at a location nearby to the OA. The STP buoy will use sea water won from local waters and hence have a low volume of potential IMS. The STP buoy will then be wet towed to the OA for positioning. STP buoy ballast discharges will occur in the OA's deep waters, which are also surrounded by deep waters.

IMS are generally unable to successfully establish in deep water ecosystems (Geiling, 2014), most likely due to a lack of light and suitable habitat to sustain their growth and survival. Therefore, most IMS are found in tidal and subtidal zones with only a few species known to extend into deeper waters of the continental shelf (Bax et al., 2003). Most species introduced to an area outside their natural range (e.g. via ballast water) will not survive to establish or subsequently become invasive or a pest (Wells et al., 2009).

IMS risks are relevant to all maritime activities, including commercial shipping, fishing, military, petroleum, and recreational boating.

7.2.3 Environmental performance outcomes and control measures

The EPO relating to this event is:

- Prevent the displacement of native marine species as a result of the introduction and establishment of IMS via activity vessels [EPO-09]

An assessment of the environmental benefits and the potential costs or issues associated with control measures for this activity are described in Table 7-3 to demonstrate that potential risks are ALARP. Control measures that are adopted have associated EPSs and measurement criteria, and are presented in Table 8-2.

Table 7-3: Control measures evaluation for introduction of IMS

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
Standard control measures				
C7.2.1	Vessels equipped with effective anti-fouling coatings (administrative control)	The likelihood of introducing IMS is reduced due to anti-fouling systems compliant with Marine Order 98.	Could lead to potential delays and therefore costs, in vessel contracting process due to availability of vessels with appropriate anti-foulant systems.	**Adopted**
C7.2.2	Vessels undertake ballast water management or treatment to achieve low-risk ballast water (administrative control)	The likelihood of introducing IMS via ballasting activities is reduced by implementing the Australian Ballast Water Management requirements (DAWE, 2020a).	Cost associated with implementing procedures. Costs associating with reducing the vessel risk to 'low' (e.g. dry docking, hull cleaning or additional costs due to inspections).	**Adopted**
C7.2.3	Apply risk-based IMS management for vessels (administrative control)	The likelihood of introducing IMS is reduced by implementing proactive biofouling management options recommended under the Australian Biofouling Management Requirements (DAWE, 2022a) and Australian National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (Marine Pest Sectoral Committee, 2009)	Cost associated with implementing procedures and implementing the mitigation measures.	**Adopted**
C7.2.4	Marine Growth Prevention System (administrative control)	The likelihood of introducing IMS is reduced by preventing marine growth (such as barnacles and mussels) on the submerged surfaces of the vessel.	Cost associated with implementing procedures and implementing the mitigation measures.	**Adopted**

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
Additional control measures				
C7.2.5	STP buoy anti-fouling coating (administrative control)	Selecting a STP buoy with an antifouling coating will prevent IMS attaching in the long-term (e.g. during the activities covered under the Barossa Production Operations EP [BAA-200 0637]).	Minimal costs associated with implementing control measure.	**Adopted**
C6.1.7	HSE inductions will include environmental requirements (administrative control)	Ensures that crew are aware of the stringent EP, Santos and legislative requirements.	Administrative costs to update existing Santos procedure and induction materials and train personnel.	**Adopted**
C6.1.3	The Activity will be undertaken in accordance with Santos HSE management and marine vessel vetting processes (administrative control)	Santos marine vetting process ensures the risk of introducing invasive marine species during activities undertaken by Santos in Australian waters are minimised through by carrying out a Biosecurity Risk Assessment prior to engagement	Regulatory requirement and therefore the cost is not identified as an issue.	**Adopted**
N/A	Heat treatment of ballast water to eliminate IMS (administrative control)	Would reduce potential for IMS to establish by reducing the potential for IMS present in ballast water.	Compared to traditional ballast treatment (e.g. chemical additive) methods, heat treatment has a higher cost and increased energy consumption. Ballast requirements are adequately managed under Australian Ballast Water Management (DAWE, 2020a) and the International Convention for the Control and Management of Ships' Ballast Water and Sediments to reduce the risk of IMS introduction.	**Rejected** – based on high cost considered disproportionate compared with risk (after application of standard control measures [see above]).
N/A	Contract vessels only operating in	Reduce potential for IMS to be transported	Vessels and equipment suitable for	**Rejected** – potential for significant

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
	local, state/territory or Commonwealth waters to reduce potential for IMS (substitute control)	into area since vessels would not have originated elsewhere.	the activity may not be available in 'local' waters. Potential significant costs and delay in activity schedule by only contracting vessels working in 'local' waters.	schedule delays and activity costs if suitable vessels are not 'locally' available. All contracted vessels must be 'low' risk of introducing IMS regardless of their origin.
N/A	Mandatory dry docking of vessels before entering field to clean vessel and/or equipment and remove biofouling (administrative control)	Ensures that the risk of IMS being present on vessel or associated equipment is low.	Significant cost (grossly disproportionate to the risk) and would lead to scheduling delays.	**Rejected** – costs disproportionately high compared with environmental benefit given the proposed risk-based management framework, which includes potential dry docking and cleaning if justified based on risk assessment.
N/A	Use an alternative ballast system to avoid uptake or discharge of water	Eliminate need for ballast water exchange, therefore decreasing risk of introducing IMS through ballast water.	Vessels suitable for the Activity do not have options for alternative ballast system, therefore would require modification at significant cost.	**Rejected** – costs disproportionately high compared with environment benefit given other controls in place already adequately reduce the risk.
N/A	Do not discharge ballast water (elimination control)	Would reduce the potential for introducing IMS by implementing a no ballast water exchange policy on vessels.	Ballast water exchange required on the vessels for stability.	**Rejected** –ballast water exchange is a safety-critical activity for marine operations.

The OPP commitment for a Quarantine Management Plan was considered. It was determined that control measures C7.2.1 and C7.2.3 adequately fulfil the intended objectives of this commitment. Furthermore, these control measures offer more rigorous and up-to-date controls, rendering the original OPP commitment unnecessary.

7.2.4 Environmental impact assessment

Receptors	• Physical environment (benthic habitats and primary producers) • Threatened, migratory, or local fauna (marine mammals, marine turtles, fish [including sharks and rays]) • Socioeconomic (commercial fisheries, other marine users, tourism) • Cultural features
Consequence	III – Moderate
Physical environment (benthic habitats and primary producers)	

The seabed in the OA is largely bare sediment and is devoid of filter feeders (e.g. sponges, soft corals) and other epifauna (Jacobs, 2016). A low abundance and diversity of infauna has been sampled in the OA and no features associated with the KEF (Shelf break and slope of the Arafura Shelf) were identified. The consequence level is considered III – Moderate.
Threatened, migratory, or local fauna (marine mammals, marine turtles, fish [including sharks and rays]) IMS, if successfully established, can outcompete native species for food or space, prey on native species or change the nature of the environment. Wildlife Conservation Plan for Migratory Shorebirds identified IMS from ballast water and hull transport as a threat to migratory shorebirds, particularly if the introduction results in the loss of benthic food sources at important intertidal habitat (CoA, 2015c). The consequence level is considered III – Moderate.
Socioeconomic (commercial fisheries, other marine users, tourism) The introduction of IMS could have a detrimental effect on commercial fisheries and aquaculture, other marine users and tourism in the area due to the IMS outcompeting native species for food or space, preying on native species or changing the nature of the environment; however, the consequence level is considered III – Moderate.
Cultural features For potential impacts to marine species of cultural significance or that provide a traditional food source, refer to the assessment for threatened, migratory or local fauna.

Likelihood	B – Unlikely
The pathways for IMS introduction are well known; consequently, standard preventive measures are proposed. The ability for IMS to colonise a habitat depends on several environmental conditions. 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 water depths across the OA are more than 200 m, this creates an unfavourable habitat for colonisation (light limiting and low habitat biodiversity with sparse epibiota). The OA is also distant from shallow coastal habitats, thus 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 unlikely.	
Residual Risk	The residual risk is considered Low.

7.2.5 Demonstration of as low as reasonably practicable

There are no alternatives to the use of activity vessels in order to undertake the Activity. The risks from IMS are well understood and, with the proposed control measures, the activity will comply with relevant regulations and guidelines. All reasonably practicable control measures were reviewed and those adopted are considered appropriate to manage the residual risk to a 'Low' level. The proposed management controls are in accordance with Santos' risk management criteria and are considered appropriate to manage the risk to ALARP.

7.2.6 Acceptability evaluation

Is the risk ranked between Very Low and Medium?	Yes – residual risk ranking is Low.
Is further information required to validate the consequence assessment?	No – potential impacts and risks well understood through the information available.
Are the risks and impacts consistent with the principles of ecologically sustainable development (ESD)?	Yes – activity evaluated in accordance with Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004), which considers principles of ESD.

Have the acceptable levels of impact and risks been informed by relevant species recovery plans, threat abatement plans and conservation advice and Australian marine park zoning objectives?	Yes – The Wildlife Conservation Plan for Seabirds (COA, 2020) identified disease, pathogens and invasive species as a threat (Table 3-10). Santos considers the impacts of IMS to be not inconsistent with this Plan. Recovery plans / conservation advice for other species that may occur in the OA do not identify invasive species or disease as a key threat or have explicit relevant objectives or management actions related to invasive species or disease. The OA does not intersect any AMP. The objectives and actions of this Plan were considered during impact and risk assessments. The controls outlined in Table 7-3 are not inconsistent with the objectives of the material listed above and Santos considers the risk of introducing IMS to be not inconsistent with these objectives.
Are performance outcomes, control measures and associated performance standards consistent with legal and regulatory requirements?	Yes – management measures are consistent with the *Biosecurity Act 2015* (Cth), Australian Ballast Water Requirements: Version 8 (DAWE, 2020a), Australian biofouling management requirements (DAWE, 2022a), Offshore Installations – Biosecurity Guide (DAWE, 2020c), International Convention for the Control and Management of Ships' Ballast Water and Sediments, Marine Order 98 (Marine pollution – anti-fouling systems), IMO Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species (2011) and National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (Marine Pest Sectoral Committee, 2009). Through acceptance of this EP, legislative and regulatory requirements will be met as per Section 1.6.2.
Are performance outcomes, control measures and associated performance standards consistent with Santos' Environment, Health and Safety Policy?	Yes – aligns with Santos' Environment, Health and Safety Policy (Appendix A).
Are performance outcomes, control measures and associated performance standards consistent with industry standards?	Yes – the most recent and comparable EPs were reviewed for consistency with the performance outcomes, control measures and associated performance standards proposed in this EP.
Have performance outcomes, control measures and associated performance standards taken into consideration Relevant Person feedback?	Yes – no objections or claims raised by Relevant Persons during consultation of this EP or the Drilling EP relating specifically to potential introduction of invasive marine species.
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – ALARP assessment conducted, with additional control measures adopted.

The mobilisation of activity vessels and equipment to undertake offshore petroleum activities is industry standard practice, and the IMS risks are well understood and subject to regulation. The activity vessels and equipment that are internationally mobilised will meet Australian biosecurity clearance requirements, and the proposed control measures are consistent with Australian biofouling management requirements (DAWE, 2022a), Australian Ballast Water Requirements: Version 8 (DAWE, 2020a) and National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (Marine Pest Sectoral Committee, 2009).

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

No Relevant Person concerns have been raised regarding this aspect, and the proposed controls will reduce the residual level of risk to Low 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 activity vessels and other support to interact with marine fauna, including potential strike or collision, potentially resulting in severe injury or mortality. There is also a potential for fauna entrainment while winning sea water for FCGT activities.
Extent	Within the OA.
Duration	During the activity.

7.3.2 Nature and scale of environmental impacts

Potential receptors: threatened, migratory fauna or local fauna (marine mammals, marine turtles, whale sharks, seabirds); and socioeconomic receptors (tourism, recreation) and cultural features via risks to fauna.

Marine fauna in surface waters that are most at risk from vessel collision include marine mammals, marine turtles, whale sharks and birds. Consultation has identified that some marine fauna may have cultural significance. The OA does not intersect any BIA or habitat critical to survival of any marine fauna species. Vessel or anthropogenic disturbance are identified as potential threats to several marine species in relevant recovery plans and conservation advices (Table 3-10). Fauna entrainment is possible while winning sea water for FCGT activities, however this will be prevented by installing screening / mesh protection barriers. Marine fauna interactions will be recorded and reported by Santos as described in Section 8.7.1.

7.3.2.1 Marine mammals

The Approved Conservation Advice for *Megaptera novaeangliae* (humpback whale) (TSSC, 2015c) indicates that humpback whales are one of the most frequently reported whale species involved in vessel strikes worldwide (Laist et al., 2001; Jensen and Silber, 2004). This observation is supported by Australian studies referenced in the National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (CoA, 2017). Increased vessel numbers (Silber and Bettridge, 2012) are not only a threat to humpback whales in relation to vessel strikes but also in relation to disturbance and displacement from key habitats. Similarly, vessel strike is also recognised by the Conservation Advice for *Balaenoptera borealis* (sei whale) (TSSC, 2015b) and Conservation Management Plan for the Blue Whale 2015–2025 (CoA, 2015a). It is noted that cetaceans are naturally inquisitive marine mammals, some of which are often attracted to vessels underway (e.g. dolphins commonly 'bow ride' with vessels).

There are no known BIAs for cetaceans within the OA and therefore it is unlikely that peaks of presence will be observed, but individuals of various species may be encountered at any time of year, including Omura's whales (not EPBC Act listed), which were frequently present in the area between April and September inclusive, with a peak in June and July (JASCO, 2016).

Collisions between vessels and cetaceans are most frequent on continental shelf areas where high vessel traffic and cetacean habitat occur simultaneously (Simmonds et al., 2004). There have been recorded instances of cetacean deaths as a result of vessel collisions in Australian waters (e.g. a Bryde's whale in Bass Strait in 1992) (Simmonds et al., 2004), although the data indicate this is likely to be associated with container ships and fast ferries. Some cetacean species, such as humpback whales, can detect and change course to avoid a vessel (Simmonds et al., 2004).

As presented in the National Strategy for Mitigating Vessel Strike of Marine Megafauna (DoEE, 2016), most reported vessel collisions for whales in Australian waters between 1990 and 2015 have

occurred along eastern or south-eastern Australia, with no reported incidents in NT waters (DoEE, 2016).

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).

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

Dugongs are not expected to occur in the OA and, therefore, are not considered credible receptors for marine fauna interaction and are excluded from further discussion in this EP.

7.3.2.2 Marine turtles

Turtle/vessel interactions arising from increased vessel traffic is also recognised as one of several key impacts to marine turtles in the Recovery Plan for Marine Turtles in Australia 2017–2027 (CoA, 2017b). In the recovery plan, vessel disturbance is identified as a risk to flatback turtles. Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle) (DEWHA, 2008b) listed boat strike as a threat. Marine turtles are highly mobile and, given the low speeds of activity vessels typically used during installation activities, are likely to be able to move from an area where there are vessels. Marine turtles make extensive migrations through the broader region; and it is possible individual turtles of any of the region's species may be encountered in the OA; however, the OA does not contain any significant feeding, breeding or aggregation areas for marine turtles.

Marine turtle mortality due to boat strike was identified as an issue in Queensland waters in the Recovery Plan for Marine Turtles in Australia 2017–2027 (CoA, 2017b). However, turtles appear to be more vulnerable to boat strike in areas of high urban population where incidents with recreational craft are higher.

7.3.2.3 Sharks, rays and other fish

The whale shark BIA does not overlap the OA and therefore significant numbers are not expected to be encountered. Conservation Advice for *Rhincodon typus* (whale shark) (TSSC, 2015g) states that vessel strike from large vessels is a threat to whale sharks. Whale sharks are at risk from vessel strikes when feeding at the surface or in shallow waters (where options to dive are limited). Whale sharks have been shown to spend approximately 25% of their time less than 2 m from the surface and more than 40% of their time in the upper 15 m of the water column (Wilson et al., 2006; Gleiss et al., 2013). The OA does not overlap known whale shark foraging areas and whale shark presence may be transitory and of a short duration. No constraints within the OA (e.g. shallow water or shorelines) would prevent whale sharks from moving away from vessels. Vessel speed has been demonstrated to be a key factor in relation to collision with marine fauna, particularly cetaceans, with faster-moving vessels posing a greater collision risk than slower vessels (Laist et.al., 2001; Jensen and Silber, 2003; Hazel, 2009). Laist et al. (2001) suggest that the most severe and lethal injuries to cetaceans are caused by vessels travelling at 14 knots or faster.

Whale sharks, other pelagic fish and demersal fish are likely to exhibit a short-term avoidance to vessels and ROVs. This is likely to be initiated through the vibrations and underwater noise emitted from these activities (Section 6.3) rather than the physical presence. Such avoidance is likely to be temporary.

7.3.2.4 Birds

The OA has no bird BIAs, but several protected species of seabirds and migratory birds may occur at times within the OA (Table 3-8). Birds may opportunistically rest on a vessel and may be attracted to activity vessels due to lighting and vessel discharges such as macerated food waste. The Wildlife Conservation Plan for Migratory Shorebirds suggest that disturbance from human activities to shorebirds may compromise energy reserved for migration (CoA, 2015c). Although seabirds may be attracted to activity vessels due to increased feeding opportunities, these behavioural changes are unlikely to alter population dynamics or significantly change the habitat use of birds due to the short duration of the Activity. The Approved Conservation Advice for *Calidris canutus* (Red knot) (TSSC, 2016b) indicates that anthropogenic disturbance is a threat, but it relates to disturbance of important sites.

The risk of bird collision with helicopter operations is an ongoing concern for the safety of flights to and from reel-lay and construction vessels. The consequence of a helicopter bird strike is related to seasonal distribution, body mass, flocking behaviour, and flight behaviour, while the probability of a strike is related to the abundances of different bird species on or near the vessels. Helicopter noise is expected to elicit a behavioural response in birds to avoid collision and, given the relatively low speeds of helicopters while flying during take-off or landing, a helicopter strike is not likely.

7.3.2.5 Cultural features

The First Nations people maintain a continuing spiritual connection with sea country, including caring for sea country and access to cultural food sources. Sections 7.3.2.1 to 7.3.2.4 describes the potential impacts to marine species of cultural significance.

No First Nations people feedback was provided about potential marine fauna interactions during consultation for the SURF EP.

Feedback provided during consultation on the Drilling EP raised concerns about the potential impact of drilling and associated interactions with marine fauna on their dreaming totems (including turtle totems).

Information was provided by Tiwi clients of the EDO about the potential impacts to marine fauna totemic species, such as marine turtles, and that if something bad happens to the totem, it can make Tiwi people sick. They also raised concerns about impacts to turtles from ships propellers, and potential for impacts to seagulls by flying helicopters over Seagull Island. Sections 7.3.2.1 to 7.3.2.4 describe the potential impacts to marine species of cultural significance.

7.3.3 Environmental performance outcomes and control measures

The EPOs relating to this event include:

- Zero incidents of injury/mortality of cetaceans/marine reptiles from collision with activity vessels. [EPO-10].
- No significant impacts to cultural features from the Activity. [EPO-14].

An assessment of the environmental benefits and the potential costs or issues associated with control measures for this activity are described in Table 7-4 to demonstrate that potential risks are ALARP. Control measures that are adopted have associated EPSs and measurement criteria, and are presented in Table 8-2. Rejected control measures have an ALARP evaluation provided to justify their rejection.

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

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
Standard control measures				
C6.3.1	Avoid activities near cetaceans and turtles (isolation control)	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 (excluding vessels which are unable to alter path while performing operations), and helicopters can increase distances from sighted fauna if required.	Potential delay in vessel and helicopter movement, increasing activity duration and costs to Santos. Cost associated with implementing procedures. Regulatory requirements under EPBC Regulations 2000.	**Adopted**
Additional control measures				
C6.1.5	Vessel speed restrictions (substitute control)	Reduces consequence of collisions (causing harm) and likelihood as fauna have longer to detect and avoid the vessel by restricting vessel speeds in the OA to 8 knots or less.	Administrative costs to update existing Santos procedure and induction materials and train personnel.	**Adopted**
C6.1.7	HSE inductions will include environmental requirements (administrative control)	Ensures that crew and helicopter operators are aware of the stringent EP, Santos and legislative requirements.	Administrative costs to update existing Santos procedure and induction materials and train personnel.	**Adopted**
C7.1.4	Vessel standard operating procedure (administrative control)	Helideck sweeps before a helicopter landing prevent seabird collision by dispersing seabirds that are resting on the helideck.	Cost of implementing procedures.	**Adopted**
C6.7.2	Contractor FCGT procedure (administrative control)	All sea water won for FCGT activities will use screening/mesh designs to prevent trapping or injuring marine fauna.	Cost associated to install screening/mesh design and implementing procedures.	**Adopted**

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
C6.2.6	Cultural Heritage (administrative control)	Shows respect for beliefs and culture of First Nations people.	Time and cost to work with First Nations communities.	**Adopted**
N/A	Dedicated MMO on vessels (EPBC Policy Statement 2.1 Part B) (administrative control)	Improved ability to spot and identify marine fauna at risk of a collision (that may cause harm).	Additional cost of contracting MMO personnel.	**Rejected** – likelihood of animals being encountered is too low to justify additional cost of MMO; personnel can observe for marine fauna when piloting vessels; cost would be grossly disproportionate to negligible environmental benefits.
N/A	Activities will only occur during daylight hours (eliminate control)	Potential for a vessel fauna collision occurring is decreased due to vessel being stationary when visibility is lower at night.	Vessels are required to support 24-hour operations. Would increase the duration of the activity resulting in significant financial costs. No other maritime industry has such a restriction.	**Rejected** – The high financial cost would be grossly disproportionate to negligible environmental benefits.
N/A	Adopt further measures to those outlined in EPBC Regulations 2000 — Part 8 Division 8.1 during peak periods of ecological sensitivity, e.g. additional management considerations for vessels outlined in the Australian National Guidelines for Whale and Dolphin Watching (DoEE, 2017) (administrative control)	Negligible due to the absence of BIAs or known seasonal aggregations and/or migration of fauna in the OA.	Administrative costs to update existing Santos procedure and induction materials and train personnel.	**Rejected** – the existing control ensures compliance with legislation. No additional relevant controls have been identified in government or industry guidelines.
N/A	Manage the timing of the activity to avoid sensitive periods (administrative control)	Negligible due to the absence of BIAs or known seasonal aggregations and/or	As the activity will take approximately 9 months there would be a high cost to demobilise and	**Rejected** – the high financial cost would be grossly disproportionate to negligible

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
		migration of fauna in the OA.	remobilise the vessels. Protected marine fauna species may be present year-round, albeit in low numbers, therefore avoidance of potential interactions is not feasible.	environmental benefits

7.3.4 Environmental impact assessment

Receptors	• Threatened, migratory or local fauna (marine mammals, marine reptiles, sharks and seabirds) • Socioeconomic (commercial fisheries, other marine users, tourism) • Cultural features
Consequence	I – Negligible
If a vessel collides with marine fauna including seabirds, there is the potential for individual animal injury or death. The number of receptors present at the OA is expected to be limited to a small number of transient individuals. No known BIAs intersect with the OA for any fauna species. The closest protected area is the Oceanic Shoals AMP, which is approximately 44 km away. Vessel movements will be of medium frequency for approximately 9 months. Injury or death to individual animals would be highly undesirable, but it would represent a small proportion of any local population and any change in population size would likely be within the range of natural variation. According to the Santos consequence descriptor definitions, this would be of Negligible (I) environmental consequence. Given the negligible consequence on species, subsequent risks or significant impacts to socioeconomic receptors (including tourism and recreation) and cultural features relating to species with cultural significance, are not anticipated.	
Likelihood	C – Possible
There are no known BIAs or known habitat critical to the survival of any marine fauna species within the OA. In addition, marine fauna tend to move away from vessels and helicopters. The Santos procedure for interacting with marine fauna (EA-91-II-00003) reduces vessel speed and introduces cautionary zones where fauna are sighted. The likelihood of marine fauna interaction resulting in injury or mortality is considered possible.	
Residual Risk	The residual risk is considered Very Low

7.3.5 Demonstration of as low as reasonably practicable

No alternative options to using vessels, ROVs and helicopters are possible for undertaking the Activity.

All reasonably practicable control measures were reviewed and those adopted are considered appropriate to manage the residual risk to a Low level. The proposed management controls are in accordance with Santos' risk management criteria and are considered appropriate to manage the risk to ALARP.

7.3.6 Acceptability evaluation

Is the risk ranked between Very Low and Medium?	Yes –residual risk ranking is Very Low.
Is further information required to validate the consequence assessment?	No – potential impacts and risks are well understood through the information available.
Are the risks and impacts consistent with the principles of ecologically sustainable development (ESD)?	Yes – activity evaluated in accordance with Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004), which considers principles of ESD.
Have the acceptable levels of impact and risks been informed by relevant species recovery plans, threat abatement plans and conservation advice and Australian marine park zoning objectives?	Yes – The following material published in relation to threatened and migratory species within the OA identifies vessel collision or anthropogenic disturbance as a threat Table 3-10: **Conservation Advice:** • Conservation Advice for *Balaenoptera physalus* (fin whale) (TSSC, 2015c) • Conservation Advice for *Balaenoptera borealis* (sei whale) (TSSC, 2015b) • Conservation Advice for *Rhincodon typus* (whale shark) (TSSC, 2015g) • Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle) (DEWHA, 2008b) **Management Plans:** • National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (CoA, 2017) • Conservation Management Plan for the Blue Whale 2015–2025 (CoA, 2015a) identifies vessel collisions as a threat to blue whales: 'Action A4: minimising vessel collisions by ensuring the risk of vessel strikes on blue whales is considered when assessing actions that increase vessel traffic in areas where blue whales occur and, if required appropriate mitigation measures are implemented; and ensure all vessel strike incidents are reported in the National Ship Strike database'. • Recovery Plan for Marine Turtles in Australia 2017–2027 (CoA, 2017b) • Wildlife Conservation Plan for Seabirds (COA, 2020) • Wildlife Conservation Plan for Migratory Shorebirds (CoA, 2015c). For all the recovery plans and management plans identified above, the objectives are achieved by adopting EPO-10 and controls outlined in Table 7-4 to ensure the activity is not inconsistent with these objectives. Recovery plans / conservation advice for other species that may occur in the OA do not identify vessel collision or anthropogenic disturbance as a key threat or have explicit relevant objectives or management actions related to vessel or anthropogenic disturbance. The OA does not intersect any AMP. The objectives and actions of these publications were considered during impact and risk assessments. The controls outlined in Table 7-4 and the risk of marine fauna interactions are not inconsistent with the objectives of the material listed above.
Are performance outcomes, control measures and associated performance standards consistent	Yes – management measures are consistent with EPBC Regulations Part 8.

with legal and regulatory requirements?	Through acceptance of this EP, legislative and regulatory requirements will be met as per Section 1.6.2.
Are performance outcomes, control measures and associated performance standards consistent with Santos' Environment, Health and Safety Policy?	Yes – aligns with Santos' Environment, Health and Safety Policy (Appendix A).
Are performance outcomes, control measures and associated performance standards consistent with industry standards?	Yes – the most recent and comparable EPs accepted by NOPSEMA were reviewed for consistency with the performance outcomes, control measures and associated performance standards proposed in this EP.
Have performance outcomes, control measures and associated performance standards taken into consideration Relevant Person feedback?	Yes – requests relating to potential marine fauna interaction have been considered. Existing control measures are considered sufficient. However given the overlap of the SURF and Drilling activity OAs, feedback received during the Drilling EP has been considered and where applicable additional EPOs, CMs and EPSs were adopted.
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – ALARP assessment conducted, with additional control measures adopted.

Activity vessels must move to undertake the activity. The possibility of vessel strike is a well understood risk for maritime operations, including for commercial shipping and fishing. Vessel movements will comply with all relevant maritime standards and regulations, including EPBC regulations to minimise risks to marine fauna. Application of the proposed management controls and adherence to regulations reduces the likelihood of vessel interactions with marine fauna. Although the potential exists for a collision to occur, it is considered a C – possible scenario. As part of Santos' reporting requirements for the activity, if an impact to cetaceans did occur in the OA, it will be reported in the National Ship Strike database (see Table 8-5).

Therefore, the impact is considered to be ALARP and environmentally acceptable.

With application of the proposed control measures, the potential impacts and risks to threatened fauna will be managed consistent with relevant recovery plans and approved conservation advice. No Relevant Person concerns have been raised regarding this event. Therefore, the impact is considered to be ALARP and environmentally acceptable.

7.4 Non-hydrocarbon chemical release

7.4.1 Description of event

Event	**Non-hydrocarbon liquids** Non-hydrocarbon liquids including miscellaneous chemicals and waste streams (water treatment chemicals and MEG for pre-commissioning activities, brine, cleaning and cooling agents, stored or spent chemicals and leftover paint materials) are used or stored on vessels during the Activity. The transfer of MEG from a supply vessel to the construction vessel will also occur via a floating hose. An accidental release of chemicals and other non-hydrocarbon liquids into the marine environment has the potential to occur from: • transferring, storing or using bulk products (e.g. water treatment chemicals) • mechanical failure of equipment, such as tank or pipework failure • handling and storage spills and leaks due to insufficient fastening or inadequate bunding • floating hose failure or rupture, coupling failure or tank overfilling • lifting and incorrect handling– dropped objects damaging liquid vessels (containers) • firefighting foam during an unplanned incident. A release of non-hydrocarbon liquids or chemicals may result in impacts to water quality and hence sensitive environmental receptors. **Non-hydrocarbon gas** The Barossa GEP and associated infrastructure, including the FPSO PLET, are outside the scope of this EP. The proposed Barossa GEP will be left in situ (preservation period) after being packed with nitrogen gas until the commissioning, start-up and operation activities, covered under the Barossa Production Operations EP (BAA-200 0637). Sections 2.5.6 and 2.5.9 describe the riser base manifold and foundation and 26″ spool installation, and Section 2.6.4 describes the associated pre-commissioning activities. The 26″ spool will connect the riser base manifold to the FPSO PLET; hence these installation activities will be near the Barossa GEP and FPSO PLET. Although highly unlikely, lifting the riser base manifold foundation and connection activities pose a negligible risk of causing damage to the FPSO PLET (greater than 200 m) and Barossa GEP should an unplanned event occur. Damage could result in a potential rupture, releasing nitrogen gas into the environment. The maximum release is approximately 3,000 tonnes of nitrogen gas (100% loss of containment). The Barossa GEP will not contain any Project fluids from the Barossa FPSO. Since nitrogen gas is non-flammable and in a low volume, the primary concern would be the risk of asphyxiation in the marine environment due to the natural dilution from wind and water depth resulting in rapid dispersion. However, it is unlikely, given that the offshore release rate greatly diminishes these effects.
Extent	The maximum volume of non-hydrocarbon liquids or chemicals that could be released during routine operations is likely to be small and limited to the volume of individual containers—hydrotest mixture chemical storage tank on the construction vessel, and intermediate bulk containers (IBCs) or drums stored on vessel decks. The worst-case credible scenario of an unplanned release would be a release of the 20 m^3 hydrotest chemical concentrate. Dilution from discharges in open waters is rapid, with 1 in 1,000 dilution usually occurring within 30 minutes (Costello and Read, 1994). If the spill is not contained on deck, a release to the marine environment would likely disperse rapidly within the OA. The environment that may be affected for non-hydrocarbon liquids or chemical release resulting in a decrease in water quality is likely to be restricted to around the vessel and contained within the OA.

Duration	The duration of the impact is limited to the time the released chemical/liquid takes to disperse to below harmful concentrations. In the ocean, this is expected to be minutes to hours.

Miscellaneous chemicals

Activity vessels will store chemicals to be used within the Activity. These include chemicals that are planned to be released or have the potential to accidentally spill into the environment. The Santos Offshore Division Operations Chemical Approval Procedure (EA-91-II-10001) will be applied to these chemicals to demonstrate that only environmentally acceptable products are used to reduce the potential risks associated with unplanned chemical releases.

Nitrogen

Molecular nitrogen is a non-hazardous and non-combustible gas that is colourless, odourless, tasteless, and inert at normal temperatures and pressures (National Center for Biotechnology Information, 2023). It constitutes approximately 78% of the Earth's atmosphere; in the ocean, more than 95% of nitrogen exists as gas (Royal Society, 2013). When released into the environment, nitrogen will rise through the water column (relative density of 0.97), forming a solution with the surrounding water. Rising gas clouds generate turbulence at the surface and mix rapidly with air. This can displace available air, resulting in a sudden lack of oxygen and the potential for asphyxiation.

7.4.2 Nature and scale of environmental impacts

Potential receptors: physical environment (water and sediment quality, benthic habitats); threatened, migratory or local fauna (marine mammals, marine reptiles, sharks and rays, other fish, and birds); socioeconomic; and cultural features.

7.4.2.1 Physical environment

Non-hydrocarbon liquids accidentally released to the marine environment may lead to contamination of the water column near vessels. The potential impacts would most likely be highly localised and restricted to the immediate area surrounding the spill, with rapid dispersal to concentrations below impact thresholds likely to occur in the open ocean. The nitrogen gas is expected to move towards the surface, with some of the gas becoming dissolved in seawater as the plume rises. A worst-case rupture would lead to the formation of a minor gas cloud which would rapidly disperse into the atmosphere.

Due to the limited volumes, the water-soluble nature of the chemicals, and expected rapid dispersal to concentrations below impact thresholds, impacts to water quality are not expected to cause flow-on effects to sediment quality or benthic habitats, including the KEF (Shelf break and slope of the Arafura Shelf) on the sea floor (more than 200 m below the surface), and shoals and scarps. There is no emergent or intertidal habitat that could be impacted by a surface spill. Because of the water depth (greater than 200 m) and distance to the land (the distance to the closest being 143 km) any spilled chemical is unlikely to reach land or affect any benthic habitats including shallow water shoals (the distance to the nearest shoal is 66 km from the OA) and the scarps identified as HM014 and HM019 (Jacobs, 2016), which are approximately 10 km and 13 km south of the OA. These 2 scarps are surrounded by deep water, with the elevated scarp (HM019) in water 160 m deep (Figure 7-3).

7.4.2.2 Threatened, migratory or local fauna

Changes to water quality could potentially lead to short-term impacts on transiting marine fauna (e.g. pelagic fish [including sharks], marine mammals, marine reptiles and seabirds), some of which may have cultural significance as totems of cultural food sources. As summarised in Table 3-9, the OA does not overlap any BIAs and therefore only low numbers of animals are expected to be encountered in the OA.

Recovery plans and conservation advice for numerous protected species identify marine pollution and contamination impacts as threats to the species.

Chemical spills are unlikely to have widespread ecological effects on threatened or migratory fauna, given the nature of the chemicals on board, the limited volumes that could be released, and the open-ocean environment of the location. Physical coating of marine fauna, in particular those present at the sea surface (e.g. seabirds), by entrained or surface hazardous liquids and sublethal or lethal effects from the toxicity of chemicals are considered unlikely given the expected low concentrations, water solubility of the water treatment chemicals, small potential volumes and short exposure times.

A worst-case nitrogen gas release could lead to the formation of a minor gas cloud which may impact air-breathing fauna, such as marine mammals, reptiles, and birds. Animals in the immediate vicinity of the release may be at risk of asphyxiation, potentially resulting in death. However, marine mammals, turtles and birds are not expected to be affected, given the predicted rapid nitrogen dispersion into the atmosphere limited to within 500 m radius of the release over a very short duration. Due to the GEP pipeline's isolated location, seabirds will be limited to individuals transiting the area and hence unlikely to be impacted.

The recovery plan for Marine Turtles in Australia 2017–2027 (CoA, 2017b) identified pollution as a threat. However, pollution sources were primarily related to agricultural, terrestrial industrial and domestic sources. The accidental chemical releases are expected to be of very short duration and localised with no persistence in the environment. In addition, turtles are also able to exhibit avoidance behaviour and will be able to move away from any temporary release of nitrogen gas.

7.4.2.3 Socioeconomic

A nitrogen gas cloud could cause an asphyxiation risk to user marine users at high concentrations. However, a potential plume is expected to be localised (within 500 m), contained within the activity vessel 500 m cautionary zone and for a very short duration. Therefore, no impact to other marine users is anticipated.

7.4.2.4 Cultural features

No First Nations people feedback was provided about potential impacts from an unplanned minor non-hydrocarbon chemical releases to cultural features during this EP or Drilling EP consultations. Section 7.4.2.2 describes the potential impact to marine species of cultural significance.

7.4.3 Environmental performance outcomes and control measures

The EPO relating to this event is:

- Zero unplanned release of chemicals to the marine environment [EPO-11].

An assessment of the environmental benefits and the potential costs or issues associated with control measures for this activity are described in Table 7-5 to demonstrate that potential risks are ALARP. Control measures that are adopted have associated EPSs and measurement criteria, and are presented in Table 8-2. Rejected control measures have an ALARP evaluation provided to justify their rejection.

Table 7-5: Control measures evaluation for non-hydrocarbon chemical release

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
Standard control measures				
C7.1.2	Dropped objects recovered where safe and practicable to do so (administrative control)	Impacts to the environment are reduced by preventing dropped objects and by retrieving dropped objects unless the environmental consequences are negligible or there are risks to safety.	Cost of implementing procedures.	**Adopted**
C7.4.1	Chemical and hydrocarbon storage areas designed to contain leaks and spills (isolation control)	Reduces the risk of accidental discharge to sea by controlling the storage hydrocarbons.	Cost of implementing procedures.	**Adopted**
C7.4.2	Chemicals and hydrocarbons will be managed in accordance with standard maritime practices (administrative control)	Reduces the risk of accidental discharge to sea by controlling the storage, handling and clean-up of chemicals.	Cost of implementing procedures.	**Adopted**
C7.4.3	No perfluorinated (PFAS) or perfluorooctane sulfonate (PFOS) will be used in firefighting foam (administrative control)	PFAS and PFOS are persistent, bioaccumulate, and have adverse health effects on humans and wildlife. Safer and environmentally friendly alternatives are available, and efforts are being made to reduce their use and release into the environment.	Cost of implementing procedures.	**Adopted**
C7.1.5	International Maritime Dangerous Goods Code (administrative control)	Reduces the risk of an environmental incident, such as an accidental release to sea or unintended chemical reaction.	Cost of implementing procedures. Regulatory requirement.	**Adopted**
C7.1.1	Implement standards and procedures for lifting equipment	Impacts to the environment are reduced by preventing dropped objects and	Cost of implementing procedures.	**Adopted**

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
	(administrative control)	dragged objects during lifting operations. Administrative costs to update induction materials and train personnel.		
C7.4.4	Vessel spill response plans (administrative control)	Implements onboard response plans to deal with unplanned chemical releases and spills quickly and efficiently to reduce impacts to the marine environment.	Administrative costs of preparing documents. Generally undertaken by vessel contractor so time for Santos personnel to confirm and check SOPEP/SMPEP in place.	**Adopted**
C7.4.5	Spill clean-up kits available in high-risk areas (protective control)	Reduces the risk of spills and leaks to sea by controlling the clean-up of chemicals and hydrocarbons.	Cost of implementing procedures.	**Adopted**
Additional control measures				
C6.1.7	HSE inductions will include environmental requirements (administrative control)	Ensures that crew are aware of the stringent EP, Santos and legislative requirements.	Administrative costs to update existing Santos procedure and induction materials and train personnel.	**Adopted**
N/A	Eliminate vessel to vessel lifting in field (elimination control)	Reduces the risk of dropped objects.	Eliminating lifting would require vessels storing more equipment and supplies on board, and/or additional trips to shore. Vessels will not have enough deck space to store all required equipment, materials, supplies needed for the duration of the activity.	**Rejected** – not feasible to eliminate lifting in the field.
N/A	Do not undertake pre-commissioning activities (elimination control)	This would eliminate any potential impacts from the FCGT activities.	FCGT activities are required to control the potential for corrosion of the flowlines and to determine if any	**Rejected** – not feasible from a technical and risk perspective.

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
			unacceptable restrictions and/or obstructions exist in the line. In addition, potential loss of production due to loss of integrity possibly leading to a larger environmental incident.	
N/A	Use raw sea water without any chemical treatment for FCGT activities (elimination control)	This would eliminate any potential impacts from the FCGT activities but increases likelihood of loss of integrity during operation and potentially greater environmental impacts.	Pre-commissioning fluids are required to verify the structural integrity of the subsea infrastructure. The volumes selected are required to achieve verification. In addition, potential loss of production due to loss of integrity possibly leading to a larger environmental incident.	**Rejected** – not feasible as not required to prevent internal corrosion and ensure pipeline integrity. Corrosion by oxidation and microbial action will occur without using sea water treatment resulting in wall thickness loss.

7.4.4 Environmental impact assessment

Receptors	• Physical environment (water quality, air quality, benthic habitat) • Threatened, migratory or local fauna (marine mammals, marine reptiles, fish [including sharks and rays] and birds) • Cultural features
Consequence	II – Minor

If a non-hydrocarbon liquid or chemical is spilt, the largest spill would likely be less than 100 L but could possibly be up to 20 m^3 from a loss of the contents of the hydrotest mixture storage tank on the construction vessel.

Impacts to water quality would be expected, but due to the dispersive nature of the ocean environment and water depths, impacts to benthic habitats (including those of the KEF [Shelf break and slope of the Arafura Shelf]) are not predicted. Species associated with the continental slope and patch reefs that characterise this KEF (e.g. demersal fish, whale sharks, sharks and turtles) are unlikely to aggregate within the OA due to the lack of sea floor features. Potential impacts to these species are described in Section 7.4.2.2. Water quality changes are expected to be short-term and localised due to the selection of environmentally acceptable chemicals and the limited quality of an unplanned spill.

Habitat degradation, deteriorating water quality and marine pollution are identified as potential threats to several marine fauna species (that may be present in the OA) in relevant recovery plans and conservation advice (Table 3-10) and to MNES (DAWE, 2022b).

A small (less than 100 L) non-hydrocarbon liquid release is unlikely to have widespread ecological effects, given the nature of the chemicals on board, the limited volume that could be released, the OA water depth

and the transient nature of marine fauna in this area. Potential impacts to the physical environment (water quality) are considered to be II – Minor. A nitrogen gas release is unlikely to have significant ecological effects due to its non-hazardous nature and its abundance in both the ocean and atmosphere. The potential release would be of short duration, limited volume, and occur at a slow rate. Additionally, the transient nature of marine fauna in the area further reduces the potential impacts. Therefore, the potential impacts on the physical environment (water and air quality) and marine fauna are considered to be minor (II - Minor). Potential impacts to the physical environment (water and air quality) and marine fauna are considered to be II – Minor. Given the minor consequence on species, subsequent risks or significant impacts to cultural features (relating to species with cultural significance) are not anticipated.	
Likelihood	C – Possible
Santos has reviewed non-hydrocarbon liquid spills and leaks from equipment and machinery in recent history (due to split hoses, small leaks, or handling errors). Most of the spills and leaks reported occurred within bunded areas, were less than 100 L, did not reach the marine environment and were cleaned up immediately. The likelihood of a small (less than 100 L) non-hydrocarbon liquids release occurring with the control measures in place is considered to be C – Possible. A pipeline rupture incident caused by installation activities with the control measures in place is considered to be B – Unlikely.	
Residual Risk	The residual risk is considered Low.

7.4.5 Demonstration of as low as reasonably practicable

A thorough set of controls has been proposed to minimise the risks of minor hazardous liquid spills and leaks occurring and subsequent environmental consequences should they occur.

All reasonably practicable control measures were reviewed and those adopted are considered appropriate to manage the residual risk to a Low level. The proposed management controls are in accordance with Santos' risk management criteria and are considered appropriate to manage the risk to ALARP.

7.4.6 Acceptability evaluation

Is the risk ranked between Very Low and Medium?	Yes –residual risk is ranked Low.
Is further information required to validate the consequence assessment?	No – potential impacts and risks are well understood through the information available.
Are the risks and impacts consistent with the principles of ecologically sustainable development (ESD)?	Yes – activity evaluated in accordance with Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004), which considers principles of ESD.
Have the acceptable levels of impact and risks been informed by relevant species recovery plans, threat abatement plans and conservation advice and Australian marine park zoning objectives?	Yes – The following material published in relation to threatened and migratory species within the OA identifies pollution as a threat (Table 3-10): **Conservation Advice:**

	• Conservation Advice for *Balaenoptera physalus* (fin whale) (TSSC, 2015c) • Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle) (DEWHA, 2008b) • Approved Conservation Advice for *Calidris ferruginea* (Curlew Sandpiper) (TSSC, 2015e) • Approved Conservation Advice for *Numenius madagascariensis* (Eastern Curlew) (TSSC, 2015f) **Recovery Plans:** • Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) (DoE, 2014a) • Recovery Plan for Marine Turtles in Australia 2017–2027 (CoA, 2017b) • Wildlife Conservation Plan for Migratory Shorebirds (CoA, 2015c) • Wildlife Conservation Plan for Seabirds (COA, 2020) Recovery plans / conservation advice for other species that may occur in the OA do not identify pollution as a key threat or have explicit relevant objectives or management actions. The objectives of these publications were considered during impact and risk assessments. The activity is consistent with these objectives. The implementation of EPO-11 and the control measures outlined in Table 7-5 will ensure that an unplanned release of non-hydrocarbon chemicals will not impact any AMP. The controls outlined in Table 7-5 are also not inconsistent with the objectives of the material listed above. Santos considers the impacts of non-hydrocarbon chemical spill to be not inconsistent with these objectives.
Are performance outcomes, control measures and associated performance standards consistent with legal and regulatory requirements?	Yes – management measures are consistent with MARPOL Annex V, MARPOL Annex III and Marine Order 94 (Marine pollution prevention – packaged harmful substances). Through acceptance of this EP, legislative and regulatory requirements will be met as per Section 1.6.2.
Are performance outcomes, control measures and associated performance standards consistent with Santos' Environment, Health and Safety Policy?	Yes – aligns with Santos' Environment, Health and Safety Policy (Appendix A).
Are performance outcomes, control measures and associated performance standards consistent with industry standards?	Yes – the most recent and comparable EPs accepted by NOPSEMA were reviewed for consistency with the performance outcomes, control measures and associated performance standards proposed in this EP.
Have performance outcomes, control measures and associated performance standards taken into consideration Relevant Person feedback?	Yes – no objections or claims were raised regarding a potential unplanned non-hydrocarbon chemical release.
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – ALARP assessment conducted, with additional control measures adopted.

With the control measures in place to prevent the accidental release of minor volumes of non-hydrocarbon chemicals, and potential environmental and socioeconomic impacts and risk are well understood, it is considered a low residual risk and acceptable.

7.5 Hydrocarbon release – minor

7.5.1 Description of event

Event	Causes for accidental hydrocarbon releases (other than MDO release from a vessel collision or bunkering) include: • loss of containment of the THS due to the THS or Xmas tree being impacted by a dropped, dragged or uncontrolled object – maximum 6.8 m^3 MEG/gas mix • ROV failure (including oil seal, hydraulic system hose and quick disconnect system failures) – maximum 5 L hydraulic fluid (synthetic blend base oil) • loss of primary containment (drums, tanks) due to handling, storage and dropped objects (e.g. swinging load during lifting activities) – maximum 20 L • vessel pipework failure or rupture, hydraulic hose failure, inadequate bunding • dropped objects damaging MDO infrastructure (hoses, pipes, tanks, etc.). Hydrocarbons could include MEG/gas mix, fuel, hydraulic fluids, lubricant oils and waste oils. During installation activities, there is a risk of a loss of containment of the THS (greater than 200 m) due to the dropping, loss of control or dragging of the production manifold or manifold foundation onto the THS (if the Christmas tree is yet to be installed) or the Christmas tree (if installed). The likelihood of such incidents occurring is remote. Note the NOPSEMA-accepted Barossa Development Drilling and Completions EP (BAD-200 0003) covers the installation of the Christmas trees and THS as well as a comprehensive suite of physical barriers and procedural controls to ensure that a loss of well control scenario is not credible. The vessels' main engines and equipment such as pumps, cranes, winches, power packs and generators require MDO for fuel and various hydraulic fluids and lubricating oils for efficient operation and maintenance of moving parts. These products are present within the equipment and also held in storage containers and tanks on the vessels. Small hydrocarbon leaks could occur from loss of primary containment due to handling, storage and dropped objects (during lifting activities or in-board refuelling such as for equipment on deck). Volumes are likely to be small and limited to the volume of individual containers (less than 20 L) stored on vessel decks. Equipment deployed overboard during installation activities (e.g. ROV operations) can result in unplanned discharges (of hydraulic fluids) directly to the marine environment due to equipment failure, equipment interactions with the vessel thrusters and/or accidental contact with subsea infrastructure. The maximum credible hydrocarbon based hydraulic fluid spill from ROV operations would be approximately 5 L. Minor accidental loss of other hydrocarbon-based liquids (e.g. used lubricating oils, cooking oil and hydraulic oil) to the marine environment could also occur via tank pipework failure or rupture, hydraulic hose failure, inadequate bunding and/or storage, insufficient fastening or inadequate handling.
Extent	The relative low volumes of spilt hydrocarbons are expected to rapidly disperse into the marine environment. Below-harmful concentrations are expected to occur at short distances from the hydrocarbon release point. Potential impacts beyond the OA are not expected.
Duration	Potentially harmful concentrations are limited to a very short period (hours to days) immediately following release.

7.5.2 Nature and scale of environmental impacts

Potential receptors: physical environment (water quality); threatened, migratory or local fauna (marine mammals, marine reptiles, fish [including sharks and rays] and birds); socioeconomic; and cultural features.

Hydraulic fluids and lubricating fluids behave similarly to MDO when spilt in the marine environment (see Section 7.6 for information on MDO behaviour in the marine environment). Hydraulic fluids and the MEG / gas mixture have a light to moderate viscosity and have a relatively rapid spreading rate and, like MDO, will dissipate quickly, particularly in high sea states. Lubricating oils are more viscous and so their rate of spread from a spill would be slightly slower.

7.5.2.1 Physical environment

Minor volumes of hydrocarbons released to the marine environment would contaminate the water column near the vessels. The potential impacts would most likely be highly localised and restricted to the immediate area surrounding the spill, with rapid dispersal to concentrations below impact thresholds likely to occur in the open ocean.

Due to the small volumes, water depths greater than 200 m and expected rapid dispersal to concentrations below impact thresholds, detectable impacts to sediment quality or benthic habitats are not expected.

There is no emergent or intertidal habitat that could be impacted by a surface spill.

7.5.2.2 Threatened migratory or local fauna

The minor and short-term changes to water quality that may result are not predicted to impact marine fauna (e.g. pelagic fish and sharks, marine mammals, marine reptiles and seabirds), some of which may have cultural significance as totems of cultural food sources. No known BIAs overlap the OA and it is unlikely these types of spills will extend beyond the OA.

Small hydrocarbon spills are unlikely to have an ecological effect on threatened or migratory fauna, given the volumes that could be released, and the dispersive nature of the open-ocean environment. Physical coating of marine fauna or lethal/sublethal toxicity effects from any accidentally released hydrocarbons is considered unlikely, given the expected low volumes/concentrations and short exposure times.

7.5.2.3 Cultural features

No First Nations people feedback was provided about potential impacts from an unplanned minor hydrocarbon release to cultural features during this EP or Drilling EP consultations. Section 7.5.2.2 describes the potential impact to marine species of cultural significance.

7.5.3 Environmental performance outcomes and control measures

The EPO relating to this event is:

- Zero unplanned release of hydrocarbons (excluding MDO) to the marine environment [EPO-12].

An assessment of the environmental benefits and the potential costs or issues associated with control measures for this activity are described in Table 7-6 to demonstrate that potential risks are ALARP. Control measures that are adopted have associated EPSs and measurement criteria, and are presented in Table 8-2. Rejected control measures have an ALARP evaluation provided to justify their rejection.

Table 7-6: Control measures evaluation for hydrocarbon spill – minor

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
Standard control measures				
C7.1.2	Dropped objects recovered where safe and practicable to do so (administrative control)	Impacts to the environment are reduced by preventing dropped objects and by retrieving dropped objects unless the environmental consequences are negligible or there are risks to safety.	Cost of implementing procedures.	**Adopted**
C7.4.1	Chemical and hydrocarbon storage areas designed to contain leaks and spills (isolation control)	Reduces the risk of accidental discharge to sea by controlling the storage hydrocarbons.	Cost of implementing procedures.	**Adopted**
C7.4.2	Chemicals and hydrocarbons will be managed in accordance with standard maritime practices (administrative control)	Reduces the risk of accidental discharge to sea by controlling the storage, handling and clean-up of chemicals.	Cost of implementing procedures.	**Adopted**
C7.1.5	International Maritime Dangerous Goods Code (administrative control)	Reduces the risk of an environmental incident, such as an accidental release to sea.	Cost of implementing procedures. Regulatory requirement.	**Adopted**
C7.4.4	Vessel spill response plans (administrative control)	Implements onboard response plans to deal with unplanned hydrocarbon releases and spills quickly and efficiently to reduce impacts to the marine environment.	Administrative costs of preparing documents. Generally undertaken by vessel contractor so time for Santos personnel to confirm and check SOPEP/SMPEP in place.	**Adopted**
C7.4.5	Spill clean-up kits available in high-risk areas (protective control)	Reduces the risk of spills and leaks to sea by controlling the clean-up of chemicals and hydrocarbons.	Cost of implementing procedures.	**Adopted**
C7.5.1	ROV inspection and maintenance procedures (administrative control)	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**

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
C6.2.1	Vessel planned maintenance system (administrative control)	Ensures that the DP and DP redundancy is maintained to mitigate risk of vessel loss of position and hence prevent dragged or uncontrolled objects. Reduces leaks from the vessel equipment as it will be operating within its parameters.	Operational costs and labour or access requirements for undertaking maintenance.	**Adopted**
C6.1.1	Activity vessels equipped and crewed in accordance with Australian maritime requirements (administrative control)	Ensures contracted vessels are operated, maintained and crewed in accordance with industry standards and regulatory requirements.	Costs associated with personnel time in checking vessel.	**Adopted**
Additional control measures				
C6.1.7	HSE inductions will include environmental requirements (administrative control)	Ensures that crew are aware of the stringent EP, Santos and legislative requirements.	Administrative costs to update existing Santos procedure and induction materials and train personnel.	**Adopted**
N/A	Eliminate vessel to vessel lifting in field (elimination control)	Reduces the risk of dropped objects.	Eliminating lifting would require vessels storing more equipment and supplies on board, and/or additional trips to shore. Vessels will not have enough deck space to store all required equipment, materials, supplies needed for the duration of the activity.	**Rejected** – not feasible to eliminate lifting in the field.

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
C7.5.2	Production manifold and manifold foundation installation procedure (administrative control)	Ensures safeguards to reduce the risk of dropped, dragged or uncontrolled production manifold or manifold foundation onto the THS or Christmas tree including: • safe vessel lift, approach to land-out and deployment locations • allowable weather criteria and limitations.	Additional personnel costs of ensuring procedures in place and followed.	**Adopted**
C7.5.3	Suitability survey report for the construction vessel installing the production manifolds and production manifold foundations (administrative control)	Ensures that the condition and capability of the construction vessel has been assessed including associated equipment to safely install the production manifolds and manifold foundations.	Personnel costs associated with ensuring procedures are in place.	**Adopted**
C7.5.4	DP trials for the construction vessel installing the production manifold and production manifold foundation (administrative control)	DP trials (such as DP system trials, FMEA proving trials, annual DP trials or field entry DP trials) ensures the safe and accurate installation of the production manifold and production manifold foundation by mitigating the risk vessel position loss from DP system or equipment failure.	Additional costs for the implementation and regulatory requirement	**Adapted**
N/A	Use the critical activity mode of operation during the installation of the production manifolds and manifold foundations (engineering control)	Mitigates risk of vessel drive-off scenarios due to operator error reducing the potential impact to the THS and Christmas tree.	Additional costs for the implementation and regulatory requirement	**Adopted** - Note: incorporated into control measure (C7.5.4).
C7.5.5	DP operator competency and familiarisation for the construction vessel installing the production manifold and production manifold foundation	Mitigates risk of vessel a “drive-off” scenario, as a result of operator error preventing impact to the THS and Christmas tree.	Additional costs for the implementation and regulatory requirement	**Adopted**

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
	(administrative control)			
N/A	Eliminate ROV activities (elimination control)	Eliminates accidental hydrocarbon releases to the marine environment due to equipment failure.	ROVs contain minimal hydrocarbons (<5 L of hydraulic fluid) and as they are inspected and maintained, the risk of failure is very low. Using ROVs in the installation and pre-commissioning activities provides visual monitoring and support to reduce seabed disturbance, length of time in field, safety and environmental risks.	**Rejected** – not technically or environmentally feasible to eliminate ROV activities. Hydrocarbon releases due to ROV failure has a very low risk and is considered sufficiently managed under ROV inspection and maintenance procedures (refer to C7.5.3).
N/A	ROVs to use biodegradable hydraulic fluids only (substitution control)	Using a biodegradable hydraulic fluid reduces potential spill impacts as the oil is less persistent in the marine environment.	ROVs contain minimal hydrocarbons (<5 L of hydraulic fluid) that is likely to be a synthetic blend base oil (inherently biodegradable). ROVs are inspected and maintained, and the risk of failure is considered very low.	**Rejected** – based on the cost to replace or modify the ROVs. The synthetic blend base oil that may be released due to ROV failure has a very low risk and is considered sufficiently managed under ROV inspection and maintenance procedures (refer to C7.5.3).

7.5.4 Environmental impact assessment

Receptors	• Physical environment (water quality) • Threatened, migratory or local fauna (marine mammals, marine reptiles, fish [including sharks and rays] and birds) • Socioeconomic (commercial fishing) • Cultural features
Consequence	I – Negligible
If a minor hydrocarbon spill occurs, the quantities would be limited to 20 L. The small volumes, dilution and dispersion from natural weathering processes such as ocean currents and evaporation are such that spills will be limited in area and duration. The susceptibility of marine fauna to hydrocarbons depends on hydrocarbon type and exposure duration; however, given that exposures would be limited in extent and duration, exposure to marine fauna from this potential hazard is considered very low. The small volumes of worst-case discharges are such that the potential for impacts to receptors will decline rapidly with time and distance at the sea surface. Harmful effects are not expected to the benthic community due to the water depths. Near the sea surface, fish can detect and avoid contact with surface slicks and, as a result, fish mortalities rarely occur in open waters from surface spills (Kennish, 1997; Scholz et al., 1992). Therefore, pelagic fish species (e.g. tuna, sharks, mackerel) are generally not highly susceptible to impacts from hydrocarbon spills. In offshore waters near the release point, pelagic fish are at risk of exposure to the more toxic aromatic components of the hydrocarbons. However, pelagic fish in offshore waters are highly mobile; therefore it is unlikely they would be exposed to toxic components for long periods in this spill scenario. Components with higher toxicity would also rapidly evaporate and concentrations would significantly diminish with distance from the spill site, limiting the potential area of impact. Given the negligible consequence on the physical environment or species, subsequent impacts to socioeconomic receptors (including commercial fishing, tourism and recreation) and cultural features are not anticipated. A small hydrocarbon spill would not result in a decreased population size at a local or regional scale or long-term reduction to water and sediment quality, but may be detectable. Accordingly, it is expected that a spill of this nature would result in I – Negligible consequence.	
Likelihood	C – Possible
The likelihood of releasing minor volumes of hydrocarbons to the environment during routine operations is considered C – Possible.	
Residual Risk	The residual risk is considered Very Low.

7.5.5 Demonstration of as low as reasonably practicable

Storing and using hydraulic and lubricating oils/fluids for equipment and machinery, including for ROV operations, is required to undertake the Activity, so their removal from the Activity is not viable.

All reasonably practicable control measures were reviewed and those adopted are considered appropriate to manage the residual risk to a Very Low level. The proposed management controls are in accordance with Santos' risk management criteria and are considered appropriate to manage the risk to ALARP.

7.5.6 Acceptability evaluation

Is the risk ranked between Very Low and Medium?	Yes –residual risk is ranked as Very Low.
Is further information required to validate the consequence assessment?	No – potential impacts and risks are well understood through the information available.

Are the risks and impacts consistent with the principles of ecologically sustainable development (ESD)?	Yes – activity evaluated in accordance with Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004), which considers principles of ESD.
Have the acceptable levels of impact and risks been informed by relevant species recovery plans, threat abatement plans and conservation advice and Australian marine park zoning objectives?	Yes – The following material published in relation to threatened and migratory species within the OA identifies pollution as a threat (Table 3-10): **Conservation Advice:** • Conservation Advice for *Balaenoptera physalus* (fin whale) (TSSC, 2015c) • Approved Conservation Advice for *Calidris ferruginea* (Curlew Sandpiper) (TSSC, 2015e) • Approved Conservation Advice for *Numenius madagascariensis* (Eastern Curlew) (TSSC, 2015f) **Recovery Plans:** • Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) (DoE, 2014a) • Recovery Plan for Marine Turtles in Australia 2017–2027 (CoA, 2017b) • Wildlife Conservation Plan for Seabirds (COA, 2020). Recovery plans / conservation advice for other species that may occur in the OA do not identify pollution as a key threat or have explicit relevant objectives or management actions. AMP zoning principles and objectives for the Marine Bioregional Plan for the North Marine Region (CoA, 2012a) were also considered. The objectives of these publications were considered during impact and risk assessments. The activity is consistent with these objectives. The controls outlined in Table 7-6 are consistent with the objectives of the material listed above. Santos considers the impacts of minor hydrocarbon spills to be not inconsistent with these objectives.
Are performance outcomes, control measures and associated performance standards consistent with legal and regulatory requirements?	Yes – management measures are consistent with Marine Order 91 (Marine pollution prevention – oil). Through acceptance of this EP, legislative and regulatory requirements will be met as per Section 1.6.2.
Are performance outcomes, control measures and associated performance standards consistent with Santos' Environment, Health and Safety Policy?	Yes – aligns with Santos' Environment, Health and Safety Policy (Appendix A).
Are performance outcomes, control measures and associated performance standards consistent with industry standards?	Yes – the most recent and comparable EPs accepted by NOPSEMA were reviewed for consistency with the performance outcomes, control measures and associated performance standards proposed in this EP.
Have performance outcomes, control measures and associated performance standards taken into consideration Relevant Person feedback?	Yes – no objections or claims were raised regarding a potential minor hydrocarbon release for SURF. However, feedback received during the Drilling EP requests from Relevant Persons relating to managing spill response activities have been considered. This includes a commitment in the OPEP to notify specific Tiwi Island individuals in the event of a spill.

Are performance standards such that the impact or risk is considered to be ALARP?	Yes – ALARP assessment conducted, with additional control measures adopted.

No Relevant Person concerns have been raised regarding this aspect, and the proposed controls will reduce the residual level of risk to Low and ALARP. Therefore, the residual risk associated with the accidental release of minor volumes of hydrocarbons is considered by Santos to be environmentally acceptable.

7.6 Hydrocarbon release – refuelling and vessel collision

7.6.1 Description of event

Event	**Worst-case credible MDO release** A credible worst-case release scenario of MDO to the marine environment could be a collision between 2 activity vessels or an activity vessel and third party. Such a collision could rupture a fuel tank at the sea surface resulting in the release of MDO to sea. A vessel collision could occur due to factors such as human error, poor navigation, vessel equipment failure or poor weather. 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 unprotected fuel tank volume. A typical reel-lay vessel, such as *Seven Oceans*, has an external unprotected MDO fuel tank with a 504 m³ capacity, the largest spill scenario volume across the activity vessel fleet. **Refuelling incident** Also considered in this section is a much smaller volume refuelling incident (fuel hose failure or rupture, coupling failure or tank overfilling) where vessel or helicopter fuel bunkering would need to be stopped manually. Fuel released before pumping stops and fuel remaining in the transfer line may be released to the environment. Spill volumes were determined from transfer hose inventory and spill prevention measures including 'dry-break' or 'breakaway' couplings, rapid shutdown of fuel pumps and spill response preparedness, with 10 m^3 considered to be the maximum volume that could be released from the hose before shutdown.

Extent	Spill trajectory modelling calculated from amalgamating 300 spill simulations (RPS, 2023) predicted some probability of a 500 m^3 MDO release extending as follows:
	• moderate exposure thresholds:
	  ○ shoreline contact was not predicted to occur
	  ○ surface oil was predicted to occur within approximately 136 km of the release location
	  ○ entrained oil (1-hour time-step, high threshold) was predicted to occur within approximately 591 km of the release location
	  ○ dissolved hydrocarbons (1-hour time-step) were predicted within 116 km of the release location.
	• low exposure thresholds:
	  ○ probability of shoreline accumulation was forecast for Indonesia-East (0.99%) with a maximum volume of oil ashore was 8 m3
	  ○ probability of shoreline accumulation was forecast for Tiwi Islands (0.33%) with a maximum volume of oil ashore was 5 m3
	  ○ surface oil was predicted to occur within approximately 402 km of the release location
	  ○ entrained oil (1-hour time-step, high threshold) was predicted to occur within approximately 1,071 km of the release location
	  ○ dissolved hydrocarbons (1-hour time-step) were predicted within 322 km of the release location.
	• The modelling does not take into consideration any of the spill prevention, mitigation and response capabilities that would be implemented in response to the spill.

Duration	A 500 m^3 release of MDO was modelled for a release over 1 hour, replicating the potential duration of a release arising from a significant collision. MDO is expected to weather quickly through evaporation and dispersion and is unlikely to persist in the environment.

7.6.2 Nature and scale of environmental impacts

Potential receptors: physical environment (water quality, shoals and banks, benthic habitats), threatened or migratory fauna (marine mammals, marine reptiles, fish [including sharks and rays]

and birds), protected areas (AMP and KEFs), socioeconomic receptors (fisheries, tourism, recreation and other third-party operators), cultural features (including a sacred site and sea country).

A hydrocarbon release will cause a decline in water quality and may cause chemical (e.g. toxicity) and physical (e.g. coating of emergent habitats, oiling of wildlife at sea surface) impacts to marine species. The severity of the impact of a hydrocarbon release depends on the magnitude of the release (i.e. extent, duration) and sensitivity of the receptor. The nature and scale of a hydrocarbon release is described throughout this section for a vessel collision scenario, given smaller hydrocarbon releases (from refuelling) will impact a smaller area than a vessel collision.

7.6.2.1 Stochastic spill dispersion modelling

The MDO spill modelling assessed the fate of the released hydrocarbons and their potential impact upon the environment. The subsections below summarise the findings of the modelling.

Modelled MDO

MDO is a group II light-persistent fuel used in the maritime industry (ITOPF, 2022). The classification is based on the MDP specific gravity in combination with relevant boiling point ranges. It has a low viscosity (4 cP), which indicates that this hydrocarbon will spread quickly when spilt at sea. MDO will have a thin to low thickness level on the sea surface, which increases the rate of evaporation. Table 7-7 lists the MDO characteristics used in the modelling.

Table 7-7: Characteristics of MDO

Density at 25°C (kg/m³)	API gravity	Viscosity at 25°C (cP)	Component boiling point (°C) % of total			
			Volatile (%) <180	Semi-volatile (%) 180–265	Low volatility (%) 265–380	Residual (%) >380
829	37.6	4.0	6	35	54	5

Source: RPS, 2023

Hydrocarbon Fate and Weathering

MDO is characterised by a high percentage of volatile components (95%), which will evaporate when on the sea surface over several days, depending upon the prevailing conditions. It also contains 5% persistent hydrocarbons, which will not evaporate, though will decay over time (Table 7-7). The heavier components of MDO tend to become entrained into the upper water column as oil droplets in the presence of breaking waves and moderate winds (i.e. >12 knots) but can refloat to the surface if these energies abate. Entrained MDO is largely concentrated in surface waters (0–10 m deep). The results of the weathering analyses are presented in Figure 7-1 and Figure 7-2.

The mass balance forecast for the calm-wind speed case (Figure 7-1) predicts that 36.1% of the MDO will evaporate within 24 hours. The majority of the remaining MDO on the sea surface will weather at a slower rate due to being comprised of the longer-chain compounds with higher boiling points. Evaporation of the residual compounds will slow significantly, and then subject to biological and photochemical degradation (RPS, 2023).

Under the variable-wind speeds case (Figure 7-2), where the winds are of greater strength on average, MDO entrainment is predicted to increase. Approximately 24 hours after the modelled spill, ~80% of the MDO is forecast to have entrained and a further 15% is forecast to have evaporated, leaving only a small proportion on the water surface (<1%). The residual compounds will tend to remain entrained beneath the surface under conditions that generate wind waves (approximately >6 m/s).

International Tanker Owners Pollution Federation (2011) categorise MDO as a light ‘group II’ hydrocarbon. In the marine environment, a 5% residual of the total quantity of MDO spilt will remain

after the volatilisation and solubilisation processes associated with weathering. In the marine environment, MDO is expected to behave as follows:

- MDO will spread rapidly in the direction of the prevailing wind and waves.
- Evaporation will be the dominant process contributing to the fate of spilled MDO from the sea surface and will account for 60 to 80% reduction of the net hydrocarbon balance.
- The evaporation rate of MDO will increase in warmer air and sea temperatures.
- MDO 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.

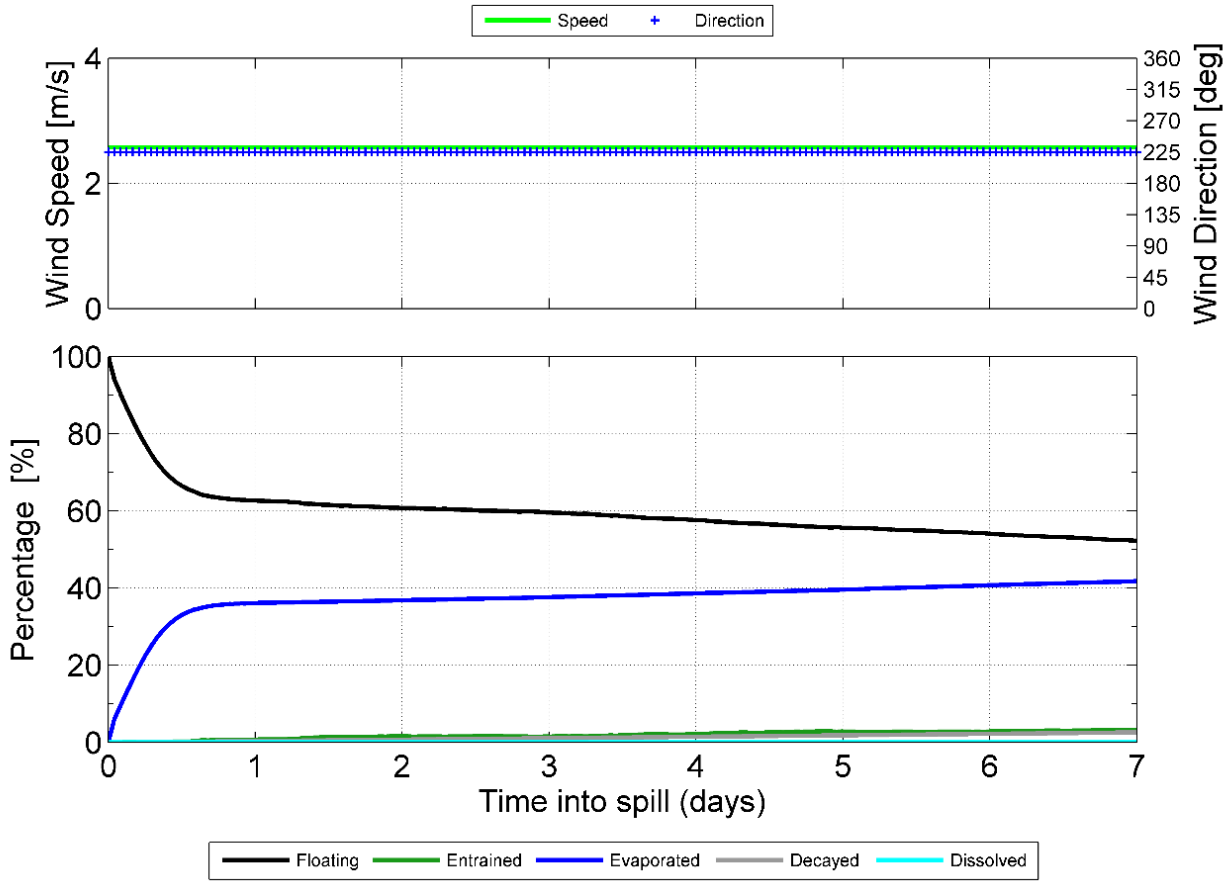


Figure 7-1: Proportional mass balance plot representing the MDO weathering subject to constant wind speeds at 27°C water temperature (RPS, 2023)

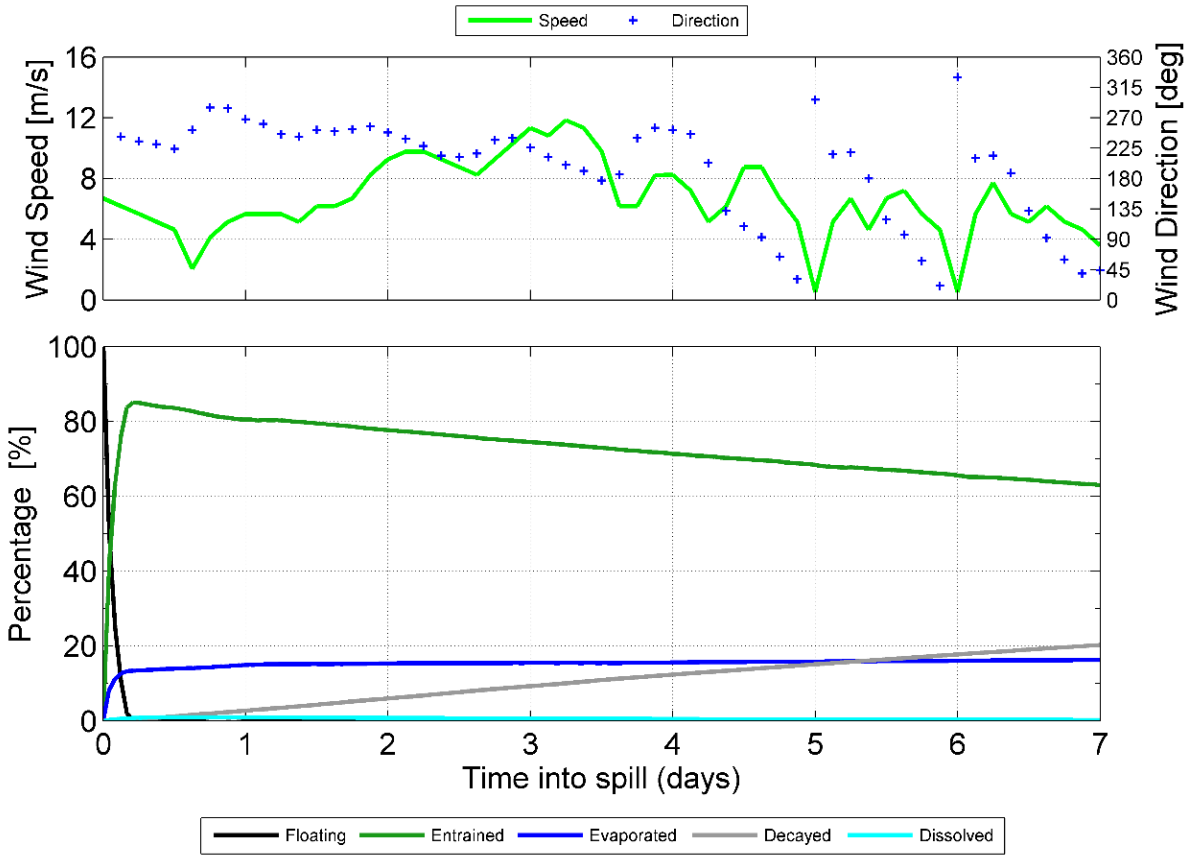


Figure 7-2: Proportional mass balance plot representing the MDO weathering subject to variable wind speeds at 27°C water temperature (RPS, 2023)

Modelling methods

The modelling was done in several stages. Firstly, the tidal currents for the region were generated using the RPS ocean/coastal model, HYDROMAP. Secondly, large-scale ocean currents were obtained from a large-scale ocean model for the same region and combined with tidal currents. The hybrid ocean/coastal model was used to describe the total water movement within the region. Finally, the 2010–2019 current and local wind data were used as inputs in the oil spill model (SIMAP) to simulate the drift, spread, weathering and fate of the spilt hydrocarbon. The model considered the fates described above in Hydrocarbon Fate and Weathering.

Exposure probabilities were determined using a stochastic modelling approach, which aggregates the behaviour of multiple random spill simulations for each of the 3 representative seasons (wet, dry and a transitional period). Each simulated spill starts at a different time of day to ensure that the predicted transport and weathering of each spill trajectory was subjected to varying wind and current conditions. A total of 100 model runs were conducted for each season, with the total stochastic dataset comprising 300 model runs for the release location.

The model results were combined to determine the annualised potential exposure to the surrounding waters, shorelines and sensitive receptors based on the thresholds outlined in the NOPSEMA Oil Spill Modelling Bulletin (NOPSEMA, 2019). This output does not represent the potential behaviour of a single spill (which would have a much smaller area of effect); instead, it indicates the probability of any given area of the sea being contacted by hydrocarbons at a particular concentration (see Table 7-9). Table 7-8 summarises the model settings and assumptions.

Table 7-8: Summary of model settings and assumptions for the vessel collision scenario

Parameter	Scenario
Scenario description	Vessel collision at the Barossa FPSO location
Number of spill simulations with randomly selected spill start times	300 total (100 per season)
Oil type	MDO
Spill volume*	500 m³
Release duration	1 hour
Simulation length	30 days

**A typical reel-lay vessel, such as* Seven Oceans, *has an external unprotected MDO fuel tank with a 504 m³ capacity, the largest spill scenario volume across the proposed activity vessel fleet.*

Hydrocarbon exposure thresholds

To inform the environmental 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 provided in Table 3-1.

To identify appropriate exposure values Santos has followed the advice provided by NOPSEMA in *Bulletin #1 Oil Spill Modelling* (2019) and scientific literature. The selected hydrocarbon exposure values are discussed in Table 7-9 to 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 [BAS-210 0109]).

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 inform the environmental assessment, exposure values that may be representative of biological impact have also been identified for the worst-case spill scenario. These are called moderate exposure values (defined by the moderate exposure value areas, MEVA) and illustrated in Figure 3-1. The spatial extent of the high exposure values are contained within the MEVA boundary. Moderate and high exposure values are modelled for each fate of hydrocarbon to identify what contact is predicted for surface (floating hydrocarbons), subsurface (entrained hydrocarbons and dissolved aromatic hydrocarbons), and shoreline accumulation of hydrocarbon at sensitivities.

The low exposure values (Table 3-1) are used as a predictive tool to set the outer boundaries of the EMBA from the worst-case spill scenario shown in Figure 3-1. This results in a highly conservative and comprehensive basis to plan and prepare for spill response, particularly scientific monitoring. 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 may be apparent. The low exposure values for surface and shoreline accumulation (Table 7-10) are used as a predictive tool to approximate a range of potential socioeconomic effects (visual amenity may be affected) and the predicted maximum spatial extent is illustrated in Figure 7-3.

Table 7-9: Moderate exposure value areas (MEVA) thresholds

Exposure zone	Threshold	Justification
Surface hydrocarbons		
Moderate exposure (10–25 g/m²)	10 g/m²	Ecological impact has been estimated to occur at 10 g/m² (a film thickness of approximately 10 µm or 0.01 mm) as this level of oiling has been observed to mortally impact birds and other wildlife associated with the water surface (French *et al*., 1996; French-McCay, 2009). This approximates the lower limit for harmful exposures to birds and marine mammals. Contact within this exposure zone may result in impacts to the marine environment and therefore was used to define the MEVA.
Entrained hydrocarbon		
High exposure (100–500 ppb)	100 ppb/over 1 hour	The 100 ppb threshold is considered conservative in terms of potential for toxicity effects leading to mortality for sensitive mature individuals and early life stages of species. This threshold indicates a potential zone of acute exposure, which is more meaningful over shorter exposure durations. The 100 ppb threshold contact within this exposure zone may result in impacts to the marine environment. The high exposure for entrained hydrocarbons was used to define the MEVA.
Dissolved aromatic hydrocarbon		
Moderate exposure (50–100 ppb)	50 ppb/over 1 hour	A conservative threshold of 50 ppb was chosen as it was more likely to indicate potentially harmful exposure to fixed habitats over short exposure durations (French-McCay, 2002). Contact within this exposure zone may result in impacts to the marine environment. This level may have potential toxic effects, particularly sublethal effects to sensitive species.
Shoreline accumulation		
Moderate accumulation (100–1,000 g/m²)	100 g/m²	Accumulated hydrocarbons above 100 g/m² may coat an animal in the intertidal range and likely impact its survival and reproductive ability (affected animals include invertebrates, marine mammals, marine reptiles and shorebirds). This threshold is the minimum thickness that can be cleaned up that does not inhibit the potential for recovery. The 100 g/m² threshold was selected to define the moderate accumulation zone and threshold for adverse shoreline accumulation. Accumulation on shorelines above this threshold may result in impacts to the marine environment.

Table 7-10: Socioeconomic exposure thresholds

Exposure zone	Threshold	Justification
Surface hydrocarbons		
Low exposure	1 g/m²	It is recognised that a lower surface 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 threshold for ecological impacts, it may be relevant to socioeconomic receptors and has been used as the exposure value to define the spatial extent of the environment that might be contacted from surface hydrocarbons.

Exposure zone	Threshold	Justification
Shoreline accumulation		
Low accumulation (10–100 g/m²)	10 g/m²	An accumulated concentration of oil above 10 g/m^2 on shorelines is considered to represent a level of socioeconomic effect (NOPSEMA, 2019). This equates to 10 mL (or 2 teaspoons) of oil per m^2. This may result in a 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).

Modelling results

The regional currents are dominated by tidal and wind-driven currents, which vary according to the season. These will influence the direction that the hydrocarbons (entrained and surface) travel in a particular season.

Modelling results predict that surface hydrocarbons may extend up to 136 km west-north-west during wet season conditions above moderate exposure value (10 g/m^2). The maximum extent at the low exposure threshold (1 g/m^2) from the release location was up to 402 km west.

No shoreline accumulation was predicted at the moderate (100 g/m^2) exposure value. The highest probability of shoreline oil accumulation above moderate exposure value (10 g/m^2) was forecast for Indonesia-East (0.99%) with a maximum of 8 m^3 oil ashore with a quickest time of approximately 11.8 days.

Modelling results predict that entrained hydrocarbons will move in all directions and during winter months the hydrocarbons will travel in an east–west direction. Entrained hydrocarbons above high exposure value (100 ppb, 1 hour) extend up to 591 km west from the release location in winter due to the strong Indonesian Throughflow ocean current. Dissolved aromatics at the moderate exposure value (50 ppb, 1 hour) were predicted to extend up to 116 km west in winter.

7.6.2.2 Deterministic spill dispersion modelling

The stochastic simulation output provides a probabilistic temporal and spatial representation of a spill incident. Individual stochastic realisations were selected to run in deterministic mode. The deterministic simulations were selected by identifying the stochastic realisations from each scenario that resulted in:

- Maximum volume of MDO ashore at or above 10 g/m^2 for Indonesia – East receptor modelled:
  - no dissolved hydrocarbons exceeding 10 ppb was predicted
  - a spill simulation commencing during transitional conditions (run 76) resulted in the maximum volume of oil ashore of 8 m^3 with a predicted length of shoreline contact of 16 km
  - maximum concentration of entrained hydrocarbons during this spill was 35 ppb also at the Indonesia – East receptor
- Maximum volume of MDO ashore at or above 10 g/m^2 for Tiwi Islands receptor modelled:
  - no dissolved hydrocarbons exceeding 10 ppb was predicted
  - a spill simulation commencing during transitional conditions (run 34) resulted in the maximum volume of oil ashore of 5 m^3 for the Tiwi Island receptor
  - greatest volume of oil ashore (at or above 10 g/m² threshold) was forecast for the Tiwi Islands receptor at 5 m^3 with a predicted length of shoreline contact of 13 km

- maximum concentration of entrained hydrocarbons during this spill was 19 ppb for the Outer Oceanic Shoals AMP receptor.

7.6.2.3 Potential hydrocarbon impact pathways and nature and scale of impact

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 surface hydrocarbons, accumulated shoreline hydrocarbons, or entrained hydrocarbon droplets. Table 7-11 summarises the chemical pathways (e.g. ingestion, inhalation or contact) from any hydrocarbon phase and used to inform the risk assessment.

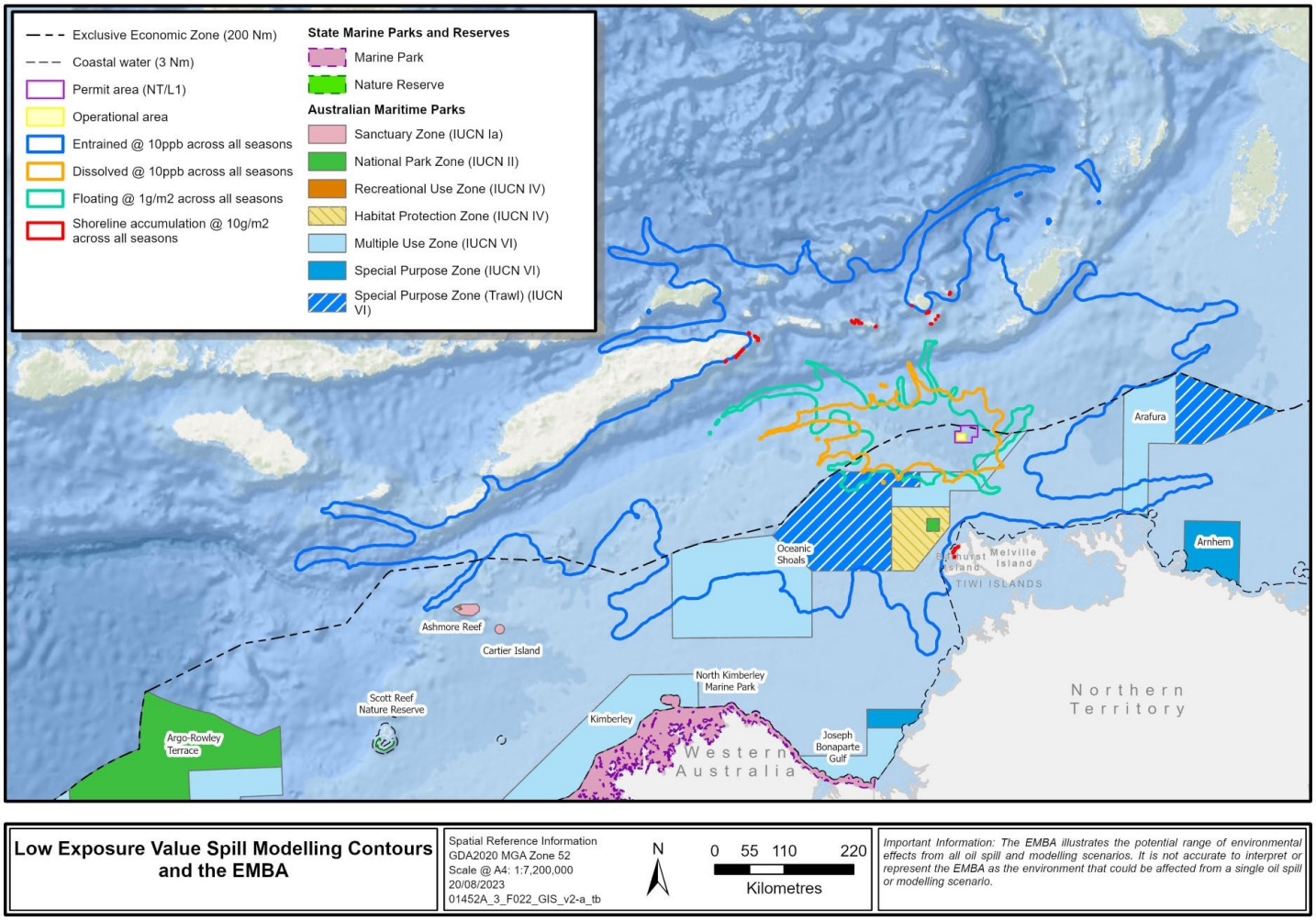


Figure 7-3: Low exposure threshold spill modelling contours and sensitive receptors, derived from all 300 spill simulations

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

Receptor	Physical pathway	Potential impacts	Chemical pathway	Potential impacts
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 hydrocarbons.	Bleaching or blackening of leaves. Defoliation. Reduced growth.	External contact by hydrocarbons and adsorption across cellular membranes.	Mortality. Bleaching or blackening of leaves. Defoliation. Disease. Reduced growth. Reduced reproductive output. Reduced seed/propagule viability.
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 hydrocarbons.	Bleaching. Increased mucous production. Reduced growth.	External contact by hydrocarbons 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.

Receptor	Physical pathway	Potential impacts	Chemical pathway	Potential impacts
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 hydrocarbons.	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.
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.

Receptor	Physical pathway	Potential impacts	Chemical pathway	Potential impacts
Birds (seabirds and shorebirds)	Contact with the surface hydrocarbons resulting in coating. Degree of coating is dependent upon the energy and tidal reach of the shoreline, the type of the receptor and continual weathering of the hydrocarbons.	Feather and skin irritation and damage, with the potential to cause secondary impacts such as: physical restriction of flight and swimming movement mortality hypothermia/impairing the waterproofing of feathers disruption to feeding/ starvation disruption to breeding disruption to migration.	Ingestion (during feeding or preening). External contact and adsorption across exposed skin and membranes. Inhalation.	Mortality. Cell damage, lesions. Secondary infections. Reduced metabolic capacity. Reduced immune response. Disease. Reduced growth. Reduced reproductive output. Growth abnormalities. Behavioural disruption.
Marine reptiles	Contact with the surface hydrocarbons resulting in coating. Degree of coating is dependent upon the energy and tidal reach of the shoreline, the type of the receptor and continual weathering of the hydrocarbons.	Irritation of eyes/mouth and potential illness, which may cause secondary impacts such as: mortality disruption to feeding/ starvation physical restriction behavioural disruption.	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.

Receptor	Physical pathway	Potential impacts	Chemical pathway	Potential impacts
Marine mammals	Coating of feeding apparatus in some species (baleen whales) from exposure to surface hydrocarbons. Potential to coat the sensory hairs around the mouths of dugongs which can impact feeding.	Irritation of eyes/mouth, damage to fur and potential illness, which may cause secondary impacts such as: mortality disruption to feeding/ starvation physical restriction behavioural disruption.	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.
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.

Receptor	Physical pathway	Potential impacts	Chemical pathway	Potential impacts
Protected areas	Coating of benthic 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.
Socioeconomic environment (commercial, subsistence and recreational fisheries, recreation & tourism, shipping, defence, shipwrecks, energy industry, cultural features)	Presence of hydrocarbon residue in the water, which may filter down to sediments or continue to biodegrade on the surface. There was no shoreline (surface) hydrocarbons accumulation predicted for any receptors in any season at any exposure value and therefore accumulated shoreline hydrocarbons and potential impact pathways are not discussed further.	Degradation of cultural or maritime heritage sites. Disruption to tourism, recreation, shipping, defence or energy industry activities. Displacement of commercial or recreational fishing; reduction in natural resources.	Impacts to water quality, sediment quality, flora and fauna, as discussed in rows above.	Mortality, injury or behavioural disruption to marine fauna relevant to commercial, subsistence and recreational fisheries or to tourism. Loss or degradation 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.

Receptor	Physical pathway	Potential impacts	Chemical pathway	Potential impacts
Cultural features	Presence of hydrocarbon residue in the water, which may filter down to sediments or continue to biodegrade on the surface. There was no surface shoreline hydrocarbons accumulation predicted for any receptors in any season at any exposure value and therefore accumulated shoreline hydrocarbons and potential impact pathways are not discussed further.	Hydrocarbons may be present in areas with cultural features. Displacement of traditional uses of environment; reduction in natural resources with cultural significance.	Impacts to water quality, sediment quality, flora and fauna, as discussed in rows above	Mortality, injury or behavioural disruption to marine fauna that has cultural significance. Loss or degradation of habitats of cultural value. Reduction in the quality of the marine environment, including environment with cultural significance.

7.6.3 Environmental performance outcomes and control measures

The EPOs relating to this event include:

- No MDO release to the marine environment [EPO-13]
- No significant impacts to cultural features from the Activity [EPO-14].

An assessment of the environmental benefits and the potential costs or issues associated with control measures for this activity are described in Table 7-12 to demonstrate that potential risks are ALARP. Control measures that are adopted have associated EPSs and measurement criteria, and are presented in Table 8-2. Rejected control measures have an ALARP evaluation provided to justify their rejection.

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 (BAS-210 0109). The OPEP contains an evaluation of oil spill preparedness arrangements to demonstrate that oil spills will be mitigated to ALARP.

Table 7-12: Control measures evaluation for hydrocarbon release – refuelling and vessel collision

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
Standard control measures				
C6.1.2	Undertake consultation with Relevant Persons (including applicable notifications) (administrative control)	Ensures other marine users are aware of the presence of the vessels and the relatively slow speed and restricted manoeuvrability. Alerts other marine users to the presence of activity vessels and 500 m exclusion zone around the installation vessels, thus reducing the likelihood of vessel collision and fishing gear snagging.	Limited additional costs to Santos. Stakeholders' time required to review consultation material and communicate with Santos.	**Adopted**
C6.1.5	Vessel speed restrictions (substitution control)	Reduces consequence of vessel-to-vessel collision impacts.	Administrative costs to update existing Santos procedure and induction materials and train personnel.	**Adopted**

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
C7.4.4	Vessel spill response plans (administrative control)	Implements onboard response plans to deal with unplanned hydrocarbon releases quickly and efficiently to reduce impacts to the marine environment.	Administrative costs of preparing documents. Generally undertaken by vessel contractor so time for Santos personnel to confirm and check SOPEP/ SMPEP in place.	**Adopted**
C6.2.1	Vessel planned maintenance system (administrative control)	Reduces risk of vessel collision and refuelling incidents because equipment is operating within planned maintenance requirements.	Operational costs and labour or access requirements of undertaking maintenance.	**Adopted**
C7.6.1	Accepted OPEP (administrative control)	Implements response plans to deal with an unplanned hydrocarbon release quickly and efficiently to reduce impacts to the marine environment.	Personnel and administrative costs associated with preparing documents, ongoing management (spill response exercises) and implementation of OPEP.	**Adopted**
C7.6.2	Vessel-specific bunkering procedures and equipment consistent with Santos marine vessel vetting requirements (administrative control)	Minimises risk of pollution to ALARP during refuelling.	Personnel costs associated with ensuring procedures are in place and implemented during refuelling.	**Adopted**
C7.6.3	No IFO or HFO will be used in activity vessels (elimination control)	Using MDO rather than a 'heavier' fuel type reduces potential spill impacts as MDO is less persistent in the marine environment.	Additional personnel costs of ensuring vessels are using the required fuel.	**Adopted**
C7.6.4	Helicopter refuelling procedure	Minimises risk of pollution to ALARP during hydrocarbon	Personnel costs associated with ensuring procedures are in	**Adopted**

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
	(administrative control)	transfers to helicopters.	place and implemented during fuel transfers.	
C6.1.1	Activity vessels equipped and crewed in accordance with Australian maritime requirements (administrative control)	Ensures contracted vessels are operated, maintained and crewed in accordance with industry standards and regulatory requirements. Ensures vessels meet Marine Assurance Standards to reduce the likelihood of vessel collision (such as minimum and working lighting for maritime safety).	Costs associated with personnel time in checking vessel.	**Adopted**
Additional control measures				
C6.2.6	Cultural Heritage (administrative control)	Shows respect for beliefs and culture of First Nations people.	Time and cost to work with First Nations communities.	**Adopted**
N/A	No fuel bunkering via hose (elimination control)	Removes spill risk from hose operations.	Cost associated with transfer of MDO via drums or containers. Not possible to modify vessel to allow additional fuel storage.	**Rejected** – Eliminating bunkering via hoses introduces new risks related to dropped objects and vessel transfers. The bunkering method is consistent with industry and maritime practices.
N/A	Require all support vessels involved in the activity to be double hulled (engineering control)	Reduces the likelihood of a loss of hydrocarbon inventory minimising potential environmental impact.	Vessels are subject to availability and must meet Santos' standards during activities; requirement of a double hull on vessels would limit the number available to Santos; also, high cost to require	**Rejected** – large costs associated with vessel selection and by having an activity schedule determined by vessel availability considered to be grossly disproportionate compared to low risk of a vessel

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
			vessels to be refitted with double hulls.	collision and low risk of a large MDO release.
N/A	Manage the timing of the activity to avoid sensitive biological periods (e.g. fish spawning, whale foraging) (administrative control)	Reduces potential environmental consequences by avoiding sensitive biological periods for conservation significant marine fauna in the MEVA.	The Activity will take approximately 9 months. High cost to suspend activities and demobilise/ remobilise the vessels. Impracticable to avoid all sensitive biological periods in the MEVA due to the variability between species (e.g. spawning fish species) and extended length.	**Rejected** – high cost is grossly disproportionate to the environmental benefits given negligible likelihood of a vessel collision and the nature and scale of potential impacts within the MEVA.
C7.6.5	Reduce the fuel capacity on activity vessels to reduce the risk of an MDO spill resulting in shoreline accumulation on the Tiwi Islands (elimination control)	Reduce the risk of consequences to nominated sacred site on the Tiwi Islands coastline.	Small reductions to vessel fuel capacities can be managed without significant cost, operational reliability, safety or other issues.	**Accepted –** Spill modelling has been completed that demonstrates the small reduction in the spatial extent of the EMBA. Hence, EMBA scenario no longer results in a prediction of Tiwi shoreline accumulation. This small reduction does not compromise the safety or operational liability of the activity vessels.

7.6.4 Environmental impact assessment

Receptors	• Physical environment and habitats – water quality, KEFs • Threatened, migratory or local fauna – plankton, invertebrates, marine mammals, marine reptiles, fish (including sharks and rays) and seabirds • Protected areas – marine parks • Socioeconomic – commercial, recreational and traditional fisheries; recreation and tourism and energy industry • Cultural features
Consequence	III – Moderate

The consequence assessment for each receptor category is summarised below.

Water quality

It is likely that water quality will be reduced at the location of the release due to hydrocarbon contamination, however, such impacts would be temporary and highly localised due to the rapid weathering of the released MDO in a remote deep-water location. Stochastic modelling results predict that entrained oil concentrations exceeding 100 ppb (at or above moderate threshold levels) may occur up to approximately 591 km from the release location.

Benthic communities and habitats

Benthic communities, such as macrofauna and infauna (e.g. filter feeders, brittle stars, crustaceans, polychaetes and molluscs) and benthic primary producers (e.g. macroalgae, seagrass and corals) are vulnerable to hydrocarbons (surface and entrained). However, as entrained hydrocarbons above threshold levels are only predicted to remain in the top 10 m of the water column, there are no shallow shoals/banks (i.e. rising to shallower than 10 m), intertidal primary producers (e.g. mangroves, seagrasses or corals) or tidal mudflats within the MEVA that can reasonably be impacted.

Marine fauna

Plankton

Plankton communities may be impacted by a hydrocarbon release, particularly entrained fractions. Toxic effects from exposure to entrained hydrocarbons may cause impacts such as blocked filter feeding organs and impacts resulting from ingesting hydrocarbons. Modelling of the credible release scenario predicts that entrained hydrocarbons above impact thresholds are expected to be highly localised around the release location. Given the high productivity of planktonic communities and the nature and scale of the credible release, these impacts are expected to be temporary and highly localised to the release location.

Pelagic and demersal fish communities (including sharks and rays)

Fish mortalities are rarely observed to occur as a result of hydrocarbon releases (ITOPF, 2011). This has generally been attributed to the possibility that pelagic fish can detect and avoid surface waters underneath hydrocarbon releases by swimming into deeper water or away from the affected areas. Fish that have been exposed to dissolved aromatic hydrocarbons are capable of eliminating the toxicants once in clean water, thus individuals exposed to a release are likely to recover (King et al., 1996). Where fish mortalities have been recorded, the releases (resulting from the groundings of the *Amoco Cadiz* [1978] and *Florida* [1969] tankers, which were significantly bigger than the worst-case credible release scenario considered in this EP) occurred in sheltered bays, which limited the ability of fish to access clean water and eliminate toxicants. Given the nature and scale of the credible release scenario and the open-ocean environment of the credible release location, impacts to pelagic and demersal fish are expected to be highly localised and temporary.

Marine mammals

Cetaceans are highly mobile and are known to transit through the region. The pygmy blue whale BIA may be contacted by hydrocarbons at or above moderate exposure values for surface and entrained hydrocarbons and therefore impacts to their migratory and distribution behaviours could be expected. Potential impacts are likely to be limited to individuals that may be transiting through the area with potential for coating of baleen (in whales) and ingestion of oiled prey (plankton/fish). Studies and field observations suggest that cetaceans may be able to detect and avoid hydrocarbon slicks (Geraci and St Aubin, 1988). Cetaceans are vulnerable to the effects of surface hydrocarbons because they must surface to breathe. Direct contact with surface slicks and inhalation of vapours may irritate eyes, airways and

lungs. Lethal or sublethal effects will depend on the concentration of the hydrocarbons and the length of exposure. Pygmy blue, Omura's and Bryde's whales have been detected in the broader Barossa area (JASCO, 2016).

Because spilt MDO is expected to disperse and weather rapidly, the potential for impacts to cetaceans will be concentrated around the release location and limited to individuals. No population-level impacts are expected.

Marine reptiles

There are two BIAs for the flatback and olive ridley turtles and habitats critical to the survival of the flatback turtle that have been identified to intersect the outer extent of the MEVA, and there is no shoreline contact. Turtles may occur in the MEVA but their presence is limited to individuals transiting in deeper water given the rapid dispersion of MDO. Because adult marine turtles exhibit no avoidance behaviour when they encounter hydrocarbon spills (NOAA, 2010), contact with surface slicks or entrained hydrocarbon can result in hydrocarbon adhering to body surfaces (Gagnon and Rawson, 2010) causing irritation of mucous membranes in the nose, throat and eyes and leading to inflammation and infection (NOAA, 2010). Oiling can also irritate and injure skin, which is most evident on vulnerable areas such as the neck and flippers (Lutcavage et al., 1995). Given the non-persistent nature of the hydrocarbons and the expected rapid weathering of surface hydrocarbons in the tropical environment, the timeframe during which turtles may be exposed to hydrocarbons above impact thresholds is of a short duration. The spatial extent of the MEVA and the wide distribution of turtle species in the region indicates that population-scale impacts are considered unlikely.

Sea snakes may be vulnerable to hydrocarbon spills due to their need to surface to breathe and may spend time at the sea surface to bask in the sun, however little information is available to describe the effects of hydrocarbon spills on sea snakes. The threatened sea snake—short-nosed and other sea snake species may occur in the limited shallow (up to 10 m deep) banks and shoals within the MEVA. Therefore, only low numbers are expected to be at risk of impact (DSEWPaC, 2011a).

Seabirds and migratory shorebirds

Seabirds and migratory shorebirds are particularly vulnerable to contact with surface hydrocarbons. Physical contact of seabirds with surface slicks is by several exposure pathways, primarily immersion, ingestion and inhalation. Contact with hydrocarbons may result in plumage fouling and hypothermia (loss of thermoregulation) (Hassan and Javed, 2011), decreased buoyancy and potential to drown, inability to fly or feed, anaemia, pneumonia, and irritation of eyes, skin, nasal cavities and mouths (AMSA, 2015; ITOPF, 2011) and result in mortality due to oiling of feathers or hydrocarbon ingestion. Longer-term exposure effects that may potentially impact seabird populations include a loss of reproductive success (loss of breeding adults) and malformation of eggs or chicks (AMSA, 2015).

A hydrocarbon spill may result in surface slicks above impact thresholds in foraging habitat for seabirds. Typically, seabird distributions are concentrated around islands—hydrocarbons in and near nesting/roosting areas may result in increased numbers of seabirds being impacted. No nesting/roosting areas occur within the MEVA.

The MEVA does not intersect any bird BIA. The closest crested tern BIA is located around Seagull Island, which is near the Tiwi Islands (approximately 140 km south of the OA). Given the nature and scale of the credible hydrocarbon release, the potential for impacts to birds is expected to be temporary (hours to days) and restricted to the area covered by sea surface hydrocarbons above impact thresholds.

Australian Marine Parks

The MEVA overlaps the Oceanic Shoals AMP. As outlined above, a hydrocarbon spill has the potential to impact water quality and a range of biological receptors. Modelling predicted that surface hydrocarbons at low exposure thresholds (1 g/m^3) were recorded in the outer regions of the Oceanic Shoals AMP at a very low probability (1.33%). These environmental values are contained within the Oceanic Shoals AMP in Commonwealth waters and the visual amenity impacts that may result in a visible sheen in the outer boundary of the Oceanic Shoals AMP. Impacts to the environmental values of the AMP are anticipated to be temporary and localised due to the rapid evaporation rates of the volatile components of MDO and its rapid natural degradation and dispersion in the open ocean.

KEFs

The open waters above the seabed of several KEFs that overlap the MEVA may be contacted by hydrocarbons. Impacts to these seabed KEFs are considered to be minimal given their location on the

seabed and the surface nature of the releases in which the concentration of the entrained hydrocarbons is highest in the upper water column (RPS, 2019). **Socioeconomic (fisheries, tourism, recreation and other third-party operators).** Shipping and other incidental marine traffic in the area is expected to be very low based on AMSA's vessel traffic data (AMSA, 2022) and the established shipping fairways designed to keep shipping traffic away from offshore infrastructure to reduce the risk of collision (AMSA, 2013). There is the potential for hydrocarbons to temporarily disrupt fishing activities (traditional, subsistence, recreational and commercial) 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. Given the volume of MDO that could potentially be released, it is unlikely 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. A hydrocarbon release may also temporarily displace traditional, commercial and recreational fishers from within sections of the MEVA. This displacement would be localised and short-term (days). A hydrocarbon release may result in tainting of commercially fished species resulting in commercial fishers being unable to sell their catch, which may result in a loss of income. Spilt hydrocarbons may also contaminate fishing gear, which may require cleaning. A MDO spill could also disrupt other energy industry operations in the region (e.g. support vessels transiting to/from Darwin), military exercises and commercial shipping. Potential consequences are considered to be Minor (II) for these socioeconomic receptors. On the basis of the above assessment, an MDO release has the potential to impact an array of environmental and socioeconomic receptors, with the highest consequence considered to be II – Minor. **Cultural features** While there was no predicted shoreline oil accumulation above moderate exposure thresholds in the event of an unplanned MDO release, there is a very low probability (0.33%) that shoreline oil accumulation may occur at the Tiwi Islands at low thresholds, including recorded and registered sacred sites. The forecasted greatest volume of oil ashore the Tiwi Islands was 5 m^3 with a predicted length of 13 km. Hence, this volume is not expected to have a visual amenity impact along the shoreline. Given, the very low probability, low accumulation volumes and duration of accumulation predicted, the impact to cultural features on Bathurst Island is expected to be negligible. However, with the additional CM (C7.6.5) and EPS (EPS7.6.5.1) in place, no shoreline contact is predicted. Potential impacts to cultural features from a hydrocarbon spill may include decline in traditional food sources or mortality of fauna with cultural significance.	
Likelihood	B – Unlikely
A worst-case MDO release resulting from a vessel collision is unlikely to have widespread ecological effects given the nature of the hydrocarbons on board, the finite volumes that could be released, the water depth and the transient nature of marine fauna in this area. Long-term impacts resulting in complete habitat loss or degradation are not considered likely given the control measures proposed to prevent releases; therefore, the Activity will be conducted in a manner that is considered acceptable. The likelihood of an MDO release occurring due to refuelling is limited given the set of mitigation and management controls in place. Consequently, the likelihood of a vessel collision releasing hydrocarbons to the environment, is considered to be unlikely.	
Residual Risk	The residual risk is considered Low.

7.6.5 Demonstration of as low as reasonably practicable

Using vessels is integral to the Activity and therefore the associated risk of unplanned hydrocarbon releases cannot be completely eliminated.

All reasonably practicable control measures were reviewed and those adopted are considered appropriate to manage the residual risk to a Low level. The proposed management controls are in accordance with Santos' risk management criteria and are considered appropriate to manage the risk to ALARP.

In terms of spill response activities, Santos will implement oil spill response as specified within the OPEP (BAS-210 0109). The OPEP includes a detailed ALARP assessment on the adequacy of arrangements available to support spill response strategies and control measures.

7.6.6 Acceptability evaluation

Is the risk ranked between Very Low and Medium?	Yes –residual risk is ranked as Low.
Is further information required to validate the consequence assessment?	No – potential impacts and risks are well understood through the information available.
Are the risks and impacts consistent with the principles of ecologically sustainable development (ESD)?	Yes – activity evaluated in accordance with Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004), which considers principles of ESD.
Have the acceptable levels of impact and risks been informed by relevant species recovery plans, threat abatement plans and conservation advice and Australian marine park zoning objectives?	Yes – The following material published in relation to threatened and migratory species within the EMBA identifies habitat degradation / modification, pollution or oil spills as a threat (Table 3-10): **Conservation Advice:** • Approved Conservation Advice for Green Sawfish (DEWHA, 2008a) • Approved Conservation Advice for Pristis (Largetooth Sawfish) (TSSC, 2014b) • Approved Conservation Advice for Glyphis garricki (northern river shark) (TSSC, 2014a) • Approved Conservation Advice for Glyphis (speartooth shark) (DoE, 2014) • Conservation Advice for Rhincodon typus (whale shark) (TSSC, 2015g) • Conservation Advice for Balaenoptera physalus (fin whale) (TSSC, 2015c) • Conservation Advice for Balaenoptera borealis (sei whale) (TSSC, 2015b) • Approved Conservation Advice for Dermochelys coriacea (Leatherback Turtle) (DEWHA, 2008b) • Approved Conservation Advice on Aipysurus apraefrontalis (Short-nosed seasnake) (DSEWPaC, 2011a) • Approved Conservation Advice for Calidris ferruginea (Curlew Sandpiper) (TSSC, 2015e) • Approved Conservation Advice for Numenius madagascariensis (Eastern Curlew) (TSSC, 2015f) • Approved Conservation Advice for Calidris canutus (Red knot) (TSSC, 2016b) **Recovery Plans:**

	• Sawfish and River Sharks Multispecies Recovery Plan (CoA, 2015b) • Recovery Plan for the Grey Nurse Shark (Carcharias taurus) (DoE, 2014a) • Recovery Plan for the White Shark (Carcharodon carcharias) (DSEWPaC, 2013) • Conservation Management Plan for the Blue Whale 2015–2025 (CoA, 2015a) • Recovery Plan for Marine Turtles in Australia 2017–2027 (CoA, 2017b) • Wildlife Conservation Plan for Migratory Shorebirds (CoA, 2015c) • Wildlife Conservation Plan for Seabirds (COA, 2020). Recovery plans / conservation advice for other species that may occur in the MEVA do not identify pollution or habitat degradation / modification as a key threat or have explicit relevant objectives or management actions. AMP zoning principles and objectives were also considered: • Marine Bioregional Plan for the North Marine Region (CoA, 2012a). The objectives of these publications were considered during impact and risk assessments. The activity is not inconsistent with these objectives. The controls outlined in Table 7-12 are consistent with the objectives of the material listed above. Santos considers the impacts of hydrocarbon release from vessel collision to be not inconsistent with these objectives.
Are performance outcomes, control measures and associated performance standards consistent with legal and regulatory requirements?	Yes – management measures are consistent with Commonwealth Acts and Marine Orders: *Marine Safety (Domestic Commercial Vessel) National Law Act 2012* (Cth) and *Navigation Act 2012* (Cth), Marine Order 30: Prevention of Collisions and Marine Order 21: Safety of Navigation and Emergency Procedures. Through acceptance of this EP, legislative and regulatory requirements will be met as per Section 1.6.2.
Are performance outcomes, control measures and associated performance standards consistent with Santos' Environment, Health and Safety Policy?	Yes – aligns with Santos' Environment, Health and Safety Policy (Appendix A).
Are performance outcomes, control measures and associated performance standards consistent with industry standards?	Yes – the most recent and comparable EPs accepted by NOPSEMA were reviewed for consistency with the performance outcomes, control measures and associated performance standards proposed in this EP.
Have performance outcomes, control measures and associated performance standards taken into consideration Relevant Person feedback?	Yes – Relevant Person feedback resulted an additional CM (C7.6.5) and EPS (EPS7.6.5.1) (refer to Table 8-2). C7.6.5 provides a control to reduce the fuel capacity on activity vessels to mitigate the very low probability (0.33%) risk of an MDO spill resulting in shoreline accumulation on the Tiwi Islands. In addition, feedback received during the Drilling EP has been considered. This feedback resulted in an additional CM (C6.2.6) and EPSs (EPS6.2.6.1) (refer to Table 8-2) which has been adopted and a commitment in the OPEP to notify specific Tiwi Island individuals in the event of a spill.

Are performance standards such that the impact or risk is considered to be ALARP?	Yes – ALARP assessment conducted, with additional control measures adopted.

The potential impacts and risks from vessel collision resulting in hydrocarbon (MDO) releases are well understood, and the activities will be managed in accordance with relevant legislation and standards. With the implementation of industry standards, Relevant Persons initiated and activity-specific control measures to reduce the likelihood of a vessel collision (and minimise impacts), the residual risk is assessed to be low and ALARP. Relevant Person concerns have been addressed regarding this hazard. Therefore, it is considered that the proposed control measures will reduce the risk of impact from an MDO release to a level that is acceptable.

7.7 Contingency spill response operations

The spill response strategies that may be adopted in the event of a hydrocarbon spill from this activity have been identified in the Barossa Subsea Infrastructure Installation Oil Pollution Emergency Plan (BAS-210 0109). An environmental assessment of these spill response strategies was conducted, as detailed below.

An environmental assessment of the hydrocarbon spill scenarios considered for this activity and relevant to spill response operations is provided in Section 7.6.

7.7.1 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 using NEBA. Spill response will be under the direction of the relevant control agency, as defined in the OPEP (BAS-210 0109), which may be Santos, 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 and applicable response planning thresholds considered to be appropriate for the worst-case spill scenarios identified for the activity are detailed in the OPEP (BAS-210 0109) and comprise: • source control • monitor and evaluate • mechanical dispersion • oiled wildlife response • scientific monitoring • waste management. Response strategies are intended to reduce the environmental consequences of a hydrocarbon spill, but poorly planned and coordinated response activities can result in a lack of, or inadequate, information being available, upon which poor decisions can be made, exacerbating or causing further environmental harm. An inadequate level of training and guidance when implementing spill response strategies can also result in environmental harm beyond that caused by the spill.
Extent	Extent of spill. Spill response could occur anywhere within the EMBA for the worst-case spill scenarios, as per response planning thresholds (Refer to Section 6.2 of the OPEP [BAS-210 0109]).
Duration	The total duration of the spill response effort will exceed the duration of the worst-case spill—persistence of the oil in the environment and the requirement to remove this oil and/or monitor impacts and recovery to sensitive receptors adds to the time. The OPEP (BAS-210 0109) further details the likely duration of specific response strategies.

7.7.2 Nature and scale of environmental impacts

Noise emissions	
Spill response operations will involve aircraft and vessels, which will generate noise both offshore and in nearshore locations within the EMBA.	
Potential receptors	• Threatened, migratory or local fauna • Protected areas • Socioeconomic receptors
Underwater noise from vessels may impact marine fauna, such as fish (including commercial species), marine reptiles and marine mammals. Section 6.3 details potential noise emission impacts from vessels and helicopters.	

Cetaceans have been identified as the key concern for vessel noise, with the pygmy blue whale distribution and migration BIA intersecting the EMBA.

Vessels may also need to enter marine parks and other areas used for tourism, commercial and recreational fishing, and traditional purposes.

Light emissions

Spill response operations will involve vessels which are required, at a minimum, to display navigational lighting. Vessels may operate near shoreline areas during spill response operations.

Spill response activities may also involve onshore operations including vehicle use and temporary camps, both of which may require lighting.

Potential receptors	• Threatened, migratory or local fauna • Protected areas • Socioeconomic receptors

Lighting may cause behavioural changes to fish, mammals, birds and marine turtles that can have a heightened consequence during key life cycle activities, such as turtle nesting and hatching. Turtles and birds, which includes threatened and migratory fauna (Table 3-8), have been identified as key fauna susceptible to lighting impacts. Section 6.4 further details the nature and scale of light emission impacts.

Spill response activities that require lighting may occur anywhere within the MEVA, including in protected areas and close to shoals.

Atmospheric emissions

Using fuels to power vessel engines, generators and mobile equipment during spill response operations will result in emissions of GHGs, such as CO_2, CH_4 and N_2O, along with non-GHGs such as sulfur oxides (SO_x) and nitrogen oxides (NO_x). Emissions will result in a localised decrease in air quality.

Potential receptors	• Threatened, migratory or local fauna • Physical environment or habitat (air quality) • Socioeconomic receptors

Atmospheric emissions from spill response equipment will be localised, and using 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; however, the scale of the impact relative to potential oil spill impacts is considered negligible.

Operational discharges and waste

Operational discharges include routine discharges from vessels used during spill response, such as:

- deck drainage
- putrescible waste and sewage
- cooling water from operating engines
- bilge water
- ballast water
- brine discharge.

Other specific spill response discharges and waste creation may occur, including:

- cleaning of oily equipment, vessels and vehicles
- sewage and putrescible and municipal waste at offshore staging sites
- creation, storage, transport and disposal of oily waste and contaminated organics.

Potential receptors	• Threatened, migratory or local fauna • Physical environment or habitat • Protected areas • Socioeconomic receptors

Operational discharges from vessels may create a localised and temporary reduction in marine water quality. Effects include nutrient enrichment, toxicity, turbidity, and temperature and salinity increases, as

detailed in Section 6.6. Discharge could potentially occur adjacent to marine communities, such as corals, seagrass and macroalgae, and in protected areas (i.e. receptors anywhere within the EMBA), which support a more diverse faunal community; however, discharges are still expected to be localised and temporary.

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

Sewage and putrescible and non-putrescible waste will be generated from offshore activities at temporary staging/mooring areas, which may include toilet and washing facilities. These wastes have the potential to impact water quality, impact habitats, and reduce the aesthetic value of the environment, which may be within protected areas.

Physical presence and disturbance

Moving and operating vessels during spill response operations has the potential to disturb the physical environment and marine habitats and fauna (e.g. vessel strike, behavioural changes), which may occur within protected areas. Disturbance may also impact socioeconomic values of an area. Vessel movement 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 also involve deliberately disturbing (hazing), capturing, handling, cleaning, rehabilitating, transporting and releasing wildlife, which could lead to additional impacts to wildlife.

Potential receptors	• Threatened, migratory and local fauna • Physical environment or habitat • Protected areas • Socioeconomic receptors

Vessel use may disturb benthic communities, including corals, seagrass and macroalgae. Impacts to habitats and communities from vessels include damage through deploying anchors and mooring lines, and from grounding. Vessel use in shallow coastal waters also increases the chance of contact with, or physical disturbance of, marine fauna such as turtles and dugongs. Booms create a physical barrier on the water surface that has the potential to injure or entangle passing surface-breathing or -feeding marine fauna.

Oiled wildlife response may include hazing, capturing, handling, cleaning, rehabilitating, transporting, cleaning and releasing wildlife susceptible to oiling, such as birds and marine turtles. Although oiled wildlife response is aimed at having a net benefit, poor responses can potentially create additional stress and exacerbate impacts from oiling, interfere with life cycle processes, hamper recovery and, in the worst instance, increase levels of mortality.

Impacts from IMS are described in Section 7.2 and are not described further in this section.

Disturbance to marine habitat, and the potential for disrupting culturally sensitive areas, may occur in protected areas (e.g. AMPs).

Disruption to other users of marine and coastal areas and townships

Spill response operations may involve using vessels and equipment in areas used by the general public or industry in Australia and potentially Indonesia. Mobilising spill response personnel into forward operating bases may also place increased demands on local accommodation and other businesses.

Potential receptors	• Socioeconomic receptors • Cultural features

Using vessels in the offshore environment and undertaking spill response operations may exclude the general public, cultural uses (e.g. access to cultural food resources and capability to care for sea country), commercial industries (e.g. fishing, tourism, energy), or come within proximity to known sacred sites (for example on Tiwi Islands). As well as limiting access, this may impact revenue with respect to commercial offshore businesses. Mobilising personnel to regional 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.

7.7.3 Environmental performance outcomes and control measures

An assessment of the environmental benefits and the potential costs or issues associated with control measures relevant to response vessels and helicopters for this Activity are described in Table 7-13 to demonstrate that the potential impacts from this aspect are ALARP. Additional control measures that are more specific to spill response are presented in the OPEP (BAS-210 0109).

Control measures that are adopted have associated EPSs and measurement criteria, which are presented in the relevant strategy sections of the OPEP (BAS-210 0109).

Table 7-13: Control measures evaluation for spill response operations

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
C6.3.1	Avoid activities near cetaceans and turtles (isolation control)	see Table 7-4	see Table 7-4	**Adopted** – see Table 7-4
C6.7.1	Apply the Offshore Division Operations Chemical Selection Procedure (EA-91-II-10001) for chemicals planned to be discharged (administrative control)	see Table 6-17	see Table 6-17	**Adopted** – see Table 6-17
C6.1.1	Activity vessels equipped and crewed in accordance with Australian maritime requirements) (administrative control)	see Table 6-14	see Table 6-14	**Adopted** – see Table 6-14
C6.5.1	Atmospheric (GHG and non-GHG) emissions from combustion managed in accordance with standard maritime practice (administrative control)	see Table 6-16	see Table 6-16	**Adopted** – see Table 6-16
C6.6.2	Routine discharges of treated sewage and grey water, in accordance with the *Navigation Act 2012* (Cth), *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth) and Marine Order 96 (Marine Pollution Prevention – Sewage) (administrative control)	see Table 6-17	see Table 6-17	**Adopted** – see Table 6-17

CM reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
C6.6.1	Routine discharges of treated bilge and deck water will comply with the *Navigation Act 2012* (Cth), *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth) and Marine Order 91 (administrative control)	see Table 6-17	see Table 6-17	**Adopted** – see Table 6-17
C6.1.2	Santos stakeholder consultation (after an accidental spill event) (administrative control)	Promotes awareness and reduces potential impacts from response to socioeconomic activities.	Minimal cost in relation to overall effort/costs in managing incident.	**Adopted** – considered a standard control for incident management.

7.7.4 Environmental impact assessment

Receptor	Consequence level
Spill response operations – noise emissions	
• Threatened, migratory or local fauna • Protected areas • Socioeconomic receptors	The receptors considered most sensitive to vessel noise are marine turtles, whale sharks and pygmy blue whales. However, by adopting control measures to limit close interaction with protected fauna (i.e. Protected Marine Fauna Interaction and Sighting Procedure [EA-91-II-00003]), only temporary behavioural disturbance is expected, with a consequence of I – Negligible.
Consequence	I – Negligible
Likelihood	C – Possible
Residual Risk	Very Low
Spill response operations – light emissions	
• Threatened, migratory or local fauna • Protected areas • Socioeconomic receptors	The receptors considered most sensitive to lighting from vessel operations are seabirds, shorebirds and marine turtles. Because there are restrictions on night-time operations by spill response vessels, which will demobilise to mooring areas offshore with safety lighting only, impacts from vessels are considered to be I – Negligible.
Consequence	I – Negligible
Likelihood	C – Possible
Residual Risk	Very Low
Spill response operations – atmospheric emissions	
• Threatened, migratory or local fauna • Physical environment or habitat • Socioeconomic receptors	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 localised and low level of emissions, impacts to protected area values, physical environment and socioeconomic receptors are predicted to be I – Negligible.
Consequence	I – Negligible

Receptor	Consequence level
Likelihood	C – Possible
Residual Risk	Very Low
Spill response operations – operational discharges and waste	
• Threatened, migratory or local fauna • Protected areas • Physical environment • Socioeconomic receptors	Activity discharges from vessels may create a localised and temporary reduction in marine water quality, which has the potential to impact shallow marine habitats in particular. However, by adopting regulatory requirements for vessel discharges, which prevent discharges close to shorelines, discharges will have a negligible impact to habitats, fauna or protected area values. Washing vessels and equipment will take place only in defined offshore hot zones thus preventing impacts to shallow habitats. Sewage, putrescible waste and municipal waste generated onshore will be stored and disposed of at approved locations. Storing, transporting and disposing of hydrocarbon-contaminated waste arising from spill response operation actions will be managed by Santos' appointed waste management contractor, and dedicated waste containment areas will prevent hydrocarbon contamination spreading or leaching. Operational discharges from spill response operations are expected to be II – Minor.
Consequence	II – Minor
Likelihood	C – Possible
Residual Risk	Low
Spill response operations – physical presence and disturbance	

Receptor	Consequence level
• Threatened, migratory or local fauna • Physical environment or habitat • Protected areas • Socioeconomic receptors	Using vessels has the potential to disturb benthic habitats, including sensitive shoal habitats such as corals and macroalgae. A review of shallow water habitats, and of bathymetry, and establishing demarcated areas for access and anchoring will reduce the level of impact to I – Negligible. These habitats or environments are likely to be values of the protected area they occur in, and therefore the impact to the protected areas from physical disturbance is also considered II – Minor. The main direct disturbance to fauna would be hazing, capturing, handling, transporting, cleaning and releasing the 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 following compliance with Santos' Wildlife Framework Plan (SO-91-BI-20014) and the NT Oil Spill Contingency Plan (DOTMS, 2014). This impact is considered II – Minor
Consequence	II – Minor
Likelihood	C – Possible
Residual Risk	Low
Spill response operations – disruption to other users of marine and coastal areas and townships	
• Socioeconomic receptors	Using vessels in the offshore environment and for spill response activities may exclude the general public, cultural uses (e.g. access to cultural food resources and capability to care for sea country) and commercial industries (e.g. fishing, tourism), or come within proximity to known sacred sites (for example on Tiwi Islands). It should be noted that vessel based response activities will be limited to areas where oil is present at high thresholds, and response activities outside of this area would include less obtrusive measures such as monitoring and surveillance and scientific monitoring. Note: This is distinct from the socioeconomic impact of a spill itself. With control measures applied, it is considered that the additional impact of spill response activities on affected industries would be II – Minor.
Consequence	II – Minor
Likelihood	C – Possible
Residual Risk	Low

The spill response activities could be within an area that may overlap with cultural features. These cultural features (refer to Section 3.2.5) will be considered through the NEBA process described in the OPEP (BAS-210 0109).

7.7.5 Demonstration of as low as reasonably practicable

A NEBA is the primary tool used during spill response to evaluate response strategies—the goal is to select 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. Effectively, the NEBA will determine whether an environmental benefit will be achieved by implementing a response strategy or by undertaking no response. The NEBA will be undertaken by the relevant controlling agency for the activity. For those activities under the control of Santos, the Incident Management Team (IMT) Environmental Team Leader will be responsible for reviewing the priority receptors and selected response strategies identified in this EP and coordinating the NEBA for each operational period. This will demonstrate that, at the strategy level, the response operations reduce additional environmental impacts to ALARP.

Spill response activities will be conducted in offshore waters using vessels and aircraft. The greatest potential for additional impacts from implementing spill response is considered to be on wildlife in offshore waters resulting from oiled wildlife response activities.

Santos, together with the controlling agency for spill response, will apply appropriate processes and standards to ensure spill response impacts are reduced to a level that is ALARP.

All reasonably practicable control measures were reviewed and those adopted are considered appropriate to manage the impacts such that the residual risk is assessed to be Low. The proposed control measures are in accordance with Santos' risk management criteria and are considered appropriate to reduce impacts to ALARP.

7.7.6 Acceptability evaluation

Is the risk ranked between Very Low and Medium?	Yes – the highest ranking residual risk is Low.
Is further information required to validate the consequence assessment?	No – potential impacts and risks are well understood through the information available.
Are the risks and impacts consistent with the principles of ecologically sustainable development (ESD)?	Yes – activity evaluated in accordance with Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004), which considers principles of ESD.
Have the acceptable levels of impact and risks been informed by relevant species recovery plans, threat abatement plans and conservation advice and Australian marine park zoning objectives?	Yes – The following material published in relation to threatened and migratory species within the EMBA identifies habitat degradation / modification, pollution or oil spills as a threat (Table 3-10): **Conservation Advice:**

	• Approved Conservation Advice for Green Sawfish (DEWHA, 2008a) • Approved Conservation Advice for *Pristis clavata* (Dwarf Sawfish) (DEWHA, 2009) • Approved Conservation Advice for *Pristis pristis* (Largetooth Sawfish) (TSSC, 2014b) • Approved Conservation Advice for *Glyphis garricki* (northern river shark) (TSSC, 2014a) • Approved Conservation Advice for *Glyphis glyphis* (speartooth shark) (DoE, 2014) • Conservation Advice for *Rhincodon typus* (whale shark) (TSSC, 2015g) • Conservation Advice for *Balaenoptera physalus* (fin whale) (TSSC, 2015c) • Conservation Advice for *Balaenoptera borealis* (sei whale) (TSSC, 2015b) • Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle) (DEWHA, 2008b) • Approved Conservation Advice on *Aipysurus apraefrontalis* (Short-nosed seasnake) (DSEWPaC, 2011a) • Conservation Advice for the Abbott's booby *Papasula abbotti* (TSSC, 2020a) • Conservation Advice *Anous tenuirostris melanops* Australian lesser noddy (TSSC, 2015a) • Approved Conservation Advice for *Calidris ferruginea* (Curlew Sandpiper) (TSSC, 2015e) • Approved Conservation Advice for *Numenius madagascariensis* (Eastern Curlew) (TSSC, 2015f) • Approved Conservation Advice for *Calidris canutus* (Red knot) (TSSC, 2016b). **Recovery Plans:** • Sawfish and River Sharks Multispecies Recovery Plan (CoA, 2015b) • Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) (DoE, 2014a) • Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013) • Conservation Management Plan for the Blue Whale 2015–2025 (CoA, 2015a) • Recovery Plan for Marine Turtles in Australia 2017–2027 (CoA, 2017b) • Wildlife Conservation Plan for Migratory Shorebirds (CoA, 2015c) • Wildlife Conservation Plan for Seabirds (COA, 2020). Recovery plans / conservation advice for other species that may occur in the EMBA do not identify pollution or habitat degradation / modification as a key threat or have explicit relevant objectives or management actions. AMP zoning principles and objectives were also considered: • Marine Bioregional Plan for the North Marine Region (CoA, 2012a) • Marine Bioregional Plan for the North-West Marine Region (CoA, 2012b) • conservation values of the identified protection priorities (Section 3.2.2.1) have been considered, including the Arafura AMP and Oceanic Shoals AMP.

	Management is consistent with the zoning of the AMPs, in that risks have been reduced to ALARP, e.g. implementing spill response activities will limit impacts, thus conserving the marine park values (described in Section 3.2.2.1 and Table 3-7). The objectives of these publications were considered during impact and risk assessments. The activity is consistent with these objectives. The controls outlined in Table 7-13 are consistent with the objectives of the material listed above. Santos considers the activity is consistent with these objectives.
Are performance outcomes, control measures and associated performance standards consistent with legal and regulatory requirements?	Yes – spill response management is consistent with the National Plan for Maritime Environmental Emergencies (AMSA, 2020), and other legislation identified in Sections 6 and 7. Through acceptance of this EP, legislative and regulatory requirements will be met as per Section 1.6.2.
Are performance outcomes, control measures and associated performance standards consistent with Santos' Environment, Health and Safety Policy?	Yes – aligns with Santos' Environment, Health and Safety Policy (Appendix A).
Are performance outcomes, control measures and associated performance standards consistent with industry standards?	Yes – the most recent and comparable EPs accepted by NOPSEMA were reviewed for consistency with the performance outcomes, control measures and associated performance standards proposed in this EP.
Have performance outcomes, control measures and associated performance standards taken into consideration Relevant Person feedback?	Yes – Relevant Person feedback indicated no recommendations for revising the EPOs, CMs or EPSs. During any spill response, a close working relationship with relevant regulatory bodies (e.g. AMSA, NT Department of Environment, Parks and Water Security [DEPWS], NT Department of Transport Marine Safety [DOTMS]) will occur; thus, there will be ongoing, coordinated consultation with Relevant Persons on the acceptability of response operations. Relevant Persons listed in Table 4-12, whose functions, interests or activities are considered at risk due to the event, will be included in the list of Relevant Persons who will be notified under Santos' incident management process during the response operations. Wildlife response will be conducted in accordance with Santos' Wildlife Framework Plan (SO-91-BI-20014), the NT Oil Spill Contingency Plan (DOTMS, 2014), and any future NT oiled wildlife response plans developed. Subject to the availability and the participation of the Tiwi Islands Ranger Groups, Santos undertakes to train the Tiwi Islands Ranger Groups prior to the Activity and provide additional on the job training post-spill to additional personnel (if required).
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – ALARP assessment conducted, with additional control measures adopted.

The implementation of spill 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, 2020). No concerns from Relevant Persons have been raised regarding response activities and the controls proposed reduce the consequences of the potential impacts to minor and ALARP. The controls used

during spill response activities are considered to reduce additional impacts and risks to an acceptable level.

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 arrangements that will be implemented in the event of an oil pollution emergency are detailed within the OPEP (BAS-210 0109). Otherwise, this section 8 sets out the implementation strategy for this EP.

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 as low as reasonably practicable; and b. control measures detailed in the environment plan are effective in reducing the environmental impacts and risks of the activity to as low as reasonably practicable and an acceptable level; and c. environmental performance outcomes and standards set out in the environment plan are being met.

The Santos Management System exists to support Santos' values and legal obligations to undertake work in a manner that is safe and sustainable. The management system is a framework of policies, standards, processes, procedures, tools and control measures that are designed to ensure:

- compliance with legal obligations (including compliance with an approved EP)
- a common approach is followed across the organisation
- proactive management
- mandatory requirements are implemented and are auditable
- management performance is measured and corrective actions are taken
- opportunities for improvement are recognised and implemented
- workforce commitments are understood and demonstrated.

The implementation strategy for this EP is designed, among other things, so that:

- environmental impacts and risks of the Activity continue to be identified for the duration of the Activity and reduced to a level that is ALARP and an acceptable level
- control measures detailed in this EP are effective in reducing environmental impacts and risks to ALARP and an acceptable level
- environmental performance outcomes and standards set out in this EP are being met
- consultation with Relevant Persons, government authorities and relevant interested persons continues as appropriate for the duration of the Activity.

8.1.1 Environment, health and safety policy

Santos' Environment, Health and Safety (EHS) Policy (Appendix A) clearly sets out Santos' strategic environmental objectives and the commitment of the management team to continuously improve our management systems and reduce the risk of harm to people and the environment. This EP has been prepared in accordance with the fundamentals of this policy. All Santos employees are required to complete an EHS Induction on commencing with Santos that includes information on their EHS obligations.

8.1.2 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 (see Sections 6 and 7) in accordance with Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004). The control measures and EPSs that will be implemented to manage the identified risks and impacts, and the EPOs that will be achieved, are detailed in Section 8.2.

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 the sections on Document Management (Section 8.9) and Audits and Inspections (Section 8.10).

Any new or proposed amendment to a control measure, EPS or EPO will be managed in accordance with the Environment Management of Change (MoC) Procedure (EA-91-IQ-10001) (Section 8.9.2). This Procedure also applies to new information about the impacts or risks of the Activity received during the post acceptance consultation implementation process.

Oil spill response control measures and EPSs and EPOs are listed in the OPEP (BAS-210 0109).

8.2 Environmental performance outcomes

To ensure environmental risks and impacts will be of an acceptable level, EPOs have been defined and are listed in Table 8-1. These outcomes will be achieved by implementing the identified control measures to the relevant EPSs, noting some control measures are applicable to multiple EPOs.

Table 8-1: Environmental performance outcomes

Reference	Environmental performance outcomes
EPO-01	No significant[28] impacts to other marine users
EPO-02	Seabed disturbance limited to planned activities and defined locations within the OA
EPO-03	No significant[28] impacts to marine fauna from noise emissions
EPO-04	No significant[28] impacts to marine fauna from lighting emissions
EPO-05	Reduce impacts to air quality (GHG and non-GHG emissions) from combustion engines and incinerators by maintaining atmospheric emissions in accordance with standard maritime practices.
EPO-06	Reduce impacts to water quality from activity vessel discharges by maintaining discharge streams in accordance with standard maritime practices.
EPO-07	No impacts to the marine environment from subsea infrastructure installation discharges resulting in a consequence severity greater than Minor.
EPO-08	No loss of equipment/cargo overboard from vessels resulting in a consequence severity greater than Minor.
EPO-09	Prevent the displacement of native marine species as a result of the introduction and establishment of IMS via activity vessels.
EPO-10	Zero incidents of injury/mortality of cetaceans/marine reptiles from collision with activity vessels.
EPO-11	Zero unplanned release of chemicals to the marine environment.
EPO-12	Zero unplanned release of hydrocarbons (excluding MDO) to the marine environment.
EPO-13	No MDO release to the marine environment.
EPO-14	No significant[28] impacts to cultural features from the Activity.

[28] 'Significant' is defined as 'an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts'. This definition is taken from DoE, 2013.

8.2.1 Control measures and performance standards

OPGGS(E)R 2009 Requirements
Regulation 13 Environmental assessment
Evaluation of environmental impacts and risks 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 (i.e. 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, EPSs and associated measurement criteria relating to oil spill preparedness and response operations are detailed in the OPEP (BAS-210 0109).

Table 8-2: Control measures and EPSs for the proposed Activity

EPO reference (Table 8-1)	Control measure	Environmental performance standard	Measurement criteria

EPO-01	C6.1.1
	Activity vessels equipped and crewed in accordance with Australian maritime requirements
		EPS6.1.1.1
		Vessels will be equipped and crewed in accordance with the *Navigation Act 2012* (Cth) (as applicable for vessel size, type and class), including implementing:
		• Marine Order 21 (Safety and emergency procedures), including:
		  ○ safety measures such as manning and watchkeeping.
		• Marine Order 27 (Safety of navigation and radio equipment), including:
		  ○ radio equipment and communications
		  ○ navigation safety measures and equipment
		  ○ danger, urgency and distress signals and messages.
		• Marine Order 30 (Prevention of Collisions), including:
		  ○ lights and signals as applicable to vessel class per COLREGS requirements.
		• Marine Order 71 (Masters and Deck Officers), including:
		  ○ all master, mate and watchkeeper officer duties undertaken by crew certified as applicable to vessel class per International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978 (STCW) requirements.
			MC6.1.1.1.1
			A Minimum Safe Manning Certificate is in place and identifies minimum crew qualifications to meet the STCW requirements (as applicable for vessel size, type and class).

			MC6.1.1.1.2 Records of Santos marine vessel vetting process (as applicable for vessel size, type and class) to demonstrate the following: • Global Maritime Distress and Safety System (GMDSS) radio logbook maintained • radio equipment available, working and tested at regular intervals • electronic and paper based charts are available on the bridge.
			MC6.1.1.1.3 A Vessel Cargo Ship Safety Equipment Certificate demonstrates the vessel has lights, shapes and means of making sound signals and distress signals in accordance with COLREGS requirements (as applicable for vessel size, type and class).
			MC6.1.1.1.4 Records of vessel crew STCW qualifications align with the Minimum Safe Manning Certificate (as applicable for vessel size, type and class).
			MC6.1.1.1.5 Non-compliance with relevant Marine Orders 21, 27, 30 and 71 and corrective action undertaken documented (as applicable for vessel size, type and class).
EPO1	C6.1.2 Undertake consultation with Relevant Persons (including applicable notifications)	EPS6.1.2.1 Consultation with Relevant Persons will be undertaken in accordance with Santos' consultation plan.	MC6.1.2.1.1 Consultation records demonstrate implementation of a Relevant Persons consultation plan.
		EPS6.1.2.2 AHS Notice to Mariners and AMSA MSI will be notified prior to relevant Barossa SURF activities.	MC6.1.2.2.1 Consultation records demonstrate AHS and AMSA MSI provided sufficient information to generate Notice to Mariners prior to relevant SURF activities.
		EPS6.1.2.3 Subsea infrastructure will be clearly marked on Australian nautical charts published by the AHO.	MC6.1.2.3.1 Evidence of transmittal of subsea infrastructure installed as part of the activities described in the SURF EP to AHO.
		EPS6.1.2.4 Establish a 500 m exclusion zone around the installation vessels.	MC6.1.2.4.1 Daily operational reports and/or published AHS Notice to Mariners demonstrate the establishment of the 500 m exclusion zone around the installation vessels.
EPO-01	C6.1.3 SURF activity undertaken in accordance with Santos HSE management and marine vessel vetting processes	EPS6.1.3.1 Vessels selected and onboarded in accordance with Santos' Offshore Marine Assurance Procedure (SO-91-ZH-10001) and Santos' Marine Offshore Assurance Criteria (1530-045-STN-0001) to ensure contracted vessels are operated, maintained and crewed in accordance with Santos and industry standards, and regulatory requirements.	MC6.1.3.1.1 All activity vessels are subject to Santos' Marine Vetting process.

EPO reference (Table 8-1)	Control measure	Environmental performance standard	Measurement criteria
EPO-01	C6.1.4 Concurrent Barossa Development activities will be managed under the Barossa Interface Management Plan	EPS6.1.4.1 Interface management plan will be developed and implemented during concurrent activities to reduce the risk of unplanned vessel interactions.	MC6.1.4.1.1 A copy of the Barossa Interface Management Plan.
			MC6.1.4.1.2 Records from the interface management process to confirm vessel interactions are managed to reduce vessel collision risk.
EPO-01	C6.1.5 Vessel speed restrictions	EPS6.1.5.1 Restrict vessel operating speeds in the OA to 8 knots or less.	MC6.1.5.1.1 Project induction material includes an environmental requirements section that details speed limit requirements.
			MC6.1.5.1.2 Induction records confirm all project personnel have completed the project induction.
			MC6.1.5.1.3 Vessel speeds in exceedance of 8 knots are contained in incident documentation and corrective action undertaken documented.
EPO-01	C6.1.6 Communications plan will be implemented for engagement prior to and during the Activity	EPS6.1.6.1 Communications plan will be implemented.	MC6.1.6.1.1 Consultation records demonstrate implementation of a communications plan.
EPO-01	C6.1.7 HSE inductions will include environmental requirements	EPS6.1.7.1 All project personnel will attend HSE inductions which will include environmental requirements as required by this EP.	MC6.1.7.1.1 Records demonstrate all project personnel have attended the Activity HSE Induction.
EPO-02	C6.2.1 Vessel planned maintenance system	EPS6.2.1.1 Documented maintenance program is in place for equipment including DP systems, engines and machinery on vessels that provides a status on the maintenance of equipment.	MC6.2.1.1.1 Records from Santos vessel vetting process confirm PMS schedule adhered to.
EPO-02	C6.2.2 Subsea infrastructure inventory	EPS6.2.2.1 Establish and maintain a comprehensive and accurate inventory of subsea infrastructure and locations.	MC6.2.2.1.1 Subsea infrastructure inventory records.
			MC6.2.2.1.2 Survey reports with installed subsea infrastructure locations.
EPO-02	C6.2.3 Vessel anchoring: no planned vessel anchoring within the OA	EPS6.2.3.1 No planned anchoring of activity vessels within the OA.	MC6.2.3.1.1 Project Induction material includes an environmental requirements section that details that no planned anchoring is permitted within OA (unless in an emergency).
			MC6.2.3.1.2 Induction records confirm all project personnel have completed the project induction.
EPO-02	C6.2.4 Vessel anchoring: use reel-lay and construction vessels with DP equipment	EPS6.2.4.1 Use reel-lay and construction vessels with DP equipment.	MC6.2.4.1.1 Records confirm activity vessels have DP equipment.

EPO reference (Table 8-1)	Control measure	Environmental performance standard	Measurement criteria
EPO-02	Refer to C6.1.7 (HSE inductions will include environmental requirements)		
EPO-02	C6.2.5 Barossa Unexpected Finds Protocol (BAS-210 0051)	EPS6.2.5.1 Barossa unexpected finds protocol will be implemented should an unexpected find be encountered to minimise impacts to heritage and cultural objects and values. This protocol is to include: • unexpected finds, stop work triggers and notification procedures • object recognition sheet • reporting methods and procedures • artefact collection and curation policies.	MC6.2.5.1.1 Induction presentation aligns with requirements listed in EPS6.2.5.1. MC6.2.5.1.2 Induction records confirm all project personnel have completed the project induction. MC6.2.5.1.3 Notification and heritage response records align with requirements listed in EPS6.2.5.1.
EPO-03	C6.3.1 Avoid activities near cetaceans and turtles	EPS6.3.1.1 Vessel(s) comply with Santos' Protected Marine Fauna Interaction and Sighting Procedure (EA-91-II-00003), which ensures compliance with Part 8 of EPBC Regulations, which includes controls for minimising the risk of collision with marine fauna.	MC6.3.1.1.1 The Project induction material includes a section outlining the EPBC Regulations – Part 8 Division 8.1 Interacting with cetaceans (and applied for marine turtles), outlining the: • Caution zone distances • Management measures for when a vessel needs to be operated within a caution zone. MC6.3.1.1.2 Induction records confirm all project personnel have completed the project induction. MC6.3.1.1.3 Recorded marine fauna observations demonstrate adherence to EPBC Regulations – Part 8 Division 8.1 Interacting with cetaceans (and applied for marine turtles), including initiation of management measures for when the vessel was operated within a caution zone.
		EPS6.3.1.2 Any vessel strikes with cetaceans will be reported in the National Ship Strike database.	MC6.3.1.2.1 Contractor incident reports will include evidence of reporting to the National Ship Strike Database (for vessel strike with cetacean incidents).
		EPS6.3.1.3 Helicopter contractor procedures comply with Santos' Protected Marine Fauna Interaction and Sighting Procedure (EA-91-II-00003), which ensures compliance with Part 8 of the EPBC Regulations, which includes controls for minimising interaction with marine fauna.	MC6.3.1.3.1 Helicopter contractor procedures align with Santos' Protected Marine Fauna Interaction and Sighting Procedure (EA-91-II-00003). MC6.3.1.3.2 Induction records confirm marine fauna interaction and sighting procedure, specifically marine fauna caution zones and controls for minimising the risk of collision with marine fauna, is communicated to helicopter operators.
EPO-03	Refer to C6.1.1 (Activity vessels equipped and crewed in accordance with Australian maritime requirements)		
EPO-03	Refer to C6.2.1 (Vessel planned maintenance system)		
EPO-03	C6.3.2 No pile driving activities	EPS6.3.2.1 No pile driving activities to occur.	MC6.3.2.1.1 No pile driving activities referenced in Contract 400941 (Barossa) Exhibit A Scope of Work.

EPO reference (Table 8-1)	Control measure	Environmental performance standard	Measurement criteria
EPO-03	C6.3.3 Helicopter planned maintenance system	EPS6.3.3.1 Documented maintenance program is in place for helicopters used on the Activity	MC6.3.3.1.1 Records confirm a maintenance program is in place and adhered to for helicopters used on the Activity.
EPO-03	C6.3.4 Pre-deployment function testing of subsea acoustic positioning system	EPS6.3.4.1 Pre-deployment function testing of subsea acoustic positioning system (LBL and/or USBL) carried out to verify transponders and transceivers are omitting acoustic pulses within operating limits	MC6.3.4.1.1 Evidence of a completed function test of subsea acoustic positioning systems (LBL and/or USBL) carried out prior to installation of subsea infrastructure on the seabed.
EPO-03	Refer to C6.1.7 (HSE inductions will include environmental requirements)		
EPO-04	Refer to C6.1.1 (Activity vessels equipped and crewed in accordance with Australian maritime requirements)		
EPO-05	C6.5.1 Atmospheric (GHG and non-GHG) emissions from combustion managed in accordance with standard maritime practice	EPS6.5.1.1 Pursuant to MARPOL Annex VI, vessels will maintain a current International Air Pollution Prevention (IAPP) Certificate and/or Engine IAPP Certificate and/or International Energy Efficiency (IEE) Certificate (or equivalent), as relevant to vessel class and type, which certifies that measures are in place to prevent ODS emissions, and reduce NO_x, SO_x, and incineration emissions during the activity.	MC6.5.1.1.1 A copy of a current IAPP Certificate (as relevant to vessel class and type).
			MC6.5.1.1.2 A copy of a current Engine IAPP Certificate (or supporting technical file for all of its applicable diesel engines, as relevant to vessel class and type).
			MC6.5.1.1.3 A copy of a current IEE Certificate (or equivalent, as relevant to vessel class and type).
		EPS6.5.1.2 Ship Energy Efficiency Management Plan, as relevant to vessel size, type and class.	MC6.5.1.2.1 A copy of the Ship Energy Efficiency Management Plan (as relevant to vessel class and type).
		EPS6.5.1.3 ODS managed in accordance with MARPOL Annex VI to reduce the risk of an accidental release of ODS to air.	MC6.5.1.3.1 A copy of the current and maintained ODS Record Book or recording system.
		EPS6.5.1.4 Incineration is carried out in accordance with MARPOL Annex VI.	MC6.5.1.4.1 Records of an IMO type approval certificate for each incinerator in use, demonstrating the incinerator is designed for operation within the limits of Regulation 16 of MARPOL Annex VI.
		EPS6.5.1.5 Waste from incineration managed in accordance with MARPOL Annex VI.	MC6.5.1.5.1 A copy of the completed Garbage Record Book or official recording system that captures incinerate waste records.
		EPS6.5.1.6 Vessels to use only IMO 2020 low sulphur standard MGO or MDO compliant fuel in accordance with MARPOL Annex VI.	MC6.5.1.6.1 Fuel bunkering records and/or relevant purchase records.
EPO-05	Refer to C6.1.1 (Activity vessels equipped and crewed in accordance with Australian maritime requirements)		
EPO-05	Refer to C6.2.1 (Vessel planned maintenance system)		
EPO-05	Refer to C6.1.7 (HSE inductions will include environmental requirements)		

EPO reference (Table 8-1)	Control measure	Environmental performance standard	Measurement criteria
EPO-06	C6.6.1 Routine discharges of treated bilge and deck water will comply with the *Navigation Act 2012* (Cth), *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth) and Marine Order 91	EPS6.6.1.1 Have a valid International Oil Pollution Prevention (IOPP) Certificate, as relevant to vessel class and type.	MC6.6.1.1.1 A copy of a current International Oil Pollution Prevention (IOPP) Certificate (as relevant to vessel class and type).
		EPS6.6.1.2 Machinery space bilge/oily water shall have IMO approved oil filtering equipment (oil/water separator) with an on-line monitoring device to measure Oil in Water (OIW) content to be less than 15 ppm prior to discharge.	MC6.6.1.2.1 Supplement to the International Oil Pollution Prevention Certificate that indicates that the vessel has an approved oil / water separator with online monitoring calibrated to discharge at less than 15 ppm OIW (as relevant to relevant to vessel class and type).
		EPS6.6.1.3 Maintain an Oil Record Book.	MC6.6.1.3.1 Evidence of a current and maintained Oil Record Book.
		EPS6.6.1.4 A deck drainage system capable of controlling the content of discharges for areas of high risk of fuel/oil/grease or hazardous chemical contamination	MC6.6.1.4.1 Records demonstrating that all potential spill sources have appropriate secondary containment capable of controlling discharges of hazardous liquids, particularly high risk areas where of fuel/oil/grease or hazardous chemicals have the potential to enter the marine environment.
		EPS6.6.1.5 Waste oil storage is available.	MC6.6.1.5.1 Records demonstrating waste oil storage is available with suitable containment measures.
		Refer to EPS7.5.1.1 (Vessels have and implement a SOPEP (or equivalent) pursuant to MARPOL Annex I.)	
EPO-06	C6.6.2 Routine discharges of treated sewage and grey water, in accordance with the *Navigation Act 2012* (Cth), *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth) and Marine Order 96 (Marine Pollution Prevention – Sewage)	EPS6.6.2.1 Valid International Sewage Pollution Prevention (ISPP) Certificate (as relevant to vessel class and type) that details the vessel has a: • MARPOL approved sewage treatment plant • sewage comminuting and disinfecting system • sewage holding tank sized appropriately to contain all generated waste (black and grey water).	MC6.6.2.1.1 A copy of valid International Sewage Pollution Prevention (ISPP) Certificate demonstrating the vessel has a MARPOL approved sewage treatment plant (as relevant to relevant to vessel class and type).
			MC6.6.2.2.1 Where the vessel does not have a MARPOL approved sewage treatment plant, records of sewage treated using an approved comminuted and disinfecting system are maintained in an Official Log Book (or similar) that records discharge locations and volumes and verifies that discharge occurred at a distance of more than 3 NM from the nearest land.
			MC6.6.2.3.1 Where the vessel does not have a MARPOL approved sewage treatment plant, records of sewage not comminuted or disinfected are maintained in an Official Log Book (or similar) that records discharge locations and volumes and verifies that discharge occurred at a distance of more than 12 NM from the nearest land.
EPO-06	C6.6.3 Routine discharges of putrescible waste, in accordance with MARPOL Annex V and Marine Order 95 (Marine Pollution Prevention – Garbage)	EPS6.6.3.1 A Garbage Record Book is maintained onboard (as relevant to vessel class and type).	MC6.6.3.1.1 Garbage Record Book is current and maintained to capture waste discharge locations (as relevant to vessel class and type).
		EPS6.6.3.2 Garbage Management Plan is in place (as relevant to vessel class and type).	MC6.6.3.2.1 Garbage Management Plan is in place (as relevant to vessel class and type).
		EPS6.6.3.3 Putrescible waste and food scraps are disposed of in accordance with MARPOL Annex V (and Marine Order 95: Marine pollution prevention – garbage).	MC6.6.3.3.1 If a macerator is in use, specifications confirm food scraps are passed through a screen with no opening wider than 25 mm.
			MC6.6.3.3.2 If a macerator is in use, the Garbage Record Book confirms food waste comminuted or ground is discharged no greater than 3 NM to nearest land.
			MC6.6.3.3.3

EPO reference (Table 8-1)	Control measure	Environmental performance standard	Measurement criteria
			If food waste is not comminuted or ground, the Garbage Record Book confirms food waste discharge occurred no greater than 12 NM to nearest land or food waste is sent ashore for disposal.
EPO-06	Refer to C6.1.7 (HSE inductions will include environmental requirements)		
EPO-07	C6.7.1 Apply the Offshore Division Operations Chemical Selection Procedure (EA-91-II-10001) for chemicals planned to be discharged	EPS6.7.1.1 Chemicals planned to be discharged to sea are Gold/Silver/D or E rated through OCNS, or PLONOR substances listed by OSPAR, or have a complete risk assessment as per Santos Offshore Division Operations Chemical Approval Procedure (EA-91-II-10001) so that only environmentally acceptable products are used.	MC6.7.1.1.1 Records demonstrate the chemical selection procedure has been implemented for all chemicals planned to be discharged
EPO-07	C6.7.2 Contractor FCGT procedure	EPS6.7.2.1 Contractor FCGT procedure will include: • metering of chemical injection volumes during flooding and hydrotest activities • dosing rates/optimised treatment rates for chemicals • FCGT activities will use screening/mesh barriers to prevent marine fauna entrainment	MC6.7.1.2.1 A copy of the contractor FCGT procedure aligned with requirements listed in EPS6.7.2.1.
EPO-08	C7.1.1 Implement standards and procedures for lifting equipment	EPS7.1.1.1 Construction vessels crane and lifting operations procedures include controls to reduce the risk of unplanned or dropped objects entering the marine environment and prevent uncontrolled or dragged objects: • lifting equipment certification and inspection • lifting crew competencies • heavy-lift procedures • preventive maintenance on cranes • weather considerations.	MC7.1.1.1.1 The construction vessel's crane and lifting operations procedures align with EPS7.1.1.1 requirements.
EPO-08	C7.1.2 Dropped objects recovered where safe and practicable to do so	EPS7.1.2.1 For all dropped objects, the incident documentation will detail the following: • assessment of environmental risk • assessment to recover the object, where safe and practicable to do so • outcomes of the recovery.	MC7.1.2.1.1 Incident documentation details considerations and outcomes of recovery of dropped objects.
EPO-08	Refer to C6.6.3 (Routine discharges of putrescible waste, in accordance with MARPOL Annex V and Marine Order 95 (Marine Pollution Prevention – Garbage))		
EPO-08	Refer to C6.1.7 (HSE inductions will include environmental requirements)		
EPO-08	C7.1.3 Contractor reel-lay vessel Environmental Installation Plan	EPS7.1.3.1 Contractor environmental documentation for the reel-lay vessel to include measures (and evidence of implementation) to mitigate the risk of PP particles and debris to the marine environment.	MC7.1.3.1.1 Contractor Environmental Installation Plan describe the method for managing the PP Environmental risk, including proper disposal methods. MC7.1.3.1.2 The Project induction material includes a section outlining the PP HSE risks, including the risk to equipment, people and the environment.

EPO reference (Table 8-1)	Control measure	Environmental performance standard	Measurement criteria
			MC7.1.3.1.3 Induction records confirm all project personnel have completed the project induction.
			MC7.1.3.1.4 Reel-lay vessel environmental checklist includes evidence of vessel sweeps for PP
EPO-08	C7.1.4 Vessel standard operating procedure	EPS7.1.4.1 Vessel standard operating procedure to include a helideck sweep/inspection before a helicopter landing to: • prevent seabird collision by dispersing seabirds that are resting on the helideck • to reduce the risk of unplanned release of waste to sea.	MC7.1.4.1.1 Evidence of a Vessel standard operating procedure (or similar) that aligns with requirements listed in EPS7.1.4.1 (as applicable to vessel type).
			MC7.1.4.1.2 Completed vessel inspection checklists demonstrates a helideck sweep/inspection before a helicopter landing is completed (as applicable to vessel type).
		EPS7.1.4.2 Vessel waste management procedures include the provision for managing and reducing the risk of windblown waste entering the marine environment	MC7.1.4.2.1 Vessel HSE inspection checklists demonstrate implementation of measures for reducing the risk of windblown waste entering the marine environment
EPO-08	C7.1.5 International Maritime Dangerous Goods Code	EPS7.1.5.1 Dangerous goods managed in accordance with International Maritime Dangerous Goods Code and Marine Order 41 (Division 4, Regulation 16) to reduce the risk of an environmental incident, such as an accidental release to sea or unintended chemical reaction.	MC7.1.5.1.1 Records demonstrate that dangerous goods carried on Registered Australian Vessels (RAVs) and foreign vessels are shipped in accordance with Marine Order 41 (Division 4, Regulation 16), and appropriate records including a completed multimodal dangerous goods form are kept.
EPO-08	Refer to C6.2.2 (Subsea infrastructure inventory)		
EPO-09	C7.2.1 Vessels equipped with effective anti-fouling coatings	EPS7.2.1.1 Vessels will have a suitable anti-fouling coating in accordance with the *Protection of the Sea (Harmful Anti-fouling Systems) Act 2006* (Cth) (as applicable for vessel size, type and class), including: • Marine Order 98 (Marine Pollution – Anti-fouling Systems) including (as required by vessel class): • a valid International Anti-fouling System Certificate.	MC7.2.1.1.1 A copy of an approved International Anti-fouling System Certificate.
EPO-09	C7.2.2 Vessels undertake ballast water management or treatment to achieve low-risk ballast water	EPS7.2.2.1 Ballast water discharges will comply with the Australian Ballast Water Management Requirements (DAWE, 2020a), which implements the requirements of the *Biosecurity Act 2015* (Cth) and the International Convention for the Control and Management of Ships' Ballast Water and Sediments (as appropriate for vessel class).	MC7.2.2.1.1 Records demonstrating a Ballast Water Management Plan (electronic or in hard copy) is in place.
			MC7.2.2.1.2 Records demonstrating a ballast water record system (electronic or in hard copy) is maintained.
			MC7.2.2.1.3 An International Ballast Water Management Certificate is in place and demonstrates the principal ballast water management method is in accordance with D-2 standards.
			MC7.2.2.1.4 If the vessel cannot demonstrate it meets D-2 standards, records of ballast water discharge logs confirm no discharge within 12 nautical miles of coastlines including any ports.
			MC7.2.2.1.5 A Biosecurity Status Document showing an approved ballast status (for vessels arriving from international locations) or a low risk exemption through a domestic ballast water risk assessment (for domestic vessels).
EPO-09	C7.2.3	EPS7.2.3.1	MC7.2.3.1.1 Vessels equipped with a Biofouling Management Plan

EPO reference (Table 8-1)	Control measure	Environmental performance standard	Measurement criteria
	Apply risk-based IMS management for vessels	Vessels will comply with the Australian Biofouling Management Requirements (DAWE, 2022a) (as appropriate to class), including: • vessels equipped with a Biofouling Management Plan • vessels maintain a Biofouling Record Book.	MC7.2.3.1.2 Vessels maintain a Biofouling Record Book.
		EPS7.2.3.2 Vessels mobilised to the OA from international or domestic waters will comply with the Australian National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (Marine Pest Sectoral Committee, 2009): • completion of IMS Risk Assessment, which includes submission of evidence that demonstrates the implementation of mitigation measures to reduce risk (using either the Vessel Check system or as described in Australian National Biofouling Management Guidance for the Petroleum Production and Exploration Industry [Marine Pest Sectoral Committee, 2009]) • only vessels classified as a low-level risk used on the project.	MC7.2.3.2.1 Records demonstrate compliance with the Australian National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (Marine Pest Sectoral Committee, 2009), including: • completion of IMS Risk Assessment, which includes submission of evidence that demonstrates the implementation of mitigation measures to reduce risk (using either the Vessel Check system or as described in Australian National Biofouling Management Guidance for the Petroleum Production and Exploration Industry [Marine Pest Sectoral Committee, 2009]) that classifies the vessel as low risk.
EPO-09	C7.2.4 Marine Growth Prevention System	EPS7.2.4.1 Vessels will have a marine growth prevention system or appropriate manual treatment systems.	MC7.2.4.1.1 Records of quarantine management system process demonstrate vessels have a marine growth prevention system or appropriate manual treatment systems.
EPO-09	C7.2.5 STP buoy anti-fouling coating	EPS7.2.5.1 The STP buoy will have an anti-fouling coating.	MC7.2.5.1.1 Records demonstrate that the STP buoy has a valid anti-foul coating applied.
EPO-09	Refer to C6.1.7 (HSE inductions will include environmental requirements)		
EPO-09	Refer to C6.1.3 (The Activity will be undertaken in accordance with Santos HSE management and marine vessel vetting processes)		
EPO-10	Refer to C6.3.1 (Avoid activities near cetaceans and turtles)		
EPO-10	Refer to C6.1.5 (Vessel speed restrictions)		
EPO-10	Refer to C6.1.7 (HSE inductions will include environmental requirements)		
EPO-10	Refer to C7.1.4 (Vessel standard operating procedure)		
EPO-10	Refer to C6.7.2 (Contractor FCGT procedure)		
EPO-11	Refer to C7.1.2 (Dropped objects recovered where safe and practicable to do so)		
EPO-11	C7.4.1 Chemical and hydrocarbon storage areas designed to contain leaks and spills	EPS7.4.1.1 Selection of vessel contractor is subject to Santos marine vessel vetting processes, specifically: • appropriate procedures for storage (e.g. bunding), labelling (including SDS available) and handling of chemicals and hydrocarbons.	MC7.4.1.1.1 A copy of hazardous materials management procedures (or similar) that include storage (e.g. bunding), labelling (including SDS available) and handling of chemicals and hydrocarbons.

EPO reference (Table 8-1)	Control measure	Environmental performance standard	Measurement criteria
EPO-11	C7.4.2 Chemicals and hydrocarbons will be managed in accordance with standard maritime practices	EPS7.4.2.1 Chemicals and hydrocarbons managed in accordance with SDS in relation to safe handling and storage, spill response and emergency procedures, and disposal considerations.	MC7.4.2.1.1 Records of contractor vessel audits and/or inspections demonstrate compliance with chemical and hydrocarbon storage and handling requirements.
			MC7.4.2.1.2 Accidental loss of chemicals overboard contained in incident documents.
		EPS7.4.2.2 SDS available for all chemicals to help identify hazards and to manage chemicals.	MC7.4.2.2.1 Completed vessel inspection checklist aligned with the EPS7.4.2.2 requirements.
EPO-11	C7.4.3 No PFAS or PFOS will be used in firefighting foam.	EPS7.4.3.1 Fire-fighting foams shall be free of PFAS and PFOS.	MC7.4.3.1.1 SDS for firefighting foam to confirm no PFAS or PFOS.
EPO-11	C7.4.4 Vessel spill response plans	EPS7.4.4.1 Vessels have and implement a SOPEP (or equivalent) pursuant to MARPOL Annex I.	MC7.4.4.1.1 Approved SOPEP (or equivalent) in place.
			MC7.4.4.1.2 Spill details contained in incident documentation.
		EPS7.4.4.2 Spill response exercises conducted in accordance with SOPEP to ensure personnel are prepared.	MC7.4.4.2.1 Spill exercise records or evidence of a spill exercise aligned with the vessel SOPEP requirements.
EPO-11	C7.4.5 Spill clean-up kits available in high-risk areas	EPS7.4.5.1 Selection of vessel contractor is subject to Santos marine vessel vetting processes, specifically spill kits stocked and ready for use by trained personnel.	MC7.4.5.1.1 Contractor vessel audit process confirm spill kits stocked and ready for use.
EPO-11	Refer to C7.1.5 (International Maritime Dangerous Goods Code)		
EPO-11	Refer to C6.1.7 (HSE inductions will include environmental requirements)		
EPO-11	Refer to C6.7.1 (Apply the Offshore Division Operations Chemical Selection Procedure [EA-91-II-10001] for chemicals planned to be discharged)		
EPO-11	Refer to C7.1.1 (Implement standards and procedures for lifting equipment)		
EPO-12	Refer to C7.1.2 (Dropped objects recovered where safe and practicable to do so)		
EPO-12	Refer to C7.4.1 (Chemical and hydrocarbon storage areas designed to contain leaks and spills)		
EPO-12	Refer to C7.4.2 (Chemicals and hydrocarbons will be managed in accordance with standard maritime practices)		
EPO-12	Refer to C7.1.5 (International Maritime Dangerous Goods Code)		

EPO reference (Table 8-1)	Control measure	Environmental performance standard	Measurement criteria
EPO-12	Refer to C7.4.4 (Vessel spill response plans)		
EPO-12	Refer to C7.4.5 (Spill clean-up kits available in high-risk areas)		
EPO-12	C7.5.1 ROV operations undertaken in accordance with good industry practice.	EPS7.5.1.1 Preventive maintenance on ROV completed as scheduled to reduce the risk of hydraulic fluid releases to sea.	MC7.5.1.1.1 Records from Santos vessel vetting process confirm ROV PMS schedule adhered to.
		EPS7.5.1.2 ROV pre-dive checklist completed to reduce the risk of hydraulic fluid releases to sea.	MC7.5.1.2.1 Records of a completed pre-dive checklist for ROV operations that includes inspections on hydraulic fittings, connections and hoses.
EPO-12	Refer to C6.2.1 (Vessel planned maintenance system)		
EPO-12	Refer to C6.1.1 (Activity vessels equipped and crewed in accordance with Australian maritime requirements)		
EPO-12	Refer to C6.1.7 (HSE inductions will include environmental requirements)		
EPO-12	C7.5.2 Production manifold and manifold foundation installation procedure	EPS7.5.2.1 The production manifold and manifold foundation installation procedure is to include the following: • safe vessel lift, approach to land-out, and deployment locations • lifting equipment, lifting points, and rigging arrangements • approach and deployment locations to be free of obstructions, debris, or other hazards • allowable weather criteria and limitations • vessel to use the critical activity mode of operation.	MC7.5.2.1.1 A copy of the production manifold and manifold foundation installation procedure demonstrating the requirements listed in EPS7.5.5.1 are met. MC7.5.2.1.2 Activity Specific Operating Guidelines (ASOG) identifies lifts that require the use of the critical activity mode of operation.
EPO-12	C7.5.3 Suitability survey report for the construction vessel installing the production manifolds and production manifold foundations	EPS7.5.3.1 The construction vessel installing the production manifolds and production manifold foundations to provide an accepted suitability survey report to demonstrate the vessel's condition and suitability, including associated equipment to install the production manifolds and manifold foundations safely.	MC7.5.3.1.1 A copy of the accepted suitability survey report.
EPO-12	C7.5.4 DP trials conducted for the construction vessel installing the production manifold and production manifold foundation	EPS7.5.4.1 The relevant DP trials (DP system trials, FMEA proving trials, annual DP trials, or field entry DP trials) conducted for the construction vessel installing the production manifold and production manifold foundation to verify the capability of the DP system, including: • maintain the vessel's position and heading under various operating conditions • back-up system, alarms and warnings are functioning correctly • detect and respond to equipment failures.	MC7.5.4.1.1 A copy of the relevant DP trial reports or evidence of tests being performed without outstanding actions.

EPO reference (Table 8-1)	Control measure	Environmental performance standard	Measurement criteria
EPO-12	C7.5.5 DP operator competency and familiarisation for the construction vessel installing the production manifold and production manifold foundation	EPS7.5.5.1.1 DP operator is trained, competent and familiar with the DP systems and equipment to mitigate the risk a drive-off scenario resulting from operator error during the installation process.	MC7.5.5.1.1 Records of Flag State endorsement or certification as a Dynamic Positioning Operator (DPO) for all DP operators.
EPO-13	Refer to C6.1.2 (Undertake consultation with Relevant Persons (including applicable notifications))		
EPO-13	Refer to C6.1.5 (Vessel speed restrictions)		
EPO-13	Refer to C7.4.4 (Vessel spill response plans)		
EPO-13	Refer to C6.2.1 (Vessel planned maintenance system)		
EPO-13	C7.6.1 Accepted OPEP	EPS7.6.1.1 In the event of an oil spill to sea, Barossa Subsea Infrastructure Installation OPEP requirements will be implemented to mitigate environmental impacts.	MC7.6.1.1.1 Completed incident documentation demonstrating the use of the Barossa Subsea Infrastructure Installation OPEP (BAS-210 0109).
EPO-13	C7.6.2 Vessel-specific bunkering procedures and equipment consistent with Santos marine vessel vetting requirements	EPS7.6.2.1 Santos will confirm vessel bunkering procedures include: • defined roles and responsibilities – bunkering to be undertaken by trained staff • use of bunkering hoses that have quick connection couplings • visual inspection of hose prior to bunkering to confirm they are in good condition and correct valve line up • assessment of weather and sea state • testing of emergency shutdown mechanism on the transfer pumps • established communication protocols between vessel master and personnel responsible for monitoring tank levels, leaks and overflows during bunkering operations • continual visual monitoring during MDO transfers of hoses, connections and tank levels to detect leaks and prevent overflows during bunkering operations.	MC7.6.2.1.1 The vessel's refuelling procedure aligned with the EPS7.6.3.1 requirements.
		EPS7.6.2.2 A permit to work or equivalent authorisation process (e.g. job safety analysis) is implemented for bunkering.	MC7.6.2.2.1 Records of contractor vessel audits and/or inspections demonstrate a permit to work or equivalent authorisation process (e.g. job safety analysis) is implemented for bunkering.
EPO-13	C7.6.3 No IFO or HFO will be used in activity vessels	EPS7.6.3.1 Vessel tanks to be free of HFO or IFO.	MC7.6.3.1.1 A copy of vessel contracts stating vessel tanks to be free of HFO or IFO.

EPO reference (Table 8-1)	Control measure	Environmental performance standard	Measurement criteria
EPO-13	C7.6.4 Helicopter refuelling procedure	EPS7.6.4.1 Helicopter refuelling procedures to include: • completed permit to work and/or job safety analysis for the activity • continual visual monitoring of gauges, hoses, fittings and the sea surface during the activity • hose and fittings checks before starting the activity • weather conditions to be assessed before the activity.	MC7.6.4.1.1 Refuelling procedure aligned with EPS7.6.4.1 requirements.
EPO-13	C7.6.5 Reduce the fuel capacity on activity vessels to reduce the risk of an MDO spill resulting in shoreline accumulation on the Tiwi Islands	EPS7.6.5.1 Activity vessels will adhere to fuel capacity limits aligned with predictive modelling to prevent Tiwi Island shoreline accumulation risks at or above low exposure thresholds. Specific limits include: • single–skinned hull activity vessels: max tank capacity 450 m^3 • double–skinned hull will be limited to a tank capacity of no more than 900 m^3	MC7.6.5.1.1 Fuel bunkering records and/or relevant purchase records.
EPO-13	Refer to C6.1.1 (Activity vessels equipped and crewed in accordance with Australian maritime requirements)		
EPO-14	Refer to C6.2.5 (Barossa Unexpected Finds Protocol [BAS-210 0051])		
EPO-14	C6.2.6 Cultural Heritage	EPS6.2.6.1 • Cultural Heritage monitors to accompany the Activity crew to conduct cultural training and introduce the Activity to the seas and the spirit beings. • Community benefits package	MC6.2.6.1.1 Progress reporting as part of the EP Annual Environmental Performance Report.

8.3 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.

Santos' SURF and Transport and Installation (T&I) Delivery Manager is accountable for the 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 implementing, managing and reviewing this EP is outlined in Table 8-3. It is also outlined in the OPEP (BAS-210 0109) for oil spill response.

Table 8-3: Chain of command, key leadership roles and responsibilities

Role	Responsibilities
Santos SURF and T&I Delivery Manager	• Accountable for implementation of this EP • Responsible for communication of Santos' policies and standards to all employees and contractors for their adherence to the same • 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 • Promotes a high level of HSE performance and drives improvement opportunities • Responsible for development and implementation of emergency response plans • Maintains communication with Santos personnel, government agencies and the media • Approves MoC documents, if acceptable and ALARP • Responsible for completion of annual HSE improvement plan
Santos Barossa Installation Engineer	• Responsible for conformance with environmental performance outcomes and standards in this EP • Delegates HSE responsibility and informs these personnel of their responsibilities under this EP • Empowers personnel to 'stop-the-job' due to HSE concerns • Responsible for compliance with processes for HSE incident reporting, investigation, correction and communication • Responsible for compliance with processes for HSE inspections and audits and implementation of corrective actions • Reviews MoC documents

Role	Responsibilities
Santos Barossa Marine Director	• Responsible for conformance with environmental performance outcomes and standards in this EP • Delegates HSE responsibility and informs these personnel of their responsibilities under this EP • Empowers personnel to 'stop-the-job' due to HSE concerns • Responsible for compliance with processes for HSE incident reporting, investigation, correction and communication • Responsible for vessel compliance with quarantine requirements to operate in Australian waters • Responsible for compliance with processes for HSE inspections and audits and implementation of and corrective actions • Reviews MoC documents • Responsible for compliance with requirements for personnel on the vessels to have the necessary qualifications, training and/or supervision
Santos Offshore Supervisors/Vessel Masters	• Responsible for compliance with all HSE laws, conventions and approvals (e.g. safety case) • Responsible for conformance with delegated environmental performance outcomes and standards in this EP • Reports any new, or increase in, HSE risk or impact • Responsible for compliance with MoC procedures • Responsible for adherence by crew to operational work systems and procedures • Responsible for implementation of requirements that plant and equipment is being operated as intended and is maintained • Empowers personnel to 'stop-the-job' due to HSE concerns • Responsible for compliance with reporting requirements for all HSE incidents, hazards and non-conformances • Facilitates HSE investigations and ensures corrective actions are implemented • Responsible for compliance with requirements for crew to be competent and prepared to respond to HSE incidents
Santos Barossa Environmental Adviser	• Monitoring conformance with EPOs and environmental performance standards, and the implementation strategy in this 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 • Responsible for fulfilment of Relevant Persons consultation and communication requirements • Responsible for communication of EP requirements to subcontractors

Role	Responsibilities
Santos Relevant Person Coordinator	• Responsible for implementation of the steps described in Section 8.11 relating to post acceptance consultation throughout the duration of the Activity • Maintains a Relevant Persons contact and information database • Maintains a Relevant Persons Notification Log specific to this EP • Maintains records of all Relevant Persons correspondence specific to this EP • Before the Activity begins and on advice of Santos Barossa Environmental Adviser, notifies all Relevant Persons listed, or as revised, in accordance with Table 8-5 • Is available before, during and after the Activity to promote opportunities for Relevant Persons to provide feedback • Internally communicates new risks and (or) controls that are raised during post acceptance consultation • Prepares quarterly updates
Santos Emergency Response Adviser	• Provides overarching incident and crisis management responsibility • Manages the crisis management team (CMT) and IMT personnel training program • Reviews and assesses competencies for CMT, IMT, and field-based incident response team members • Manages the duty roster system for CMT and IMT personnel • Manages the maintenance and readiness of incident response resources and equipment
Santos Oil Spill Response Adviser	• Provides ongoing guidance, framework, and direction on the OPEP (BAS-210 0109) • Develops and maintains arrangements and contracts for incident response support from third parties • Develops and defines objectives, strategies and tactical plans for response preparedness defined in the OPEP (BAS-210 0109) • Undertakes assurance activities on arrangements outlined within the OPEP (BAS-210 0109)

8.4 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 that each employee and contractor is aware of their responsibilities in relation to this EP and has appropriate training and competency.

8.4.1 Activity inductions

Inductions addressing environmental management requirements are to be implemented and to include information about:

- Santos' Environment, Health and Safety Policy (Appendix A) and management system
- the applicable regulatory regimes
- environmental sensitivities (e.g. nearby protected marine areas, sensitive environmental periods)
- communications to avoid vessel interaction
- activities with highest risk (e.g. IMS and hydrocarbon releases)
- relevant EP commitments (e.g. Table 8-1, Table 8-2)
- incident reporting and notifications
- regulatory compliance reporting
- MoC process
- oil pollution emergency response (e.g. OPEP requirements)
- maritime and First Nations cultural heritage awareness.

8.4.2 Training and competency

All members of the workforce on the activity vessels will complete relevant training and hold qualifications and certificates for their role. 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 by using online databases, staff onboarding processes and training departments, etc.

Personnel qualification and training records will be sampled before and/or during an activity. These checks will be performed during the procurement process, facility acceptance testing, inductions, crew change, and operational inspections and audits.

Additional training and competency requirements for Relevant Personnel specific to spill response are provided in the OPEP (BAS-210 0109).

8.4.3 Workforce involvement and communication

Daily operational meetings will be held at which HSE will be a permanent 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 (e.g. 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 (e.g. oil on water, dropped objects).

8.5 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 updating the plan.
Regulation 14(8AA)
The oil pollution emergency plan must include adequate arrangements for responding to and monitoring oil pollution, including the following:

a. the control measures necessary for timely response to an emergency that results or may result in oil pollution; b. the arrangements and capability that will be in place, for the duration of the activity, to ensure timely implementation of the control measures, including arrangements for ongoing maintenance of response capability; c. the arrangements and capability that will be in place for monitoring the effectiveness of the control measures and ensuring that the environmental performance standards for the control measures are met; d. the arrangements and capability in place for monitoring oil pollution to inform response activities.
Regulation 14(8A)
The implementation strategy must include arrangements for testing the response arrangements in the oil pollution emergency plan that are appropriate to the response arrangements and to the nature and scale of the risk of oil pollution for the activity.
Regulation 14(8B)
The arrangements for testing the response arrangements must include: a. a statement of the objectives of testing; and b. a proposed schedule of tests; and c. mechanisms to examine the effectiveness of response arrangements against the objectives of testing; and d. mechanisms to address recommendations arising from tests.
Regulation 14(8C)
The proposed schedule of tests must provide for the following: a. testing the response arrangements when they are introduced; b. testing the response arrangements when they are significantly amended; c. testing the response arrangements not later than 12 months after the most recent test; d. if a new location for the activity is added to the environment plan after the response arrangements have been tested, and before the next test is conducted–testing the response arrangements in relation to the new location as soon as practicable after it is added to the plan; e. if a facility becomes operational after the response arrangements have been tested and before the next test is conducted–testing the response arrangements in relation to the facility when it becomes operational.
Regulation 14(8D)
The implementation strategy must provide for monitoring of impacts to the environment from oil pollution and response activities that: (a)is appropriate to the nature and scale of the risk of environmental impacts for the activity; and (b)is sufficient to inform any remediation activities
Regulation 14(8E)
The implementation strategy must include information demonstrating that the response arrangements in the oil pollution emergency plan are consistent with the national system for oil pollution preparedness and response.

Vessels must have and must implement incident response plans, such as an emergency response plan and SMPEP or SOPEP. Regular incident response drills and exercises (e.g. as defined in an emergency response plan, SMPEP or SOPEP) will be performed to refresh the crew in using equipment and implementing incident response procedures.

The OPEP (BAS-210 0109) is a stand-alone document that details spill management arrangements, including the Santos incident management structure.

The OPEP provides Activity information comprising:

- a description of the spill profile
- applicable response strategies and control measures
- net environmental benefit analysis (NEBA)
- spill response ALARP assessment
- arrangements for testing the response arrangements
- arrangements for impact monitoring.

Santos will implement the OPEP 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, including to addresses the requirements of regulations 14(8)-(8E) inclusive.

8.6 Incident reporting, investigation and follow-up

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.

Section 8.8.2 details the implementation strategy to maintain records of emissions and discharges, whether occurring during normal operations or otherwise (where practicable), in accordance with regulation 14(7) of the OPGGS(E)R. All personnel will be informed through inductions and daily operational meetings of their duty to report HSE incidents and hazards (including unplanned discharges and emissions). Reported HSE incidents and hazards will be shared during daily operational meetings and will be documented in the incident management systems as appropriate. HSE incidents will be investigated using root cause analysis.

Environmental recordable and reportable incidents will be reported to NOPSEMA as required, in accordance with Table 8-5. The incident reporting requirements will be provided to all crew on the facilities and vessels with special attention to the reporting timeframes to provide for accurate and timely reporting.

For the purposes of this activity, in accordance with regulation 4 of the OPGGS(E)R:

- a recordable incident, for an activity under this EP, means a breach of an EPO or EPS in this EP that is not a reportable incident
- a reportable incident, for an activity under this EP, 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.

8.7 Supporting management processes and procedures

8.7.1 Contractor health, safety and environment requirements

Santos' HSE Contractor Management Operating Standard (SMS-HSS-OS08) supports the minimum requirements and expectations for HSE management of contractors and subcontractors. In addition, the Barossa Development has a contractual HSE exhibit for the subsea scopes of work. The HSE exhibit has a detailed environmental requirements section for:

- contractor to determine environmental risks and proposed controls
- understanding and compliance with applicable environmental legislation
- contractor group to have involvement in meeting environmental requirements
- this EP used to manage environmental risks
- key activities to support continuous environmental improvement
- definition of the OA
- chemical selection and approvals
- prohibition of materials and chemicals
- vessel requirements.

The HSE requirements for contracts/contractor management during pre-contract planning, contracting, contract execution and contract completion and evaluation are outlined in the HSE Contractor Management Operating Standard (SMS-HSS-OS08) and include these minimum requirements:

- contractors must comply with all applicable HSE laws and regulations and any additional guidelines, operating standards and policies provided to the contractor
- a review of the contractor's HSE management system must be completed by Santos before contract is awarded
- Santos can conduct audits/inspections of the contractor's operations, equipment and emergency procedures at any time.

8.7.2 Santos marine vessel vetting process

Santos manages marine vessel vetting and assurance using a hierarchy of procedures, outlined below. These requirements for vessel acceptance criteria include technical, personnel (e.g. crew competencies) and operational requirements for marine vessels engaged by Santos.

8.7.2.1 Marine vetting and audit process manual for offshore vessels

Santos' Offshore Marine Assurance Procedure (SO-91-ZH-10001) is a standard that requires all vessels used by Santos to be vetted. The vetting process is based on industry standards and best practices, along with considerations of guidelines and recommendations from recognised industry organisations such as Oil Companies International Marine Forum (OCIMF) and International Maritime Contractors Association (IMCA), and international regulatory agencies like the IMO and vessel classification societies.

Santos' Offshore Marine Assurance Procedure (SO-91-ZH-10001) requires a valid Offshore Vessel Inspection Database (OVID) report or Common Marine Inspection Document (CMID) report as required for vessel operation types.

For vessels where the OVID and/or CMID are not valid or available, a Santos approved inspection report is required.

8.7.2.2 Marine operations manual

The Marine Operations Manual (IOSC/OPS/HBK/0003) details:

- standard operating procedures for all vessels under contract with Santos
- compliance requirements for relevant maritime legislation and relevant guidelines, standards and codes
- compliance requirements for international conventions and agreements, including:
  - International Convention for the Control and Management of Ships' Ballast Water and Sediments 2004
  - SOLAS 1974 and its Protocol of 1988
  - International Convention for the Prevention of Pollution from Ships 1973/1978 (MARPOL 73/78)
  - Convention on the International Regulations for Preventing Collisions at Sea 1972 (COLREGS)
  - International Convention on Standards of Training, Certification and Watchkeeping (STCW) for Seafarers, 1978.
- compliance requirements for industry standards as set up by:
  - OCIMF
  - IMCA
  - Guidelines for Offshore Marine Operations
  - Nautical Institute.
- Santos and contractor standards, procedures and best practice management, including:
  - vessels' safety of navigation
  - vessels using DP systems
  - vessels' bunkering procedures
  - crew competency and training records
  - biosecurity management
  - chemical storage and handling procedures
  - discharge management procedures
  - waste management procedures
  - anchoring procedures
  - vessel and equipment maintenance procedures as per the vessel-specific safety management system.

Before commencing activities, Santos performs a risk assessment or HSE qualification evaluation process for each vessel to identify any HSE issues or specific management requirements.

8.7.3 Santos waste management process

Waste management will be undertaken in a manner consistent with Santos' waste management processes, including application of the waste management hierarchy, classification and segregation of waste streams, appropriate storage, transportation requirements, record management (e.g. waste inventories and tracking), use of licenced contractors/facilities and auditing.

8.7.4 Ballast water management

8.7.4.1 Summary of requirements

The Australian ballast water management requirements set out the obligations on vessel operators regarding managing ballast water and ballast tank sediment when operating within Australian seas. These requirements include legislative obligations under the *Biosecurity Act 2015* (Cth) and the International Convention for the Control and Management of Ships' Ballast Water and Sediments. The requirements provide guidance for vessel operators on best practice policies and apply to all vessels operating internationally and domestically in Australia. All vessels designed to carry ballast water (as applicable to vessel class) are required to carry the following:

- a valid ballast water management plan
- a valid international ballast water management certificate
- a type approval certificate specific to the type of ballast water management system installed (if installed)
- maintenance of a complete and accurate record of all ballast water movements, including those conducted in Australian waters.

Ballast water exchange should be conducted in areas at least 12 Nm from the nearest land and in water at least 50 m deep (having regard to the D-2 standard exemptions in the Australian Ballast Water Management Requirements [DAWE, 2020a]). Volumetric exchange must be at least 95% of the relevant tank.

Records on ballast water exchange must include the start and finish times and geographic coordinates of the operation.

All ballast water management equipment, such as pumps, will be maintained per the vessel's preventive maintenance system and regularly tested to ascertain accurate calculations for ballast water exchange operations.

8.7.4.2 Australian pre-arrival report

All international vessels (intending to ballast) must submit a pre-arrival report (through the Maritime Arrival Reporting System [MARS]) at least 12 hours prior to arrival. The Ballast Water Report will be assessed by the DAFF through MARS, and a response will be issued through the Biosecurity Status Document. Domestic vessels can request a low-risk exemption through a domestic risk assessment through MARS.

MARS is the online portal used by commercial vessel masters and shipping agents to submit the reports required of all international vessels seeking Australian biosecurity clearance and to request services such as coastal strip, waste removal, ship sanitation certification and crew change.

DAFF will request evidence from vessels with a ballast water management system of:

- a valid ballast water management plan specific to the vessel (consistent with the Ballast Water Management Convention)
- a valid ballast water management certificate, or certificate of compliance, that is approved by a port state administration, or a recognised survey authority (consistent with the Convention)
- ballast water management records clearly demonstrate the ballast water management system has been operated consistently with the ballast water management plan.

A DAFF biosecurity officer may board the vessel to verify the pre-arrival report and personnel proficiency in the operation and maintenance of the ballast water management system.

8.7.5 Biofouling management

IMS may be present as biofouling on the vessel hull or within piping, sea chests, etc. Biofouling, which may be found on and in a vessel, reflects the vessel's design, construction, maintenance and operations. Each of these aspects introduces particular biofouling vulnerabilities but also offers opportunities to limit the extent and development of biofouling, with commensurate reduction in biosecurity risks.

8.7.5.1 Summary of requirements

Biofouling management for international vessels will comply the Australian biofouling management requirements (DAWE, 2022a), which implements the requirements of the *Biosecurity Act 2015* (Cth) and the IMO 2011 Guidelines for the Control and Management of Ships' biofouling to Minimize the Transfer of Invasive Aquatic Species.

Under the new regulations, all operators of vessels intending to enter Australian territorial waters must provide information relating to biofouling management through the mandatory pre-arrival report 12–96 hours prior to arrival. In addition, the vessel operator must demonstrate proactive management of biofouling by implementing one of the 3 accepted proactive biofouling management options:

- implementation of an effective biofouling management plan
- cleaned all biofouling within 30 days prior to arriving in Australian territory
- implementation of an alternative biofouling management method pre-approved by the department.

Vessels mobilised to the OA from international or domestic waters must also comply with the National biofouling management guidelines for the petroleum production and exploration industry (Marine Pest Sectoral Committee, 2009).

8.7.5.2 Vessel risk assessment

This includes:

- completing a biofouling risk assessment
- implementing mitigation measures commensurate with the level of risk.

Figure 8-1 illustrates the risk assessment process. Factors that will inform risk include:

- timing of marine pest risk assessment relative to the activity vessel mobilisation to provide sufficient time to implement control measures in cases where management is warranted
- activity vessel location history since last dry dock and clean to inform whether the activity vessel may have been exposed to high-risk ports/locations
- level of biofouling and the presence of species of concern (particularly the presence of marine pests) within biofouling communities on the vessels associated with the activity (often informed by biofouling record books and/or maintenance/cleaning or inspection programs)
- operational profile relevant to biosecurity risk such as operating speed, time alongside a facility and the need for ballast exchanges within the title area
- receiving environment including the presence of shallow-water sensitivities near the activity and the presence and area of non-biocidal surfaces on facilities that could harbour marine pests
- presence and effectiveness of external and internal marine growth prevention systems including effectiveness and integrity of anti-fouling coatings and functionality of internal treatment systems

- qualifications and competency of those conducting and reviewing the risk assessment and making management decisions.

8.7.5.3 Vessel risk status

Vessels must achieve a 'low' risk status to demonstrate to the government that Santos has taken all reasonable measures to minimise the risk of IMS. The risk assessment categorises the vessel's risk status as:

- low – low risk of introducing IMS; no additional management measures required
- uncertain – risk of introducing IMS is not apparent; precautionary approach adopted, additional management measures required to achieve low status
- high – high risk of introducing IMS; additional management measures will be required.

8.7.5.4 Potential management measures to achieve low risk status

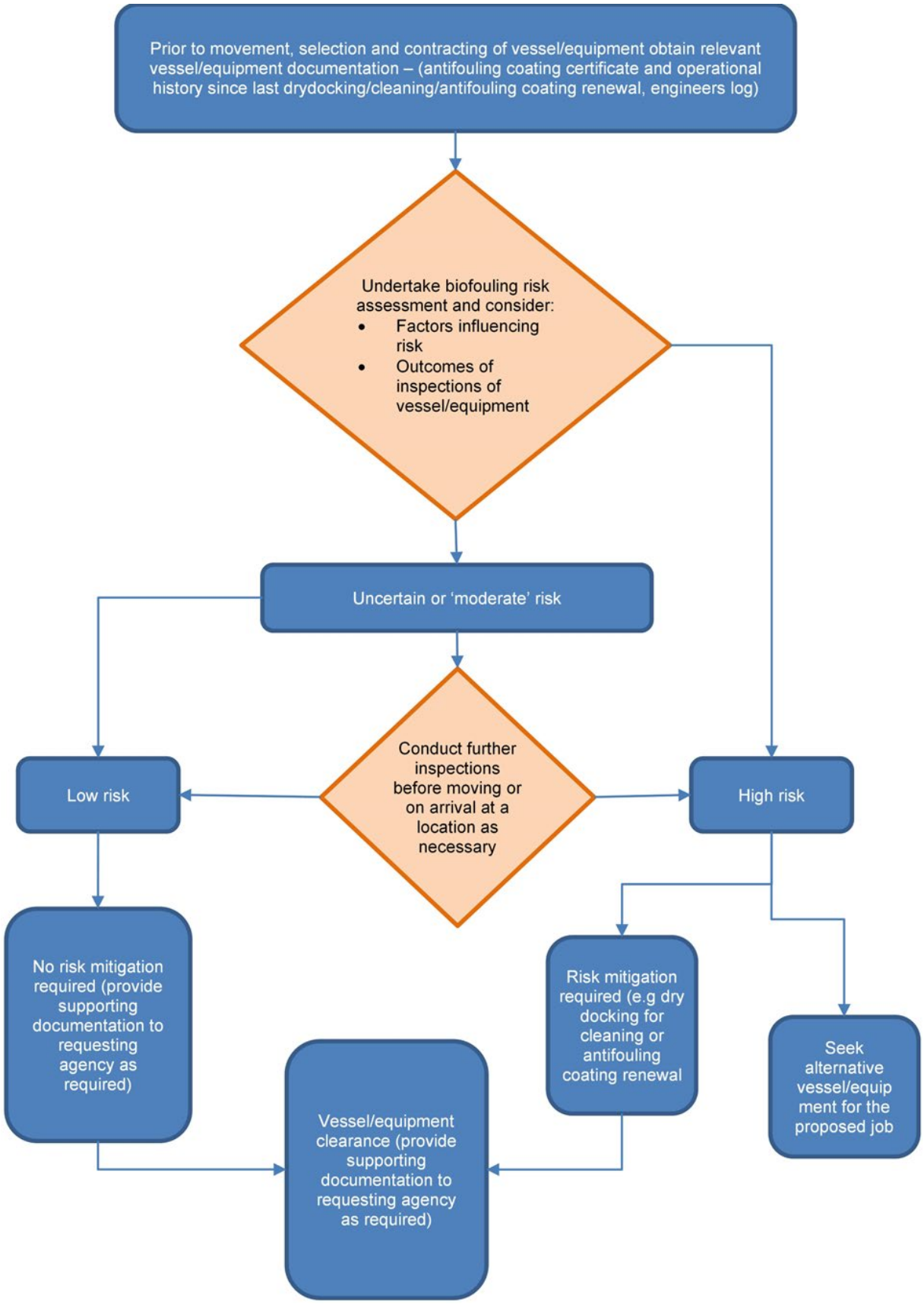
The outcome of the risk assessment will determine the management measures required. If the vessel is deemed as 'low' risk status, no other measures are required (providing the vessel does not exceed the 7-day threshold at stationary or slow speed, in waters outside Australia).

For vessels that are assessed as having an 'uncertain' or 'high' risk, contractors will engage a qualified IMS inspector to conduct inspections and/or provide advice on obtaining 'low' status. Table 8-4 lists mitigation measures that can be applied to achieve 'low' risk status.

Table 8-4: Biofouling mitigation measures

Mitigation measure	Overview
IMS inspection	Visual inspection of submerged surfaces and niche areas by a qualified biosecurity inspector to better understand the actual biosecurity risk.
In-water cleaning	The appropriateness of in-water cleaning operations must be a decision made closely with an IMS inspector on a case-by-case basis. Many factors will be considered, including: • degree and type of biofouling • location of biofouling on the vessel. Before undertaking in-water cleaning within Australia, approval from the relevant state/territory authority must be granted and conditions may be imposed. Application must be made to the administering authority (harbour master, local government or state/territory environmental protection agency) at least 5 working days before the proposed start of work.
Dry docking cleaning	Dry docking and removing/cleaning biofouling will include hull surfaces, niche areas such as sea chests, all retractable equipment such as thrusters, intakes and outlets, anodes and voids.
Temporal or spatial controls	Temporal or spatial controls to limit vessel exposure to sources of risk.
Applying anti fouling coating	Depending on its age, the vessel may require a new anti-fouling coating to be applied by professional operators. The anti-fouling coating type will be based on technical advice. All vessels more than 400 gross tonnage require a valid anti-fouling system certificate.
Treating internal sea water systems	In the absence of a marine growth prevention system, internal sea water systems may need to be cleaned. Cleaning actions may include:

Mitigation measure	Overview
	• dehydration • heat • physical removal • chemical treatment. Ideally, treating internal sea water systems will be undertaken before the vessel is mobilised to Australia. If chemical treatments are to be undertaken within Australian waters, advice must be sought from the Australian Pesticides and Veterinary Medical Authority (https://apvma.gov.au/) in relation to permit and reporting requirements—it is prohibited to clean internal systems in Australian waters without a permit.



Source: Marine Pest Sectoral Committee (2009)

Figure 8-1: Generic biofouling risk assessment process

8.7.6 Systems, practices and procedures

All activities associated with the Activity are identified, planned and implemented in accordance with relevant legislation, EP commitments and Santos' environment standards and procedures. Processes are in place to verify that the controls and performance standards contained in this EP are being implemented to manage environmental impacts and risks associated with the maintenance activities to ALARP and to an acceptable level.

8.7.7 Health, safety and environmental management system interfaces

The reel-lay and construction vessels will operate under their own safety case, which addresses generic aspects. The safety case revision documentation address project- and location-specific aspects, including the health, safety and environment management system interfaces between the contractor and Santos and any additional hazards/risks associated with specific operations of the Activity.

Santos and its contractor intend to have a clear demarcation of management system interfaces to ensure there will be no confusion between the roles and responsibilities of personnel, organisations, environmental management, procedures (such as the SURF safety case) and/or reporting structure.

8.8 Reporting and notifications

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.

8.8.1 Notifications and compliance reporting

Regulatory, other notification and compliance reporting requirements are summarised in Table 8-5.

Table 8-5: Activity notification and reporting requirements

Initiation	Required Information	Timing	Type	Recipient
Before the Activity				
AMSA/AHO (refer Table 4-14)	Notification of proposed start and end dates and any other relevant information for the Notice to Mariners to be issued. AMSA's Joint Rescue Coordination Centre (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 48 hours before vessel operations begin	Written	AMSA's JRCC **rccaus@amsa.gov.au**
		No less than 4 weeks before vessel operations begin	Written	AHO **datacentre@hydro.gov.au**
Quarterly updates	The Activity will be included in the Quarterly Update until the Activity has ended.	Quarterly	Online on Santos' website and automated notifications to registered/ subscribed interested parties	Relevant Persons and any other interested party who has registered or subscribed for quarterly updates.
DAFF (refer Table 4-14)	Santos will: • pursuant to the Commonwealth *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 DAFF before interacting with domestic vessels and aircraft • undertake pre-arrival approval for vessels arriving from an international location (where applicable) using MARS to meet DAFF's biosecurity reporting obligations.	Where applicable, apply for biosecurity risk assessment at least one month before Activity begins. MARS reporting at least 12 hours before arrival of international vessels.	Written	DAFF Biosecurity (vessels, aircraft and personnel). **https://www.agriculture.gov.au/biosecurity-trade/aircraft-vessels-military/vessels/mars**
DAFF (Fisheries)	Prior notification of planned Activity commencement for the purpose of awareness of potential impacts to Commonwealth fishery licence holders.	No less than 4 weeks prior to the start of activities.	Written	DAFF
Department of Defence	Prior notification of planned Activity commencement, for the purposes of: • consideration of Defence activities • consideration of restricted airspace	No less than 5 weeks prior to the start of activities.	Written	Department of Defence
Department of Primary Industries and Regional Development (DPIRD)	Prior notification of planned Activity commencement for the purpose of awareness of potential impacts to WA State fishery licence holders.	No less than 4 weeks prior to the start of activities.	Written	DPIRD
Western Australian Fishing Industry Council (WAFIC)	Prior notification of planned Activity commencement for the purpose of awareness of potential impacts to WA State fishery licence holders.	No less than 4 weeks prior to the start of activities.	Written	WAFIC
Marine user notifications to Relevant Persons identified in Table 8-6 (as may be updated from time to time).	Prior notification to Operational Area marine users of planned Activity commencement.	At least ten days before the Activity begins	Written	As indicated in Table 8-6 by email.
Tiwi Islands clan groups	Prior notification of planned Activity commencement.	At least 10 days before the Activity begins	Written	Tiwi Resources (on behalf of Tiwi Islands clan groups). Tiwi Resources will notify clan group representatives.
Other First Nations Groups, as agreed through the post acceptance	Prior notification of planned Activity commencement.	At least 10 days before the Activity begins	Written	As determined through the post acceptance consultation implementation process.

Initiation	Required Information	Timing	Type	Recipient
consultation implementation process. And through the NLC				
OPGGS(E)R 29 – Notification NOPSEMA must be notified that the activity is to begin	Complete NOPSEMA's Regulation 29 Start or End of Activity Notification form before the activity[29].	At least 10 days before the activity begins.	Written	NOPSEMA **https://securefile.nopsema.gov.au/filedrop/submissions**
OPGGS(E)R 30 – Notification NT Department of Industry, Tourism and Trade (DITT) must be notified that the Activity is to begin.	Activity commencement notification.	At least 10 days before the activity begins.	Written	NTDITT – Energy Division
During the Activity				
OPGGS(E)R 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. Report will also address progress of Santos' identification and/or implementation of sea country initiatives.	An environmental performance report will be submitted to NOPSEMA annually from the date of acceptance of this EP.	Written	NOPSEMA **https://securefile.nopsema.gov.au/filedrop/submissions**
OPGGS(E)R 26 and 26A – Reportable Incident NOPSEMA must be notified of any reportable incidents • A reportable incident is defined as per Section 8.6	The oral notification must contain: • all material facts and circumstances concerning the reportable incident known or able to be found out by reasonable search or enquiry • 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 2 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 1300 674 472
	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 **https://securefile.nopsema.gov.au/filedrop/submissions** National Offshore Petroleum Titles Administrator (NOPTA) **reporting@nopta.gov.au** Department of the responsible State or NT Minister
	A written report must contain: • all material facts and circumstances concerning the reportable incident known or that could be found out by reasonable search or enquiry • 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 Report using NOPSEMA's Report of an Accident, Dangerous Occurrence or Environmental Incident form[29].	Must be submitted as soon as practicable, and in any case not later than 3 days after the first occurrence of the reportable incident unless NOPSEMA specifies otherwise. Same report to be submitted to NOPTA and the Department of the responsible State or NT Minister within 7 days after giving the written report to NOPSEMA.	Written	NOPSEMA **https://securefile.nopsema.gov.au/filedrop/submissions** NOPTA **reporting@nopta.gov.au** Department of the responsible State or NT Minister

[29] **https://www.nopsema.gov.au/document-hub/forms-and-templates**

Initiation	Required Information	Timing	Type	Recipient
AMSA Reporting	Titleholder agrees to notify AMSA of any marine pollution incident[30].	Notification within 2 hours of incident.	Oral	AMSA JRCC 1800 641 792
	Harmful Substances Report[31] and situation report (SITREP) available online (refer OPEP [BAS-210 0109]).	Harmful Substances Report as requested by AMSA following verbal notification.	Written	AMSA JRCC rccaus@amsa.gov.au
DBCA-WA Reporting Notification in the event of a hydrocarbon release	Verbal notification of any hydrocarbon release.	Verbal notification as soon as reasonably practicable.	Oral	DBCA-WA Kimberly regional office
DNP 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 events that occur within a marine park or are likely to impact a marine park as soon as possible. Notification should be provided to the 24-hour Marine Compliance Duty Officer. 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 (BAS-210 0109) • confirmation of providing access to relevant monitoring and evaluation reports when available • contact details for the response coordinator. • Note: The DNP may request daily or weekly situation reports, depending on the scale and severity of the pollution incident.	As soon as reasonably practicable.	Oral	DNP (Marine Park Compliance Duty Officer) 0419 293 465
DCCEEW Reporting • Any harm or mortality to EPBC Act listed threatened marine fauna • Discovery of underwater cultural heritage	Notification of any harm or mortality to an EPBC Act listed species of marine fauna whether attributable to the activity or not.	Email notification within 7 days.	Written	DCCEEW **EPBC.permits@environment.gov.au**
	If MNES are considered at risk from a spill or response strategy, or where there is death or injury to a protected species.	Email notification as soon as practicable.	Written	DCCEEW (Director of Monitoring and Audit section)
	Underwater cultural heritage details recorded in online database if discovered during activity and notified to DCCEEW.	As soon as practicable, in any case no later than 21 days after discovery.	Written	DCCEEW
Australian Marine Mammal Centre Reporting (DCCEEW) Any ship strike incident with cetaceans will 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	DCCEEW
NT DEPWS **NT EPA** All actual or impending spills in NT waters	Verbal reporting will transfer sufficient information to conduct a coordinated emergency response. All reporting will be performed by the vessel master as per the vessel–specific SOPEP.	As soon as practicable.	Oral	DEPWS; NT EPA (Pollution response hotline; Environmental Operations)
	Written reports will contain all material facts and circumstances concerning the reportable incident, actions taken to avoid or mitigate any adverse impacts, and corrective action taken.	Written report as soon as practicable.	Written	DEPWS; NT EPA (Pollution response hotline; Environmental Operations)
AFMA	Verbal notification if any spill may affect Commonwealth-managed fisheries within the EMBA.	Verbal notification within 8 hours.	Verbal	AFMA

[30] 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.

[31] https://www.amsa.gov.au/forms/harmful-substances-report-polrep-oil

Initiation	Required Information	Timing	Type	Recipient
Department of Foreign Affairs and Trade (DFAT)	Any oil spill that has entered or is likely to enter international waters.	Verbal phone call notification within 8 hours, if the spill is likely to extend into international waters.	Verbal	DFAT (24-hour consular emergency centre)
		Follow up with email outlining details of incident.	Written	DFAT (24-hour consular emergency centre)
Consultation with AMSA (Table 4-14)	Notification of updates to both AHO and JRCC on progress and, importantly, any changes to the intended operations.	As soon as possible.	Written	AMSA's JRCC AHO
Unexpected Finds Protocol (BAS-210 0051) Santos procedure with internal timing notification requirements.	Notification of the discovery of an unexpected find.	Verbal notification within 2 hours.	Verbal	Cosmos Archaeology (Maritime Archaeologist) or other archaeology consultant +612 9568 5800 **inquiries@cosmosarch.com**
Tiwi Resources (Ranger Coordinator), Tiwi Land Council and Munupi Clan members	Notification of all spills heading towards the Tiwi Islands.	Within eight hours of incident being identified	Oral – by phone call	Tiwi Resources (Ranger Coordinator), Tiwi Land Council and nominated Munupi Clan members (per OPEP (BAS-210 0109), Table 7-1), subject to obtaining relevant email addresses
	Follow up email notification outlining details of incident.	After oral notification.	Written	
Other First Nations Groups, as agreed through the post acceptance consultation implementation process and through the NLC	Notification of all spills heading towards the relevant parties' interests.	Within eight hours of incident being identified.	Oral – by phone call	As determined through the post acceptance consultation implementation process.
	Follow up email notification outlining details of incident.	After oral notification.	Written	As determined through the post acceptance consultation implementation process.
End of the Activity				
OPGGS(E)R 29 – Notifications NOPSEMA must be notified that the activity is completed	Complete NOPSEMA's Regulation 29 Start or End of Activity Notification form[29].	Within 10 days after completion of the activity.	Phone call and written	NOPSEMA **https://securefile.nopsema.gov.au/filedrop/submissions**
OPGGS(E)R 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[29].	At the completion of the Activity and all EP obligations.	Written	NOPSEMA **https://securefile.nopsema.gov.au/filedrop/submissions**
AMSA (JRCC) consultation	Notification that activity has completed.	Within 10 days of completion.	Written	JRCC
AHO	Notification that activity has completed.	Within 10 days of completion.	Written	AHO
DAFF	Notification that Activity has completed.	Within ten days of completion.	Written	DAFF
DoD	Notification that Activity has completed.	Within ten days of completion.	Written	DoD
DPIRD	Notification that Activity has completed.	Within ten days of completion.	Written	DPIRD
WAFIC	Notification that Activity has completed.	Within ten days of completion.	Written	WAFIC
Marine user notifications to Relevant Persons identified as in Table 8.5 (as may be updated from time to time).	Notification to OA marine users that Activity has completed.	Within ten days of completion.	Written	As indicated in Table 8-6 by email

Initiation	Required Information	Timing	Type	Recipient
Tiwi Islands clan groups	Notification that Activity has completed.	Within ten days of completion.	Written	Tiwi Resources (on behalf of Tiwi Islands clan groups). Tiwi Resources will notify clan group representatives.
Other First Nations Groups, as agreed through the post acceptance consultation implementation process and through the NLC	Notification that Activity has completed.	Within ten days of completion.	Written	As determined through the post acceptance consultation implementation process.

Table 8-6: Marine user notification recipients

Person to be issued marine user notifications	Notification Recipient
Australian Border Force (ABF)	ABF
Australian Fisheries Management Authority (AFMA)	AFMA
Australian Institute of Marine Science (AIMS)	AIMS
Department of Defence – Navy (DoD – Navy)	DoD - Navy
NT Department of Industry, Tourism & Trade - Fisheries (NTDITT – Fisheries Division)	NTDITT - Fisheries
NT Seafood Council (NTSC)	NTSC
NT Guided Fishing Industry Association	NT Guided Fishing Industry Association
Tourism NT	Tourism NT
Top End Tourism	Top End Tourism
Northern Prawn Fishing Industry Pty Ltd (NPFI)	NPFI
Northern Prawn Fishery commercial licence-holders	NPFI
Northern Territory Seafood Council (NTSC)	NTSC
NT Timor Reef Fishery commercial licence holders	NTSC
Australian Southern Bluefin Tuna Industry Association (ASBTIA)	ASBTIA
Southern Bluefin Tuna Fishery licence-holders	ASBTIA and AFMA
Western Skipjack Tuna Fishery licence-holders	ASBTIA and AFMA
Western Tuna and Billfish Fishery licence-holders	ASBTIA and AFMA
Aquarium Fishery licence-holders	NTSC and NTDITT – Fisheries Division
Spanish Mackerel Fishery licence-holders	NTSC and NTDITT – Fisheries Division
Demersal Fishery licence-holders	NTSC and NTDITT – Fisheries Division
Offshore Net and Line Fishery licence-holders	NTSC and NTDITT – Fisheries Division
Small Pelagic (Development) Fishery licence-holders	NTSC and NTDITT – Fisheries Division
Pearl Oyster Fishery licence-holders	NTSC and NTDITT – Fisheries Division
Eni Australia Ltd	Eni Australia Ltd
Woodside Energy Ltd	Woodside Energy Ltd
INPEX Ichthys Pty Ltd	INPEX Ichthys Pty Ltd

8.8.2 Monitoring and recording 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.

Discharges to the marine environment associated with this activity will be recorded and controlled in accordance with requirements under relevant Marine Orders and/or MARPOL requirements.

Santos and vessel contractors will maintain records so that emissions and discharges can be determined or estimated. Such records will be maintained for 5 years. Contractors must make these records available upon request.

In addition, Santos will maintain records of discharges or emissions (where practicable), to the environment as described in Table 8-7.

Table 8-7: Monitoring of emissions and discharges

Discharge/emission	Parameter	Quantitative record
Pre-commissioning fluids	Volumes consumed	Volumes used will be estimated based on known inventories
Air emissions	Fuel volume	GHG calculations based on measured fuel use in accordance with NGER reporting requirements
Oily water	Volume and location	Oil Record Book* or equivalent report
Ballast water	Volume and location	Ballast water log
Garbage (including food scraps)	Volume and location	Volumes recorded in Garbage Record Book*
Sewage	Volume and location	Estimated based on POB and days on location
Unplanned discharge of: • solid objects • hazardous liquids	Volume	NOPSEMA recordable or reportable incident reports as per Table 8-5
Unplanned hydrocarbon release	Volume	NOPSEMA recordable or reportable incident reports as per Table 8-5

** Maintained as per vessel class in accordance with relevant Marine Orders.*

8.9 Document management

8.9.1 Information management and document control

This EP and OPEP (BAS-210 0109), as well as approved MoC documents, are controlled documents and current versions will be available on Santos' intranet. Santos contractors are required to maintain current versions of these documents.

EPOs and EPSs will be measured based on the measurement criteria listed in Table 8-2. Such records will be maintained for 5 years. Contractors must make these records available upon request.

8.9.2 Management of change

The MoC process (EA-91-IQ-10001) provides a systematic approach to initiate, assess, approve, implement and close out actions associated with the change in Activity. Implementation of the MoC process is designed so that all activities undertaken by Santos are in full compliance with regulatory approvals and conditions and that changes have been properly considered, risk assessed, approved and communicated to all appropriate stakeholders accompanied by a detailed record of the change in Activity.

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 must be submitted to NOPSEMA. Additional consultation with Relevant Persons may be appropriate in order to complete the MoC process, depending on the nature and scale of the change.

The MoC procedure also allows for the assessment of new information that may become available after EP acceptance. When feedback is received from external stakeholders, consideration will be given as to whether it includes information concerning the environmental impacts or risks of Santos' activities, and if so, whether these impacts or risks were provided for in the relevant approval documentation (e.g. in this EP). If not provided for, the MoC process will be initiated in a timely manner in order for the significance of the new or increased impacts or risks to be assessed.

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 CM or EPS changes are communicated to the workforce and implemented. Any MoC will be distributed to the relevant roles identified in Table 8-3, and the most relevant management position is responsible for communication and implementation of the MoC. This may include crew meetings, briefings or communications as appropriate for the change.

8.9.3 Reviews

This EP has assessed impacts and risk across the entire OA, during any time of the year, for planned and unplanned events given the nature of the 24/7 operations and the length of time for which the Activity will continue.

It is recognised that during the period for which this EP is in force, the following may change:

- legislation
- businesses conditions, activities, systems, processes and people
- industry practices
- science and technology
- societal, and relevant and interested persons expectations.

The following tasks are undertaken so that Santos maintains up-to-date knowledge of the industry, legislation and conservation advice:

- maintain membership of Australian Energy Producers (formerly Australian Petroleum Production and Exploration Association) 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
- undertake annual spill response exercises to check spill response arrangements and capability are adequate

- undertake post acceptance implementation consultation with relevant and interested persons as outlined in Section 8.11
- subscribe to various regulator updates
- have regular liaison meetings with NOPSEMA.

If identified changes have an impact on the Activity or risks described and assessed in this EP that may trigger a requirement under regulations 7, 8 or 17, the changes will be reviewed and any changes required to the EP are to be assessed and documented in accordance with Santos' MoC procedure (Section 8.9.2).

8.10 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.

8.10.1 Assurance and audits

Santos maintains a risk based activity assurance and audit schedule which is reviewed and updated from time to time.

Assurance activities and audits will be undertaken in a manner consistent with Santos' Assurance Operating Standard (SMS-LRG-OS03).

During the Activity, an assurance review against the EP and/or OPEP will be performed at least annually, and may be desktop only or include a field-based component.

Assurance and audit findings may include opportunities for improvement and non-conformances. Audit non-conformances are managed as described in Section 8.10.3.

8.10.2 Inspections

HSE inspections will be conducted at the following frequency to identify hazards, incidents and nonconformances with this EP:

- Reel-lay and construction vessels – minimum weekly
- Support and supply vessels – minimum monthly

These inspections will also check compliance against a selection of the EPOs and EPSs of this EP (Table 8-2) and inform end-of-activity reporting (Table 8-5).

8.10.3 Nonconformance management

EP non-compliances will be addressed and resolved by a systematic corrective action process as outlined in Santos' Compliance Operating Standard (SMS-LRG-OS04). Non-compliances arising from audits and inspections will be entered into Santos' incident and action tracking management system (i.e. HSE Toolbox). 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.

8.10.4 Continuous improvement

For this EP, continuous improvement will be driven by:

- 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
- actions taken to address objections or claims, and issues raised during the post acceptance consultation implementation process (Section 8.11).

This may result in a review of the EP, with changes applied in accordance with Section 8.9.2.

Identified continuous improvement opportunities will be assessed in accordance with the MoC process so that any potential changes to this EP, or OPEP (BAS-210 0109), are managed in accordance with the OPGGS(E)R and in a controlled manner.

8.11 Post acceptance consultation implementation strategy

OPGGS(E)R 2009 Requirements
Regulation 14(9)
The implementation strategy must provide for appropriate consultation with: • relevant authorities of the Commonwealth, a State or Territory; and • other relevant interested persons or organisations.

Santos is committed to appropriate post acceptance consultation implementation for this Activity with relevant government authorities and other relevant interested persons and organisations. Having regard to the nature of relevant interested persons and organisations, Santos' post acceptance consultation implementation strategy has been tailored to provide for effective consultation with different groups, based on Santos' experience consulting with these groups previously.

8.11.1 Post-consultation implementation strategy with First Nations Groups

Santos will undertake consultation over the life of the activity primarily through representative organisations. Having regard to Santos' experience consulting with First Nations groups, and feedback from First Nations relevant persons, Santos considers that consultation through representative bodies provides an appropriate mechanism for ongoing consultation with First Nations relevant interested persons, in that representative bodies provide for regular, culturally appropriate engagement with First Nations persons in order to ensure information can be disseminated to communities regularly and in a manner which is readily accessible to First Nations group. Consultation will be undertaken on a regular basis, particularly through activity planning and execution, with nominated representatives (as nominated by each of the representative organisations) of the:

- NLC, TLC and KLC.
- Tiwi Islands people.
- Mulurryud Consultative Committee (Croker Island people)
- Other First Nations people who wish to be consulted going forward.

More broadly, Santos is seeking to establish a network of consultative committees to support consultation activities for other proposed regional activities, building on the consultation model developed by the representatives of the Mulurryud Consultative Committee in response to Santos' engagement activities.

Santos recognises the Mulurryud Consultative Committee as a representative forum for the purpose of Reg 11A consultation. Santos has been provided a copy of the Committee's charter, which includes details the committee's purpose of enabling culturally appropriate consultation with the Croker Island people through committee membership representing and comprising First Nations and custodians of Croker Island and surrounding sea country.

To this end Santos will continue to work with its external First Nations cultural advisers to help identify where consultative committees should be established for other Santos activities based on activity-specific impacts and risks. Santos recognises that the connectedness of these cultural advisers have to regional communities and the role they play in interpreting technical industry information for communities where English may be a fifth language.

Post-implementation consultation will include consideration of culturally appropriate management measures where First Nations people believe that there may be impacts or risks, or have concerns with regards to:

- traditional lands and waters
- sea country interests
- totemic species
- other cultural values or sensitivities of importance

As per the Croker Island model, it is envisaged that other regional committees will self-determine committee membership to be representative of those who have authority to speak for country in accordance with traditional lore and custom.

Santos acknowledges that these committees will provide appropriate fora for consultation, complementary to those activities undertaken through Land Councils and Aboriginal Corporations which typically have more legally defined representative functions.

The activities of these committees are proposed to be supplemented with broader community information sessions, as well as regular updates to Land Councils and Aboriginal Corporations on activity milestones and achievements.

Santos will also, through relevant Land Councils (who are relevant persons), consult about worthwhile First Nations initiatives that could include, but are not necessarily be limited to:

- employment of cultural awareness community observers (CACOs), who will conduct cultural awareness inductions for field base staff across each of the major work packages
- support of ranger programs subject to the availability and participation of Ranger Groups, and studies to help First Nations people preserve environmental and cultural features and values
- seeking to facilitate employment opportunities for First Nations people as trainee HSE advisors for the Activity, subject to the availability and participation of First Nations trainees, with a view to them obtaining HSE qualifications and competencies to enable future ongoing employment in HSE. Further, Santos plans to discuss the way in which it might be able to facilitate presentations by the trainee advisers to their communities about HSE management of the Activity.
- periodic community townhalls across regional locations relevant to the Barossa Project, to provide Project updates and to provide an opportunity for feedback from CACOs
- Santos will facilitate trips to the Activity site, at intervals (as necessary), taking into account cultural advice as to the most appropriate clan members to attend such trips.

Santos acknowledges that some First Nations clans and individuals consider that they have cultural and spiritual beliefs and connections to the seas. Section 3.2.5 details Santos understanding of cultural features including tangible and intangible cultural artifacts, practices and beliefs. Santos is committed to working with relevant land councils, other First Nations organisations, and cultural liaisons to ensure that relevant senior and authoritative First Nations community members are engaged with Santos on the identification and implementation of any other appropriate cultural practices by Santos in relation to intangible spiritual and/or cultural heritage connections and beliefs that they commonly use when travelling through country where they believe spiritual beings may exist. For example, a common practice is the use of ceremonies to introduce activities or the presence of strangers to spiritual beings.

8.11.2 Post-consultation implementation strategy - approach

Formal acceptance of the EP will be communicated via the NOPSEMA website. Santos will also provide access to the EP via the NOPSEMA website and will provide details on the Santos website on how to provide ongoing feedback in relation to the Activity.

Activity notifications and reports will be made in accordance with Table 8-5. The notifications and reports are based on legislative requirements, standing arrangements with particular Relevant Persons, Relevant Persons' requests for notification made during Regulation 11A consultation or as otherwise deemed appropriate by Santos.

Following Activity commencement, Santos will provide quarterly updates on the Activity. The updates will be posted on Santos' website, with notifications to registered / subscribed interested parties.

Santos will continue to accept, assess and respond to post acceptance consultation feedback during the life of the Activity. Records of any post acceptance consultation will be maintained in an appropriate Santos consultation database.

If, during the course of post acceptance consultation, Santos receives information demonstrating a new or increased environmental impact or risk that is not provided for in this EP, as in force at the time, Santos will apply its MoC process outlined in Section 8.9.2.

Santos will maintain a database of relevant authorities, and other relevant interested persons and organisations for this Activity. This includes updating its database in light of post acceptance consultation, including identification of new Relevant Persons, and information obtained during Regulation 11A consultation in the preparation of subsequent EPs for the Barossa Gas Project. This database will be used to inform the Activity notifications as detailed in Table 8-5.

Santos is developing a community engagement package with senior representatives of the communities on the Tiwi and Croker Islands that will include the above suggestions and other initiatives to ensure that the First Nations people and communities will share in the benefits of Barossa Gas Project proceeding.

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Title	Document No.
Assurance Operating Standard	SMS-LRG-OS03
Assurance Procedure	SMS-LRG-OS03-PD01
Barossa Darwin Pipeline Duplication Environment Plan	BAA-210 0074
Barossa Development Drilling and Completions Environment Plan	BAD-200 0003
Barossa Development Subsea Infrastructure Installation Oil Pollution Emergency Plan (OPEP)	BAS-210 0109
Barossa Gas Export Pipeline Installation Environment Plan	BAA-210 0010
Barossa Interface Management Plan	To be developed
Barossa Manufacturing Record Book Index Requirements	BAA-100 0238
Barossa Production Operations Environment Plan	BAA-200 0637
Barossa Project Environmental Compliance Assurance Plan	BAA-200 0635
Barossa Unexpected Finds Protocol	BAS-210 0051
Compliance Operating Standard	SMS-LRG-OS04
Environment Management of Change Procedure	EA-91-IQ-10001
HSE Contractor Management Operating Standard	SMS-HSS-OS08
Marine Offshore Assurance Criteria	1530-045-STN-0001
Marine Operations Manual	IOSC/OPS/HBK/0003
Offshore Division Environmental Hazard Identification and Assessment Guideline	EA-91-IG-00004
Offshore Division Operations Chemical Approval Procedure	EA-91-II-10001
Offshore Marine Assurance Procedure	SO-91-ZH-10001
Protected Marine Fauna Interaction and Sighting Procedure	EA-91-II-00003
Risk Management Policy	QE-91-IF-10050
Risk Management Procedure	SMS-MS1-ST01-TP1
Risk Management Standard	SMS-MS1
SURF Values & Sensitivities of the Marine Environment	BAS-210 0132
Wildlife Framework Plan	SO-91-BI-20014

Appendix A Santos' environment, health and safety policy

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:	David Banks, Chief Operating Officer		
Approved by:	The Board	Version:	3

15 August 2022

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Appendix B Requirements (including legislative requirements) applicable to the Activity

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
Commonwealth				
Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (Cth) (ATSIHP Act)	This Act provides for the preservation and protection from injury or desecration areas and objects in Australia and Australian waters that are of significance to Aboriginal people in accordance with Aboriginal tradition. 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 – the ATSIHP Act is not directly relevant to the environmental management of the Activity as there are no areas within the OA or the EMBA that have been the subject of a 'significant Aboriginal areas' declaration under the ATSIHP Act. However, in the event such areas are declared in the future, this Act could potentially become relevant to the activities. Accordingly, this Act has been identified for completeness.	Commonwealth – Attorney-General's Department DCCEEW	There are no requirements arising under the ATSIHP Act that apply to the environmental management of the Activity. Refer to Sections 3.2.4.8 and 3.2.5 in relation to relevant heritage values and cultural features more broadly.
Aboriginal Land Rights (Northern Territory) Act 1976 (Cth) (ALR Act)	An Act providing for the granting of Traditional Aboriginal Land in the NT for the benefit of Aboriginals, and for other purposes. Establishes Land Councils and enables them to operate.	No – the ALR Act is not directly relevant to environmental management of the Activity. There are no predicted impacts to land or nearshore locations (including the Tiwi Islands) associated with the Activity. However, the TLC which is established under the ALR Act, represents Tiwi people in the protection of land, sea and environment. Accordingly, this Act	Commonwealth – Attorney-General's Department Commonwealth – Department of the Prime Minister and Cabinet Tiwi Land Council (TLC)	There are no requirements arising under the ALR Act that apply to the environmental management of the Activity. Refer to Sections 3.2.4.8 and 3.2.5 in relation to relevant heritage values and cultural features more broadly. Refer also to Section 3.2.5.10 in relation to consultation with the TLC and Tiwi people.

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
		has been identified for completeness (and to provide context for the consultation undertaken by Santos with the TLC and Tiwi people in the course of preparing this environment plan).		
Australian Maritime Safety Authority Act 1990 (Cth) (AMSA Act)	This Act establishes the Australian Maritime Safety Authority (AMSA), which manages the National Plan for Maritime Environmental Emergencies in coordination with industry. AMSA is also responsible for administering Marine Orders in Commonwealth waters. The Act also aims to promote maritime safety, protect the marine environment from pollution and environmental damage from ships, provide for a national search and rescue service and promote the efficient provision of service by 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.	Yes – while the Act does not contain any explicit requirements relevant to the environmental management of the Activity, it establishes and sets out the functions of AMSA, which functions relate to environmental management including in respect of response to spill events and administration of marine orders.	AMSA Commonwealth – Department of Infrastructure, Transport, Regional Development, Communications and the Arts	AMSA has been consulted as a Relevant Person – refer to Section 3.2.5.10 in preparing the EP, and will be notified throughout activities in accordance with Table 8-3. AMSA's relevant functions are described in Section 7.6.

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
Biosecurity Act 2015 (Cth) Biosecurity Regulation 2016 (Cth) Australian Ballast Water Management Requirements, Version 8	This Act relates to the management of diseases and pests that may cause harm to human, animal or plant health or the environment. The Act includes provisions for ballast water management plans and certificates, record keeping obligations and powers to ensure compliance. 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. Australian Ballast Water Management Requirements outline the mandatory ballast water management requirements to reduce the risk of introducing invasive marine species (IMS) into Australia's marine environment through ballast water from international vessels. These requirements are enforceable under the *Biosecurity Act 2015* (Cth) and include obligations under the International	Yes - this Act and Regulations apply to all foreign vessels operating in Australian waters and these vessels must comply with the Australian Ballast Water Management Requirements.	DAFF	Refer to Section 7.2 and Section 8 which contains control measures in respect of the implementation of the Australian Ballast Water Management Requirements 2017.

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
	Convention for the Control and Management of Ships' Ballast Water and Sediments.			
Climate Change Act 2022 (Cth) (Climate Act)	The Climate Act commenced in September 2022. The Climate Act sets out Australia's net-zero commitments and codifies Australia's net 2030 and 2050 GHG emissions reductions targets under the Paris Agreement.	While the energy industry is not subject to direct obligations under this Act, this Act legislates Australia's emissions net zero targets by 2050.	Commonwealth – Climate Change Authority	Refer to Section 6.5 which refers to Santos' Climate Change Policy.
Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) Environment Protection and Biodiversity Conservation Regulations 2000 (Cth)	While the OPGGS (E) Regulations under the OPGGS Act (see below) regulate day to day petroleum activities and apply to any activity that may have an impact on the environment, the EPBC Act regulates the assessment and approval of proposed actions that are likely to have a significant impact on a matter of National Environmental Significance (MNES). Actions that are likely to have a significant impact on a MNES referral under the EPBC Act; the assessment process is administered by the Department of Climate Change, Energy, the Environment and Water. Schedule 8 of the EPBC Regulations outlines the Australian IUCN Reserve Management Principles.	Yes – the EPBC Act applies to all aspects of the Activity that have the potential to impact MNES, and the Regulations contain requirements regarding interactions with cetaceans. The Barossa Gas Project, including the Activity, will be undertaken in accordance with the 'class approval' granted by the Commonwealth Environment Minister under the EPBC Act on 27 February 2014. This approval applies to petroleum activities that are taken in Commonwealth waters in accordance with an endorsed program (being the environmental management authorisation process administered by NOPSEMA under the OPGGS Act and the OPGGS (E) Regulations).	DCCEEW NOPSEMA	The Barossa Development is approved under the EPBC Act. Refer to Sections 3.2 – Environmental Values and Sensitivities as well as Sections 6 and 7 – Planned impacts and unplanned events for treatment of MNES. Consideration has also been afforded to Section 527E of the EPBC Act. See the note below this table (Appendix B.1) containing Santos' approach to addressing the requirements of Section 527E.

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
	Further, the Regulations provide for the protection and conservation of cetaceans, and create various offences for actions that may endanger them.			
Fisheries Management Act 1991 (Cth) (FM Act)	Management plans for fisheries are established under the FM Act, and this Act also sets out the legislative basis for Statutory Fishing Rights (SFRs), licences and permits. The Act defines the Australian Fishing Zone (AFZ) and provides for the majority of Commonwealth fisheries offences. The Act also establishes the functions of the AMFA, including in relation to the pursuit of ecologically sustainable development.	No – the FM Act is not directly relevant to the environmental management of the Activity. However, in the event of a spill, the Act provides the regulatory framework for any necessary fisheries management decisions in Commonwealth waters. Further, the AFMA is responsible for managing Commonwealth fisheries and is a relevant agency where the Activity has the potential to impact on fisheries resources in AFMA managed fisheries. The OA overlaps four Commonwealth commercial fisheries managed by the AFMA, with the EMBA overlapping one additional Commonwealth fishery. Accordingly, this Act has been identified for completeness (and to provide context for the consultation undertaken by Santos with the AFMA in the course of preparing this environment plan).	AFMA DAFF	There are no requirements arising under the FM Act that apply to the environmental management of the Activity, however as to aspects of this EP relevant to AFMA's functions, see: Section 3.2.4.1– Commercial Fisheries Section 3.2.5.10 – Consultation Sections 6 and 7 – Planned impacts and unplanned events
Marine Orders	Marine Orders are subordinate rules made pursuant to the *Navigation Act 2012* (Cth),	Yes - various Marine Orders apply to activities under this EP, including in relation to vessel	AMSA	Discharges to the marine environment will be recorded and controlled in accordance with

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
	Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (Cth), *Protection of the Sea (Harmful Anti-Fouling Systems) Act 2006* (Cth) and the *Marine Safety (Domestic Commercial Vessel) National Law Act 2012* (Cth) affecting the maritime industry. They are a means of implementing Australia's international maritime obligations by giving effect to international conventions in Australian law.	movements, safety, discharges and emissions. The Marine Orders (MO) relevant to this EP include: • MO 21 - Safety and emergency arrangements • MO 27 – Safety of navigation and radio equipment • MO 30 – Prevention of collisions • MO 41 – Carriage of Dangerous Goods • Marine Order 71 Masters and deck officers • MO 91 – Marine pollution prevention - oil • MO 93 – Marine pollution prevention – noxious liquid substances • MO 94 – Marine pollution prevention – packaged harmful substances • MO 95 – Marine pollution prevention - garbage • MO 96 – Marine pollution prevention - sewage • MO 97 – Marine pollution prevention – air pollution • MO 98 – Marine pollution – anti-fouling systems		relevant marine orders – refer Section 8.8.2. Santos has implemented control measures directed to ensuring compliance with Marine Orders – refer to Section 8.2.1. Sections 6.5, 6.6, 7.1, 7.2, 7.4, 7.5, 7.6 and 7.7 are relevant to the implementation of Marine Orders.

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
Marine Safety (Domestic Commercial Vessel) National Law Act 2012 (Cth) Marine Safety (Domestic Commercial Vessel) National Law Regulation 2013 (Cth)	This Act is a single regulatory framework for the certification, construction, equipment, design and operation of domestic commercial vessels inside Australia's exclusive economic zone. The Act names AMSA as the National Marine Safety Regulator and confers functions on AMSA in relation to marine safety, including that AMSA may make and maintain Marine Orders. The Regulations under the Act set out the definition of a vessel and details and requirements of the accredited marine surveyor scheme.	Yes – all vessel movements associated with the Activity will be governed by AMSA marine safety regulations under the Act. The Act also imposes duties on owners, masters and crew of domestic commercial vessels in relation to the safety of the vessel, relevant to the owners, masters and crew of any Australian Activity vessels under this EP. The Act also sets requirements in relation to the survey of marine vessels which any Australian Activity vessels must comply with.	AMSA	Santos, when engaging vessel contractors, shall assure the vessel contractors compliance with applicable maritime law and regulations (Section 6.1, 6.3, 6.4, 6.5, 7.5, 7.6 and 7.7).
National Biofouling Management Guidelines for the Petroleum Production and Exploration Industry 2009	The guidance document provides recommendations for the management of biofouling hazards by the petroleum industry.	Yes - applying the recommendations within this document and implementing effective biofouling controls can reduce the risk of the introduction of IMS.	DAFF	Refer to Section 7.2 and especially to Section 7.2.6 which confirms that management is consistent with this Guideline.
National Greenhouse and Energy Reporting Act 2007 (Cth) (NGER Act) National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015	The NGER Act applies to the atmospheric emissions through combustion engine use to operate the vessels associated with the Activity. The NGER Act provides for a single national reporting framework for the reporting and dissemination of information about greenhouse gas emissions,	Yes - the Barossa Gas Project will be a designated large facility under the NGER Act and as such will be subject to the Safeguard Mechanism. This means that Santos, among other things, will have an obligation to ensure that the net covered emissions of GHGs from the operation of the	DCCEEW Clean Energy Regulator Climate Change Authority	Refer to Section 6.5

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
	greenhouse gas projects and energy use and production of corporations. The Safeguard Mechanism is also administered under the NGER Act.	Barossa Gas Project do not exceed the applicable baseline.		
Native Title Act 1993 (Cth) (NT Act)	The NT Act recognises the rights and interests of Aboriginal and Torres Strait Islander people in land and waters according to their traditional laws and customs, and creates processes through which native title can be recognised and protected. Under s 280(2) of the OPGGS Act, petroleum activities must be carried out in a manner that does not interfere with the enjoyment of native title rights and interests under the NT Act to a greater extent than necessary.	No – the NT Act is not directly relevant to environmental management of the Activity. There are no native title claims or determinations within the OA or the EMBA. However, the NLC is a Representative Aboriginal/Torres Strait Islander Body under the NT Act for parts of the OA and EMBA. Accordingly, this Act has been identified for completeness (and to provide context for the consultation undertaken by Santos with the NLC in the course of preparing this environment plan).	Commonwealth – Attorney-General's Department Commonwealth – Department of the Prime Minister and Cabinet National Native Title Tribunal Federal Court of Australia	There are no requirements arising under the NT Act that apply to the environmental management of the Activity. Refer to Sections 3.2.4.8 and 3.2.5 in relation to relevant heritage values and cultural features more broadly. Refer also to Section 3.2.5.10 in relation to consultation with NLC.
Navigation Act 2012 (Cth)	The Act aims to promote the SOLAS and safe navigation, prevent pollution of the marine environment and ensure AMSA has the power to carry out inspection of vessels and enforce national and international standards. Specifically, this Act empowers AMSA to make Marine Orders, which are legislative instruments, with respect to any	Yes – all vessel movements associated with the Activity will be governed by marine safety regulations and Marine Orders under the Act. See Marine Orders, above.	AMSA Commonwealth - Department of Infrastructure, Transport, Regional Development, Communications and the Arts	Santos, when engaging vessel contractors, shall assure the vessel contractors compliance with applicable maritime law and regulations (Section 6.1, 7.6 and 7.7).

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
	matter for which provision must or may be made by the regulations. A number of Marine Orders enacted under this Act apply directly to offshore petroleum activities: • Marine Order 21: Safety and emergency arrangements • Marine Order 27: Safety of navigation and radio equipment • Marine Order 30: Prevention of collisions • Marine Order 41: Carriage of Dangerous Goods • Marine Order 58: Safe management of vessels • Marine Order 71 Masters and deck officers AMSA has the authority and responsibility for the operational activities under the Act, including vessel certification, seafarers' qualifications, marine pollution prevention, monitoring and enforcement activities.			
Offshore Petroleum and Greenhouse Gas Storage Act 2006 (Cth) Offshore Petroleum and Greenhouse Gas Storage (Environment)	Petroleum exploration and development activities in Australia's offshore areas are subject to the environmental requirements specified in the OPGGS Act and associated	Yes – activities under the EP are to be performed: • consistent with the principles of ecologically sustainable development as set out in	NOPSEMA DISR	Requirements under the OPGGS Act and associated Regulations are addressed throughout this EP.

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
Regulations 2009 (Cth)	Regulations. The OPGGS Act contains a broad requirement for titleholders to operate in accordance with 'good oil-field practice'. Specific environmental provisions relating to work practices essentially require operators to control and prevent the escape of wastes and petroleum. The Act also requires that activities are carried out in a manner that does not unduly interfere with other rights or interests, including the conservation of the resources of the sea and seabed, such as fishing or shipping. In some cases, where there are particular environmental sensitivities or multiple use issues it may be necessary to apply special conditions to an exploration permit area. The holder of a petroleum title must maintain adequate insurance against expenses or liabilities arising from activities in the title, including expenses relating to clean-up or other remedying of the effects of the escape of petroleum. The OPGGS(E)R provide an objective based regime for the management of environmental performance for Australian	section 3A of the EPBC Act; and • so environmental impacts and risks of the Activity are reduced to ALARP and are of an acceptable level. This EP must demonstrate that the Activity will be undertaken in line with the principles of ecologically sustainable development, and that impacts and risks resulting from these activities are ALARP and acceptable.		

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
	offshore petroleum exploration and production activities in areas of Commonwealth jurisdiction. Key objectives of the OPGGS(E)R include to: • ensure operations are performed in a way that is consistent with the principles of ecologically sustainable development • adopt best practice to achieve agreed environment protection standards in industry operations • encourage industry to continuously improve its environmental performance.			
Ozone Protection and Synthetic Greenhouse Gas Management Act 1989 (Cth) Ozone Protection and Synthetic Greenhouse Gas Management Regulations 1995 (Cth)	Regulates the manufacture, importation and use of ODSs (typically used in fire-fighting equipment and refrigerants). Applicable to the handling of any ODS. The Act provides a licensing system for import, export and manufacture of ODSs and equipment containing ODSs, while the Regulations control the end-use of ODSs, which are licensed by DCCEEW.	Yes – this Act applies where ODS is found on Activity vessel refrigeration systems. The activity vessels may use ODSs and therefore are regulated under this Act.	DCCEEW	Santos, when engaging vessel contractors, shall assure the vessel contractors compliance with applicable maritime law and regulations. Refer also to Section 6.5 and in particular confirmation at Section 6.5.6 that management of emissions is consistent with this Act. Relevant Activity vessels will follow ODS handling procedures.
Protection of the Sea (Civil Liability of Bunker Oil Pollution	This Act implements the requirements for the International Convention on Civil Liability for Bunker Oil Pollution Damage, by	No – activities under this EP do not involve the use of any vessels carrying over 2,000 tonnes of oil, as regulated under the Act.	AMSA Department of Infrastructure, Transport, Regional	Refer to Section 7.6.

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
Damage) Act 2008 (Cth)	imposing insurance certification requirements in respect of regulated Australian vessels carrying more than 2,000 tonnes of oil in bulk as cargo.		Development, Communications and the Arts	
Protection of the Sea (Harmful Anti-fouling Systems) Act 2006 (Cth)	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. This is enacted by Marine Order 98 (Marine pollution – anti-fouling systems) 2013.	Yes - 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 of IMS/harmful impact on Australian biodiversity. Australian ships, or foreign ships in Australian shipping facilities, must not be applied with harmful anti-fouling compounds (organotins). Activity vessels will comply with the relevant requirements of this Act.	AMSA Commonwealth, Department of Infrastructure, Transport, Regional Development, Communications and the Arts	See Section 7.2, and C7.2.1. See also Marine Orders, above.
Protection of the Sea (Powers of Intervention) Act 1981 (Cth) Protection of the Sea (Powers of Intervention) Regulations 1983 (Cth)	This Act authorises the Commonwealth (through AMSA) 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. The Regulations set out requirements to notify AMSA in respect of changes to the ownership or master of a vessel.	Yes - this Act applies to vessel discharges and movements associated with the Activity. The Act is relevant in that Santos must comply with Marine Orders made under the Act. See Marine Orders, above. Further, the Act confers powers on AMSA to take action in the event of a spill or likely spill of oil or noxious subjects from a ship, which functions are relevant in the event of an MDO spill arising from activities under this EP.	AMSA Commonwealth – Department of Infrastructure, Transport, Regional Development, Communications and the Arts	See above at Marine Orders.

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (Cth) Protection of the Sea (Prevention of Pollution from Ships) (Orders) Regulations 1994 (Cth)	This Act and Regulations relate 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 shipboard management plans, shipboard oil pollution emergency plans, shipboard marine pollution emergency plans, and ship-to-ship operations plans. The following Marine Orders relating to marine pollution prevention have been put in place to give effect to relevant regulations of Annexes I, II, III, IV, V and VI of MARPOL 73/78: • Marine Order 91: Marine pollution prevention – oil • Marine Order 93: Marine pollution prevention – noxious liquid substances • Marine Order 94: Marine pollution prevention – packaged harmful substances • Marine Order 95: Marine pollution prevention – garbage • Marine Order 96: Marine pollution prevention – sewage	Yes - Santos and its contractors must comply with relevant requirements under this Act and Regulations in respect of Activity vessels, including requirements to have a shipboard oil pollution emergency plan and a marine pollution emergency plan. The requirement to maintain a ship energy efficiency management plan is not applicable to Activity vessels as the vessels will not be engaged on an overseas voyage when undertaking activities under this EP.	AMSA Commonwealth – Department of Infrastructure, Transport, Regional Development, Communications and the Arts	Santos, when engaging vessel owners/contractor, shall assure the vessel contractors compliance with applicable marine orders. Vessel owners/contractors are to ensure the requirements of MARPOL 73/78, this Act and Regulations, and relevant port state Marine Orders are adhered to as relevant to the activities under this EP. See, in particular, Sections 6.6, 7.2, 7.4, 7.5, 7.6 and 7.7. The requirement for Santos to maintain an oil pollution emergency plan is addressed within the OPEP (see Section 8 for further information). In relation to shipboard marine pollution emergency plans, see Section 8.5 – Emergency preparedness and response of this EP, as well as C7.5.1.

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
	• Marine Order 97: Marine pollution prevention – air pollution.			
Underwater Cultural Heritage Act 2018 (Cth) (UCH Act)	The UCH Act replaced the *Historic Shipwrecks Act 1976* (Cth) and extends protection to other wrecks such as submerged aircraft and to human remains. The UCH Act protects the heritage values of vessels and aircrafts and the remains of vessels and aircrafts that have been in Australian waters. Heritage that has been in Australian waters for at least 75 years is automatically protected, while other heritage can be declared to be protected by the Minister. It is an offence to interfere with heritage covered by this Act. Key obligations include: • not disturbing protected underwater heritage during the course of a proposed action without a permit; • observing the requirements of protected zones and obtaining a permit to enter one if required; and • notifying of the discovery of any suspected underwater heritage identified during the	Yes – Santos has identified that no known listed historic shipwrecks or plane wrecks occur within the OA, and multiple known historic aircraft and shipwrecks and other sites occur within the EMBA. Despite this, there is no predicted impact to cultural heritage values in relation to this shipwreck resulting from activities under the EP, including from unplanned risks. Although there are no presently predicted impacts, the UCH Act imposes obligations in the event of an article of heritage being discovered. The UCH Act requires that that anyone who finds an article of underwater cultural heritage which appears to be of an archaeological character needs to notify the relevant authorities, via online form.	Commonwealth – DCCEEW	Reporting obligations under the UCH Act are addressed in Table 8-5. As to Santos's assessment of existing heritage under the UCH Act, see Section 3.2.4.8.

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
	course of proposed action within 21 days of discovery.			
NT Legislation				
Heritage Act 2011 (NT)	This Act establishes the NT Heritage Council and governs protection of both natural and cultural heritage places and objects within the NT jurisdiction by establishing heritage offences and regulating activities that may impact heritage places and objects, including through a process for obtaining work approvals.	Yes – this Act is applicable to the extent that unplanned events may impact natural and cultural heritage places or objects in the NT, constituting a heritage offence under the Act.	NT Department of Territory Families, Housing and Communities	There are no requirements arising under this Act that apply to activities under this EP, however for aspects of this EP addressing unplanned events, which are relevant to avoiding impacts to natural and cultural heritage places or objects, see: Section 7 – Unplanned events risk and impact assessment
Fisheries Act 1988 (NT) Fisheries Regulations 1992 (NT)	The *Fisheries Act 1988* (NT) provides for the regulation, conservation and management of fisheries and fishery resources so as to maintain their sustainable utilisation, to regulate the sale and processing of fish and aquatic life, and for related purposes.	No – the Act is not directly relevant to the environmental management of the Activity. However, for a Joint Authority Fishery (such as the Timor Reef Fishery), in the event of an emergency, the Act provides the regulatory framework for the Joint Authority to make any necessary fisheries management decisions. The OA overlaps the Timor Reef Fishery which is jointly managed by the NT and Commonwealth. The EMBA intersects with numerous NT-managed fisheries regulated under this Act. Accordingly, this Act has been identified for completeness (and to provide context for the	NT Department of Industry, Tourism and Trade – Fisheries Division	There are no requirements arising under the Act that apply to the environmental management of the Activity, however as to aspects of this EP relevant to the NT Department of Industry, Tourism and Trade's functions, see: Section 3.2.4.1 – Commercial Fisheries Sections 3.2.5.10, 6 and 7.

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
		consultation undertaken by Santos with the NT Department of Industry, Tourism and Trade in the course of preparing this EP).		
International agreements and conventions				
1997 Treaty between Australia and Indonesia establishing an EEZ Boundary and Certain Seabed Boundaries (Perth Treaty)	This treaty has been signed but not yet ratified. When ratified, the treaty will finalise the EEZ boundary between Australia and Indonesia. Under the Perth Treaty, there are areas of overlapping jurisdiction where Australia exercises seabed jurisdiction including exploration for petroleum, and Indonesia exercises water column jurisdiction including fishing rights.	Yes - the southern boundary of the Perth Treaty is near the OA and within the EMBA. Although the Treaty has not been ratified and imposes no obligations on Santos, it is relevant to Santos's assessment of potential Relevant Persons and has therefore been identified in for completeness.	N/A	There are no requirements arising under the Treaty that apply to the environmental management of the Activity. See Section 3.2.4.2 – Indonesian and Timorese commercial and subsistence fishing.
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 (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 the EPBC Act. Birds listed on the annex to this agreement must be placed on the migratory species list under the EPBC Act.	Yes – only to the extent that a credible spill scenario may result in impact to migratory seabirds foraging in the EMBA.	N/A	In the event of a spill scenario that impacts migratory birds, Santos will implement its spill response operations. Section 3.2.3 – Threatened and migratory fauna Sections 7.6 – Hydrocarbon release Section 7.7 – Spill Response Operations
Agreement Between the Government of Australia and the Government of the People's Republic of	This agreement recognises the special international concern for the protection of migratory birds and birds in danger of extinction that migrate between Australia	Yes – only to the extent that a credible spill scenario may result in impact to migratory seabirds foraging in the EMBA.	N/A	In the event of a spill scenario that impacts migratory birds, Santos will implement its spill response operations.

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
China for the Protection of Migratory Birds and Their Environment 1986 (CAMBA)	and China. Implemented in the EPBC Act.			Section 3.2.3 – Threatened and migratory fauna Sections 7.6 – Hydrocarbon release Section 7.7 – Spill Response Operations
Agreement Between the Government of Australia and the Government of the Republic of Korea for the Protection of Migratory Birds 2006 (ROKAMBA)	This agreement recognises the special international concern for the protection of migratory birds and birds in danger of extinction that migrate between Australia and Korea. Implemented in EPBC Act. Birds listed on the annex to this agreement must be placed on the migratory species list under the EPBC Act.	Yes – only to the extent that a credible spill scenario may result in impact to migratory seabirds foraging in the EMBA.	N/A	In the event of a spill scenario that impacts migratory birds, Santos will implement its spill response operations. Section 3.2.3 – Threatened and migratory fauna Sections 7.6 – Hydrocarbon release Section 7.7 – Spill Response Operations
Convention on Biological Diversity 1992	This convention has three main objectives: the conservation of biodiversity; the sustainable use of its components; and the fair and equitable sharing of the benefits arising from the use of genetic resources.	Yes – relevant only insofar as the Activity may interact with MNES (threatened and migratory species) protected under the EPBC Act.	N/A	Section 3.2 – Environmental Values and Sensitivities Section 6 – Planned activities risk and impact assessment Section 7 – Unplanned events risk and impact assessment
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.	N/A	Section 3.2 – Environmental Values and Sensitivities Section 7 – Unplanned events risk and impact assessment

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
Convention on the International Regulations for Preventing Collisions at Sea 1972 (COLREGS)	Convention prescribes internationally agreed measures for the navigation, management and working of a vessel, and the lights and signals to be provided and used on a vessel. Given effect in Australia by Marine Order 30 – Prevention of Collisions.	Yes – refer to *Navigation Act 2012* (Cth) and Marine Orders	N/A	Santos has implemented control measures directed to ensuring compliance with Marine Orders – refer to Section 8.2.1.
International Convention for the Control and Management of Ships' Ballast Water and Sediments 2004	This Convention was adopted by the IMO and entered into force globally in 2017. It aims to prevent the spread of harmful aquatic organisms from one region to another, by establishing standards and procedures for managing and controlling ships' ballast water and sediments. Thus, ballast water management systems must be approved in accordance with this Convention. From 8 September 2017, all vessels that use ballast water are required to meet the Regulation D2 discharge standard of this Convention at their next renewal survey.	Yes – refer to Australian Ballast Water Management Requirements	N/A	Refer to Section 6.6 and 7.2.
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	Yes – refer to *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth), *Navigation Act 2012* (Cth) and Marine Orders	N/A	Sections 6 and 7 – Planned and unplanned events

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
	pollutants from ships. It contains 6 Annexes, dealing respectively with oil, noxious liquid substances, harmful packaged substances, sewage, garbage and air pollution. 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 2012* and several Parts of Marine Orders made under this legislation.			
International Convention for the Safety of Life at Sea 1974 (SOLAS) and its Protocol of 1988	This convention is generally regarded as the most important of all international treaties concerning the safety of merchant ships. Implemented by the *Navigation Act 2012* (Cth) and Marine Orders under that Act.	Yes – refer to *Navigation Act 2012* (Cth) and Marine Orders	N/A	Section 6.1– Interactions with other marine users Section 8 – Implementation strategy
International 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. Parts of this convention are implemented by the *Protection of*	Yes – in the event of a worst-case credible spill scenario, this may enact a national arrangement for response. Refer to *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth).	N/A	In the event of a spill scenario, Santos will implement its spill response operations. Sections 7.6 – Hydrocarbon release Section 7.7 – Spill Response Operations

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
	the Sea (Prevention of Pollution from Ships) Act 1983 (Cth).			
International Convention on Standards of Training, Certification and Watchkeeping (STCW) for Seafarers, 1978	Prescribes internationally agreed minimum standards relating to training, certification and watchkeeping for seafarers. Given effect in Australia by Marine Order 71 (Masters and Deck Officers).	Yes – refer to *Navigation Act 2012* (Cth) and Marine Orders	N/A	Santos has implemented control measures directed to ensuring compliance with Marine Orders – refer to Section 8.2.1.
Memorandum of Understanding between Australia and Indonesia on the Operations of Indonesian Traditional Fishermen in Areas of the Australian Fishing Zone and Continental Shelf – 1974	Enables traditional fishing by Indonesian traditional fishers within the sections of the Australian EEZ.	There are no requirements arising under the Treaty that apply to the environmental management of the Activity.	N/A	See Section 3.2.5.10 – Consultation, and Section 3.2.4.2 – Indonesian and Timorese commercial and subsistence fishing.
Paris Agreement on Climate Change 2015	This Agreement aims to tackle climate change and its negative impacts. It sets the long-term goal of substantially reducing global GHG emissions to limit global temperature rise this century well below 2°C above pre-industrial levels while pursuing efforts to limit the temperature increase even further to 1.5 °C to prevent dangerous human-caused interference with the climate system.	Yes - provides the international framework and context around Australia's nationally determined contributions. This helps establish the defined acceptable level of Barossa Development GHG emissions. See also *Climate Change Act 2022* (Cth)	N/A	Refer to Section 6.5 which refers to Santos' Climate Change Policy.

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
United Nations Educational, Scientific and Cultural Organization Convention on the Protection of Underwater Cultural Heritage 2001	This Convention provides a framework preservation and protection of underwater cultural heritage. This includes traces of human existence of cultural, historical, or archaeological nature that have been submerged for at least 100 years. This Convention is aligned with the sustainable development objectives of the United Nations Agenda 2030.	Yes - provides the framework to protect and reduce the impact of Barossa installation activities on underwater heritage.	N/A	N/A
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 March 1994.	Yes – only relevant to the extent that to reduce impact of GHG emissions associated with activity vessel use, Santos will comply with MARPOL Annex VI (Marine Order 97: Marine pollution prevention – air pollution) and require the use of low sulphur fuel.	N/A	Santos will comply with Marine Order 97. Section 6.5 – Atmospheric emissions

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
Commonwealth				
Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (Cth) (ATSIHP Act)	This Act provides for the preservation and protection from injury or desecration areas and objects in Australia and Australian waters that are of significance to Aboriginal people in accordance with Aboriginal tradition. 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 – the ATSIHP Act is not directly relevant to the environmental management of the Activity as there are no areas within the OA or the EMBA that have been the subject of a 'significant Aboriginal areas' declaration under the ATSIHP Act. However, in the event such areas are declared in the future, this Act could potentially become relevant to the activities. Accordingly, this Act has been identified for completeness.	Commonwealth – Attorney-General's Department DCCEEW	There are no requirements arising under the ATSIHP Act that apply to the environmental management of the Activity. Refer to Sections 3.2.4.8 and 3.2.5 in relation to relevant heritage values and cultural features more broadly.
Aboriginal Land Rights (Northern Territory) Act 1976 (Cth) (ALR Act)	An Act providing for the granting of Traditional Aboriginal Land in the NT for the benefit of Aboriginals, and for other purposes. Establishes Land Councils and enables them to operate.	No – the ALR Act is not directly relevant to environmental management of the Activity. There are no predicted impacts to land or nearshore locations (including the Tiwi Islands) associated with the Activity. However, the TLC which is established under the ALR Act, represents Tiwi people in the protection of land, sea and environment. Accordingly, this Act has been identified for completeness (and to provide context for the consultation undertaken by Santos with the TLC and Tiwi people in the course of preparing this environment plan).	Commonwealth – Attorney-General's Department Commonwealth – Department of the Prime Minister and Cabinet Tiwi Land Council (TLC)	There are no requirements arising under the ALR Act that apply to the environmental management of the Activity. Refer to Sections 3.2.4.8 and 3.2.5 in relation to relevant heritage values and cultural features more broadly. Refer also to Section 3.2.5.10 in relation to consultation with the TLC and Tiwi people.

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
Australian Maritime Safety Authority Act 1990 (Cth) (AMSA Act)	This Act establishes the Australian Maritime Safety Authority (AMSA), which manages the National Plan for Maritime Environmental Emergencies in coordination with industry. AMSA is also responsible for administering Marine Orders in Commonwealth waters. The Act also aims to promote maritime safety, protect the marine environment from pollution and environmental damage from ships, provide for a national search and rescue service and promote the efficient provision of service by 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.	Yes – while the Act does not contain any explicit requirements relevant to the environmental management of the Activity, it establishes and sets out the functions of AMSA, which functions relate to environmental management including in respect of response to spill events and administration of marine orders.	AMSA Commonwealth – Department of Infrastructure, Transport, Regional Development, Communications and the Arts	AMSA has been consulted as a Relevant Person – refer to Section 3.2.5.10 in preparing the EP, and will be notified throughout activities in accordance with Table 8-3. AMSA's relevant functions are described in Section 7.6.

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
Biosecurity Act 2015 (Cth) Biosecurity Regulation 2016 (Cth) Australian Ballast Water Management Requirements, Version 8	This Act relates to the management of diseases and pests that may cause harm to human, animal or plant health or the environment. The Act includes provisions for ballast water management plans and certificates, record keeping obligations and powers to ensure compliance. 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. Australian Ballast Water Management Requirements outline the mandatory ballast water management requirements to reduce the risk of introducing invasive marine species (IMS) into Australia's marine environment through ballast water from international vessels. These requirements are enforceable under the *Biosecurity Act 2015* (Cth) and include obligations under the International	Yes - this Act and Regulations apply to all foreign vessels operating in Australian waters and these vessels must comply with the Australian Ballast Water Management Requirements.	DAFF	Refer to Section 7.2 and Section 8 which contains control measures in respect of the implementation of the Australian Ballast Water Management Requirements 2017.

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
	Convention for the Control and Management of Ships' Ballast Water and Sediments.			
Climate Change Act 2022 (Cth) (Climate Act)	The Climate Act commenced in September 2022. The Climate Act sets out Australia's net-zero commitments and codifies Australia's net 2030 and 2050 GHG emissions reductions targets under the Paris Agreement.	While the energy industry is not subject to direct obligations under this Act, this Act legislates Australia's emissions net zero targets by 2050.	Commonwealth – Climate Change Authority	Refer to Section 6.5 which refers to Santos' Climate Change Policy.
Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) Environment Protection and Biodiversity Conservation Regulations 2000 (Cth)	While the OPGGS (E) Regulations under the OPGGS Act (see below) regulate day to day petroleum activities and apply to any activity that may have an impact on the environment, the EPBC Act regulates the assessment and approval of proposed actions that are likely to have a significant impact on a matter of National Environmental Significance (MNES). Actions that are likely to have a significant impact on a MNES referral under the EPBC Act; the assessment process is administered by the Department of Climate Change, Energy, the Environment and Water. Schedule 8 of the EPBC Regulations outlines the Australian IUCN Reserve Management Principles.	Yes – the EPBC Act applies to all aspects of the Activity that have the potential to impact MNES, and the Regulations contain requirements regarding interactions with cetaceans. The Barossa Gas Project, including the Activity, will be undertaken in accordance with the 'class approval' granted by the Commonwealth Environment Minister under the EPBC Act on 27 February 2014. This approval applies to petroleum activities that are taken in Commonwealth waters in accordance with an endorsed program (being the environmental management authorisation process administered by NOPSEMA under the OPGGS Act and the OPGGS (E) Regulations).	DCCEEW NOPSEMA	The Barossa Development is approved under the EPBC Act. Refer to Sections 3.2 – Environmental Values and Sensitivities as well as Sections 6 and 7 – Planned impacts and unplanned events for treatment of MNES. Consideration has also been afforded to Section 527E of the EPBC Act. See the note below this table (Appendix B.1) containing Santos' approach to addressing the requirements of Section 527E.

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
	Further, the Regulations provide for the protection and conservation of cetaceans, and create various offences for actions that may endanger them.			
Fisheries Management Act 1991 (Cth) (FM Act)	Management plans for fisheries are established under the FM Act, and this Act also sets out the legislative basis for Statutory Fishing Rights (SFRs), licences and permits. The Act defines the Australian Fishing Zone (AFZ) and provides for the majority of Commonwealth fisheries offences. The Act also establishes the functions of the AMFA, including in relation to the pursuit of ecologically sustainable development.	No – the FM Act is not directly relevant to the environmental management of the Activity. However, in the event of a spill, the Act provides the regulatory framework for any necessary fisheries management decisions in Commonwealth waters. Further, the AFMA is responsible for managing Commonwealth fisheries and is a relevant agency where the Activity has the potential to impact on fisheries resources in AFMA managed fisheries. The OA overlaps four Commonwealth commercial fisheries managed by the AFMA, with the EMBA overlapping one additional Commonwealth fishery. Accordingly, this Act has been identified for completeness (and to provide context for the consultation undertaken by Santos with the AFMA in the course of preparing this environment plan).	AFMA DAFF	There are no requirements arising under the FM Act that apply to the environmental management of the Activity, however as to aspects of this EP relevant to AFMA's functions, see: Section 3.2.4.1– Commercial Fisheries Section 3.2.5.10 – Consultation Sections 6 and 7 – Planned impacts and unplanned events
Marine Orders	Marine Orders are subordinate rules made pursuant to the *Navigation Act 2012* (Cth),	Yes - various Marine Orders apply to activities under this EP, including in relation to vessel	AMSA	Discharges to the marine environment will be recorded and controlled in accordance with

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
	Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (Cth), *Protection of the Sea (Harmful Anti-Fouling Systems) Act 2006* (Cth) and the *Marine Safety (Domestic Commercial Vessel) National Law Act 2012* (Cth) affecting the maritime industry. They are a means of implementing Australia's international maritime obligations by giving effect to international conventions in Australian law.	movements, safety, discharges and emissions. The Marine Orders (MO) relevant to this EP include: • MO 21 - Safety and emergency arrangements • MO 27 – Safety of navigation and radio equipment • MO 30 – Prevention of collisions • MO 41 – Carriage of Dangerous Goods • Marine Order 71 Masters and deck officers • MO 91 – Marine pollution prevention - oil • MO 93 – Marine pollution prevention – noxious liquid substances • MO 94 – Marine pollution prevention – packaged harmful substances • MO 95 – Marine pollution prevention - garbage • MO 96 – Marine pollution prevention - sewage • MO 97 – Marine pollution prevention – air pollution • MO 98 – Marine pollution – anti-fouling systems		relevant marine orders – refer Section 8.8.2. Santos has implemented control measures directed to ensuring compliance with Marine Orders – refer to Section 8.2.1. Sections 6.5, 6.6, 7.1, 7.2, 7.4, 7.5, 7.6 and 7.7 are relevant to the implementation of Marine Orders.

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
Marine Safety (Domestic Commercial Vessel) National Law Act 2012 (Cth) Marine Safety (Domestic Commercial Vessel) National Law Regulation 2013 (Cth)	This Act is a single regulatory framework for the certification, construction, equipment, design and operation of domestic commercial vessels inside Australia's exclusive economic zone. The Act names AMSA as the National Marine Safety Regulator and confers functions on AMSA in relation to marine safety, including that AMSA may make and maintain Marine Orders. The Regulations under the Act set out the definition of a vessel and details and requirements of the accredited marine surveyor scheme.	Yes – all vessel movements associated with the Activity will be governed by AMSA marine safety regulations under the Act. The Act also imposes duties on owners, masters and crew of domestic commercial vessels in relation to the safety of the vessel, relevant to the owners, masters and crew of any Australian Activity vessels under this EP. The Act also sets requirements in relation to the survey of marine vessels which any Australian Activity vessels must comply with.	AMSA	Santos, when engaging vessel contractors, shall assure the vessel contractors compliance with applicable maritime law and regulations (Section 6.1, 6.3, 6.4, 6.5, 7.5, 7.6 and 7.7).
National Biofouling Management Guidelines for the Petroleum Production and Exploration Industry 2009	The guidance document provides recommendations for the management of biofouling hazards by the petroleum industry.	Yes - applying the recommendations within this document and implementing effective biofouling controls can reduce the risk of the introduction of IMS.	DAFF	Refer to Section 7.2 and especially to Section 7.2.6 which confirms that management is consistent with this Guideline.
National Greenhouse and Energy Reporting Act 2007 (Cth) (NGER Act) National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015	The NGER Act applies to the atmospheric emissions through combustion engine use to operate the vessels associated with the Activity. The NGER Act provides for a single national reporting framework for the reporting and dissemination of information about greenhouse gas emissions,	Yes - the Barossa Gas Project will be a designated large facility under the NGER Act and as such will be subject to the Safeguard Mechanism. This means that Santos, among other things, will have an obligation to ensure that the net covered emissions of GHGs from the operation of the	DCCEEW Clean Energy Regulator Climate Change Authority	Refer to Section 6.5

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
	greenhouse gas projects and energy use and production of corporations. The Safeguard Mechanism is also administered under the NGER Act.	Barossa Gas Project do not exceed the applicable baseline.		
Native Title Act 1993 (Cth) (NT Act)	The NT Act recognises the rights and interests of Aboriginal and Torres Strait Islander people in land and waters according to their traditional laws and customs, and creates processes through which native title can be recognised and protected. Under s 280(2) of the OPGGS Act, petroleum activities must be carried out in a manner that does not interfere with the enjoyment of native title rights and interests under the NT Act to a greater extent than necessary.	No – the NT Act is not directly relevant to environmental management of the Activity. There are no native title claims or determinations within the OA or the EMBA. However, the NLC is a Representative Aboriginal/Torres Strait Islander Body under the NT Act for parts of the OA and EMBA. Accordingly, this Act has been identified for completeness (and to provide context for the consultation undertaken by Santos with the NLC in the course of preparing this environment plan).	Commonwealth – Attorney-General's Department Commonwealth – Department of the Prime Minister and Cabinet National Native Title Tribunal Federal Court of Australia	There are no requirements arising under the NT Act that apply to the environmental management of the Activity. Refer to Sections 3.2.4.8 and 3.2.5 in relation to relevant heritage values and cultural features more broadly. Refer also to Section 3.2.5.10 in relation to consultation with NLC.
Navigation Act 2012 (Cth)	The Act aims to promote the SOLAS and safe navigation, prevent pollution of the marine environment and ensure AMSA has the power to carry out inspection of vessels and enforce national and international standards. Specifically, this Act empowers AMSA to make Marine Orders, which are legislative instruments, with respect to any	Yes – all vessel movements associated with the Activity will be governed by marine safety regulations and Marine Orders under the Act. See Marine Orders, above.	AMSA Commonwealth - Department of Infrastructure, Transport, Regional Development, Communications and the Arts	Santos, when engaging vessel contractors, shall assure the vessel contractors compliance with applicable maritime law and regulations (Section 6.1, 7.6 and 7.7).

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
	matter for which provision must or may be made by the regulations. A number of Marine Orders enacted under this Act apply directly to offshore petroleum activities: • Marine Order 21: Safety and emergency arrangements • Marine Order 27: Safety of navigation and radio equipment • Marine Order 30: Prevention of collisions • Marine Order 41: Carriage of Dangerous Goods • Marine Order 58: Safe management of vessels • Marine Order 71 Masters and deck officers AMSA has the authority and responsibility for the operational activities under the Act, including vessel certification, seafarers' qualifications, marine pollution prevention, monitoring and enforcement activities.			
Offshore Petroleum and Greenhouse Gas Storage Act 2006 (Cth) Offshore Petroleum and Greenhouse Gas Storage (Environment)	Petroleum exploration and development activities in Australia's offshore areas are subject to the environmental requirements specified in the OPGGS Act and associated	Yes – activities under the EP are to be performed: • consistent with the principles of ecologically sustainable development as set out in	NOPSEMA DISR	Requirements under the OPGGS Act and associated Regulations are addressed throughout this EP.

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
Regulations 2009 (Cth)	Regulations. The OPGGS Act contains a broad requirement for titleholders to operate in accordance with 'good oil-field practice'. Specific environmental provisions relating to work practices essentially require operators to control and prevent the escape of wastes and petroleum. The Act also requires that activities are carried out in a manner that does not unduly interfere with other rights or interests, including the conservation of the resources of the sea and seabed, such as fishing or shipping. In some cases, where there are particular environmental sensitivities or multiple use issues it may be necessary to apply special conditions to an exploration permit area. The holder of a petroleum title must maintain adequate insurance against expenses or liabilities arising from activities in the title, including expenses relating to clean-up or other remedying of the effects of the escape of petroleum. The OPGGS(E)R provide an objective based regime for the management of environmental performance for Australian	section 3A of the EPBC Act; and • so environmental impacts and risks of the Activity are reduced to ALARP and are of an acceptable level. This EP must demonstrate that the Activity will be undertaken in line with the principles of ecologically sustainable development, and that impacts and risks resulting from these activities are ALARP and acceptable.		

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
	offshore petroleum exploration and production activities in areas of Commonwealth jurisdiction. Key objectives of the OPGGS(E)R include to: • ensure operations are performed in a way that is consistent with the principles of ecologically sustainable development • adopt best practice to achieve agreed environment protection standards in industry operations • encourage industry to continuously improve its environmental performance.			
Ozone Protection and Synthetic Greenhouse Gas Management Act 1989 (Cth) Ozone Protection and Synthetic Greenhouse Gas Management Regulations 1995 (Cth)	Regulates the manufacture, importation and use of ODSs (typically used in fire-fighting equipment and refrigerants). Applicable to the handling of any ODS. The Act provides a licensing system for import, export and manufacture of ODSs and equipment containing ODSs, while the Regulations control the end-use of ODSs, which are licensed by DCCEEW.	Yes – this Act applies where ODS is found on Activity vessel refrigeration systems. The activity vessels may use ODSs and therefore are regulated under this Act.	DCCEEW	Santos, when engaging vessel contractors, shall assure the vessel contractors compliance with applicable maritime law and regulations. Refer also to Section 6.5 and in particular confirmation at Section 6.5.6 that management of emissions is consistent with this Act. Relevant Activity vessels will follow ODS handling procedures.
Protection of the Sea (Civil Liability of Bunker Oil Pollution	This Act implements the requirements for the International Convention on Civil Liability for Bunker Oil Pollution Damage, by	No – activities under this EP do not involve the use of any vessels carrying over 2,000 tonnes of oil, as regulated under the Act.	AMSA Department of Infrastructure, Transport, Regional	Refer to Section 7.6.

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
Damage) Act 2008 (Cth)	imposing insurance certification requirements in respect of regulated Australian vessels carrying more than 2,000 tonnes of oil in bulk as cargo.		Development, Communications and the Arts	
Protection of the Sea (Harmful Anti-fouling Systems) Act 2006 (Cth)	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. This is enacted by Marine Order 98 (Marine pollution – anti-fouling systems) 2013.	Yes - 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 of IMS/harmful impact on Australian biodiversity. Australian ships, or foreign ships in Australian shipping facilities, must not be applied with harmful anti-fouling compounds (organotins). Activity vessels will comply with the relevant requirements of this Act.	AMSA Commonwealth, Department of Infrastructure, Transport, Regional Development, Communications and the Arts	See Section 7.2, and C7.2.1. See also Marine Orders, above.
Protection of the Sea (Powers of Intervention) Act 1981 (Cth) Protection of the Sea (Powers of Intervention) Regulations 1983 (Cth)	This Act authorises the Commonwealth (through AMSA) 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. The Regulations set out requirements to notify AMSA in respect of changes to the ownership or master of a vessel.	Yes - this Act applies to vessel discharges and movements associated with the Activity. The Act is relevant in that Santos must comply with Marine Orders made under the Act. See Marine Orders, above. Further, the Act confers powers on AMSA to take action in the event of a spill or likely spill of oil or noxious subjects from a ship, which functions are relevant in the event of an MDO spill arising from activities under this EP.	AMSA Commonwealth – Department of Infrastructure, Transport, Regional Development, Communications and the Arts	See above at Marine Orders.

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (Cth) Protection of the Sea (Prevention of Pollution from Ships) (Orders) Regulations 1994 (Cth)	This Act and Regulations relate 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 shipboard management plans, shipboard oil pollution emergency plans, shipboard marine pollution emergency plans, and ship-to-ship operations plans. The following Marine Orders relating to marine pollution prevention have been put in place to give effect to relevant regulations of Annexes I, II, III, IV, V and VI of MARPOL 73/78: • Marine Order 91: Marine pollution prevention – oil • Marine Order 93: Marine pollution prevention – noxious liquid substances • Marine Order 94: Marine pollution prevention – packaged harmful substances • Marine Order 95: Marine pollution prevention – garbage • Marine Order 96: Marine pollution prevention – sewage	Yes - Santos and its contractors must comply with relevant requirements under this Act and Regulations in respect of Activity vessels, including requirements to have a shipboard oil pollution emergency plan and a marine pollution emergency plan. The requirement to maintain a ship energy efficiency management plan is not applicable to Activity vessels as the vessels will not be engaged on an overseas voyage when undertaking activities under this EP.	AMSA Commonwealth – Department of Infrastructure, Transport, Regional Development, Communications and the Arts	Santos, when engaging vessel owners/contractor, shall assure the vessel contractors compliance with applicable marine orders. Vessel owners/contractors are to ensure the requirements of MARPOL 73/78, this Act and Regulations, and relevant port state Marine Orders are adhered to as relevant to the activities under this EP. See, in particular, Sections 6.6, 7.2, 7.4, 7.5, 7.6 and 7.7. The requirement for Santos to maintain an oil pollution emergency plan is addressed within the OPEP (see Section 8 for further information). In relation to shipboard marine pollution emergency plans, see Section 8.5 – Emergency preparedness and response of this EP, as well as C7.5.1.

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
	• Marine Order 97: Marine pollution prevention – air pollution.			
Underwater Cultural Heritage Act 2018 (Cth) (UCH Act)	The UCH Act replaced the *Historic Shipwrecks Act 1976* (Cth) and extends protection to other wrecks such as submerged aircraft and to human remains. The UCH Act protects the heritage values of vessels and aircrafts and the remains of vessels and aircrafts that have been in Australian waters. Heritage that has been in Australian waters for at least 75 years is automatically protected, while other heritage can be declared to be protected by the Minister. It is an offence to interfere with heritage covered by this Act. Key obligations include: • not disturbing protected underwater heritage during the course of a proposed action without a permit; • observing the requirements of protected zones and obtaining a permit to enter one if required; and • notifying of the discovery of any suspected underwater heritage identified during the	Yes – Santos has identified that no known listed historic shipwrecks or plane wrecks occur within the OA, and multiple known historic aircraft and shipwrecks and other sites occur within the EMBA. Despite this, there is no predicted impact to cultural heritage values in relation to this shipwreck resulting from activities under the EP, including from unplanned risks. Although there are no presently predicted impacts, the UCH Act imposes obligations in the event of an article of heritage being discovered. The UCH Act requires that that anyone who finds an article of underwater cultural heritage which appears to be of an archaeological character needs to notify the relevant authorities, via online form.	Commonwealth – DCCEEW	Reporting obligations under the UCH Act are addressed in Table 8-5. As to Santos's assessment of existing heritage under the UCH Act, see Section 3.2.4.8.

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
	course of proposed action within 21 days of discovery.			
NT Legislation				
Heritage Act 2011 (NT)	This Act establishes the NT Heritage Council and governs protection of both natural and cultural heritage places and objects within the NT jurisdiction by establishing heritage offences and regulating activities that may impact heritage places and objects, including through a process for obtaining work approvals.	Yes – this Act is applicable to the extent that unplanned events may impact natural and cultural heritage places or objects in the NT, constituting a heritage offence under the Act.	NT Department of Territory Families, Housing and Communities	There are no requirements arising under this Act that apply to activities under this EP, however for aspects of this EP addressing unplanned events, which are relevant to avoiding impacts to natural and cultural heritage places or objects, see: Section 7 – Unplanned events risk and impact assessment
Fisheries Act 1988 (NT) Fisheries Regulations 1992 (NT)	The *Fisheries Act 1988* (NT) provides for the regulation, conservation and management of fisheries and fishery resources so as to maintain their sustainable utilisation, to regulate the sale and processing of fish and aquatic life, and for related purposes.	No – the Act is not directly relevant to the environmental management of the Activity. However, for a Joint Authority Fishery (such as the Timor Reef Fishery), in the event of an emergency, the Act provides the regulatory framework for the Joint Authority to make any necessary fisheries management decisions. The OA overlaps the Timor Reef Fishery which is jointly managed by the NT and Commonwealth. The EMBA intersects with numerous NT-managed fisheries regulated under this Act. Accordingly, this Act has been identified for completeness (and to provide context for the	NT Department of Industry, Tourism and Trade – Fisheries Division	There are no requirements arising under the Act that apply to the environmental management of the Activity, however as to aspects of this EP relevant to the NT Department of Industry, Tourism and Trade's functions, see: Section 3.2.4.1 – Commercial Fisheries Sections 3.2.5.10, 6 and 7.

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
		consultation undertaken by Santos with the NT Department of Industry, Tourism and Trade in the course of preparing this EP).		
International agreements and conventions				
1997 Treaty between Australia and Indonesia establishing an EEZ Boundary and Certain Seabed Boundaries (Perth Treaty)	This treaty has been signed but not yet ratified. When ratified, the treaty will finalise the EEZ boundary between Australia and Indonesia. Under the Perth Treaty, there are areas of overlapping jurisdiction where Australia exercises seabed jurisdiction including exploration for petroleum, and Indonesia exercises water column jurisdiction including fishing rights.	Yes - the southern boundary of the Perth Treaty is near the OA and within the EMBA. Although the Treaty has not been ratified and imposes no obligations on Santos, it is relevant to Santos's assessment of potential Relevant Persons and has therefore been identified in for completeness.	N/A	There are no requirements arising under the Treaty that apply to the environmental management of the Activity. See Section 3.2.4.2 – Indonesian and Timorese commercial and subsistence fishing.
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 (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 the EPBC Act. Birds listed on the annex to this agreement must be placed on the migratory species list under the EPBC Act.	Yes – only to the extent that a credible spill scenario may result in impact to migratory seabirds foraging in the EMBA.	N/A	In the event of a spill scenario that impacts migratory birds, Santos will implement its spill response operations. Section 3.2.3 – Threatened and migratory fauna Sections 7.6 – Hydrocarbon release Section 7.7 – Spill Response Operations
Agreement Between the Government of Australia and the Government of the People's Republic of	This agreement recognises the special international concern for the protection of migratory birds and birds in danger of extinction that migrate between Australia	Yes – only to the extent that a credible spill scenario may result in impact to migratory seabirds foraging in the EMBA.	N/A	In the event of a spill scenario that impacts migratory birds, Santos will implement its spill response operations.

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
China for the Protection of Migratory Birds and Their Environment 1986 (CAMBA)	and China. Implemented in the EPBC Act.			Section 3.2.3 – Threatened and migratory fauna Sections 7.6 – Hydrocarbon release Section 7.7 – Spill Response Operations
Agreement Between the Government of Australia and the Government of the Republic of Korea for the Protection of Migratory Birds 2006 (ROKAMBA)	This agreement recognises the special international concern for the protection of migratory birds and birds in danger of extinction that migrate between Australia and Korea. Implemented in EPBC Act. Birds listed on the annex to this agreement must be placed on the migratory species list under the EPBC Act.	Yes – only to the extent that a credible spill scenario may result in impact to migratory seabirds foraging in the EMBA.	N/A	In the event of a spill scenario that impacts migratory birds, Santos will implement its spill response operations. Section 3.2.3 – Threatened and migratory fauna Sections 7.6 – Hydrocarbon release Section 7.7 – Spill Response Operations
Convention on Biological Diversity 1992	This convention has three main objectives: the conservation of biodiversity; the sustainable use of its components; and the fair and equitable sharing of the benefits arising from the use of genetic resources.	Yes – relevant only insofar as the Activity may interact with MNES (threatened and migratory species) protected under the EPBC Act.	N/A	Section 3.2 – Environmental Values and Sensitivities Section 6 – Planned activities risk and impact assessment Section 7 – Unplanned events risk and impact assessment
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.	N/A	Section 3.2 – Environmental Values and Sensitivities Section 7 – Unplanned events risk and impact assessment

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
Convention on the International Regulations for Preventing Collisions at Sea 1972 (COLREGS)	Convention prescribes internationally agreed measures for the navigation, management and working of a vessel, and the lights and signals to be provided and used on a vessel. Given effect in Australia by Marine Order 30 – Prevention of Collisions.	Yes – refer to *Navigation Act 2012* (Cth) and Marine Orders	N/A	Santos has implemented control measures directed to ensuring compliance with Marine Orders – refer to Section 8.2.1.
International Convention for the Control and Management of Ships' Ballast Water and Sediments 2004	This Convention was adopted by the IMO and entered into force globally in 2017. It aims to prevent the spread of harmful aquatic organisms from one region to another, by establishing standards and procedures for managing and controlling ships' ballast water and sediments. Thus, ballast water management systems must be approved in accordance with this Convention. From 8 September 2017, all vessels that use ballast water are required to meet the Regulation D2 discharge standard of this Convention at their next renewal survey.	Yes – refer to Australian Ballast Water Management Requirements	N/A	Refer to Section 6.6 and 7.2.
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	Yes – refer to *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth), *Navigation Act 2012* (Cth) and Marine Orders	N/A	Sections 6 and 7 – Planned and unplanned events

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
	pollutants from ships. It contains 6 Annexes, dealing respectively with oil, noxious liquid substances, harmful packaged substances, sewage, garbage and air pollution. 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 2012* and several Parts of Marine Orders made under this legislation.			
International Convention for the Safety of Life at Sea 1974 (SOLAS) and its Protocol of 1988	This convention is generally regarded as the most important of all international treaties concerning the safety of merchant ships. Implemented by the *Navigation Act 2012* (Cth) and Marine Orders under that Act.	Yes – refer to *Navigation Act 2012* (Cth) and Marine Orders	N/A	Section 6.1– Interactions with other marine users Section 8 – Implementation strategy
International 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. Parts of this convention are implemented by the *Protection of*	Yes – in the event of a worst-case credible spill scenario, this may enact a national arrangement for response. Refer to *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth).	N/A	In the event of a spill scenario, Santos will implement its spill response operations. Sections 7.6 – Hydrocarbon release Section 7.7 – Spill Response Operations

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
	the Sea (Prevention of Pollution from Ships) Act 1983 (Cth).			
International Convention on Standards of Training, Certification and Watchkeeping (STCW) for Seafarers, 1978	Prescribes internationally agreed minimum standards relating to training, certification and watchkeeping for seafarers. Given effect in Australia by Marine Order 71 (Masters and Deck Officers).	Yes – refer to *Navigation Act 2012* (Cth) and Marine Orders	N/A	Santos has implemented control measures directed to ensuring compliance with Marine Orders – refer to Section 8.2.1.
Memorandum of Understanding between Australia and Indonesia on the Operations of Indonesian Traditional Fishermen in Areas of the Australian Fishing Zone and Continental Shelf – 1974	Enables traditional fishing by Indonesian traditional fishers within the sections of the Australian EEZ.	There are no requirements arising under the Treaty that apply to the environmental management of the Activity.	N/A	See Section 3.2.5.10 – Consultation, and Section 3.2.4.2 – Indonesian and Timorese commercial and subsistence fishing.
Paris Agreement on Climate Change 2015	This Agreement aims to tackle climate change and its negative impacts. It sets the long-term goal of substantially reducing global GHG emissions to limit global temperature rise this century well below 2°C above pre-industrial levels while pursuing efforts to limit the temperature increase even further to 1.5 °C to prevent dangerous human-caused interference with the climate system.	Yes - provides the international framework and context around Australia's nationally determined contributions. This helps establish the defined acceptable level of Barossa Development GHG emissions. See also *Climate Change Act 2022* (Cth)	N/A	Refer to Section 6.5 which refers to Santos' Climate Change Policy.

Legislation	Summary	Applicable to Activity and relevant to environmental management?	Administering authority	How Santos will meet requirements
United Nations Educational, Scientific and Cultural Organization Convention on the Protection of Underwater Cultural Heritage 2001	This Convention provides a framework preservation and protection of underwater cultural heritage. This includes traces of human existence of cultural, historical, or archaeological nature that have been submerged for at least 100 years. This Convention is aligned with the sustainable development objectives of the United Nations Agenda 2030.	Yes - provides the framework to protect and reduce the impact of Barossa installation activities on underwater heritage.	N/A	N/A
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 March 1994.	Yes – only relevant to the extent that to reduce impact of GHG emissions associated with activity vessel use, Santos will comply with MARPOL Annex VI (Marine Order 97: Marine pollution prevention – air pollution) and require the use of low sulphur fuel.	N/A	Santos will comply with Marine Order 97. Section 6.5 – Atmospheric emissions

B.1 Consideration of the indirect consequences under section 527E of the EPBC Act

Subsection 75(2) of the EPBC Act requires that the Minister responsible for administering the EPBC Act, or their delegate when deciding whether an action is a controlled action, consider 'all adverse impacts (if any)' the action has, will have, or is likely to have, on protected matters.

For the purposes of the Act, under section 527E(1) an event or circumstance is an 'impact' of an action taken by a person if: (a) the event or circumstance is a direct consequence of the action; or (b) for an event or circumstance that is an indirect consequence of the action—subject to subsection 527E(2), the action is a substantial cause of that event or circumstance.

In respect to section 527E(1)(b), events/circumstances that are a result of actions taken by a third party (called a 'secondary action'), such as those arising in the context of scope 3 GHG emissions, will only be an indirect consequence of the action (called the 'primary action') where:

- the action is a substantial cause of the event or circumstance
- the primary action facilitates the secondary action to a major extent
- both the secondary action and event/circumstance is either within the contemplation of the proponent of the primary action or is a reasonably foreseeable consequence of the primary action.

Santos has considered the potential for 'indirect consequences' to arise in relation to the Barossa Development and specifically the petroleum activity that is the subject of this EP. In this context, for the purposes of applying section 527E(1)(b) and (2) of the EPBC Act to the OPGGS(E)R regulatory regime:

- the 'event or circumstances' is consumption or combustion of gas by a third party
- the 'impact' is emission of GHGs
- the 'action' is:
    - the whole Barossa Development in the context of an OPP assessment
    - the particular petroleum activity (or activities) in the context of an EP assessment.

The OPP for the Barossa Development was submitted by Santos in October 2016 and accepted by NOPSEMA in March 2018. A comprehensive environmental impact assessment was completed in accordance with established practice and policies at that time.

In the context of an EP, the nature of the 'petroleum activity' will determine the scope of relevant 'indirect consequences'. This may be a subset of the consequences that are relevant when undertaking an OPP assessment, as the activities are a component of the project as a whole.

For an event or circumstance to be an indirect consequence of a petroleum activity, the petroleum activity must be demonstrated as:

- A substantial cause of that event or circumstance (s. 527E(1)(b)); and
- Facilitating, to a major extent, the action taken by the third party (as further explained in s. 527E(2)).

Neither the term 'substantial' or 'major' is defined in the EPBC Act. In accordance with typically usage and dictionary definitions:

- ‘substantial’ means weighty or big, in a relative sense to be considerable and with reference to degrees of relevance, something more than significant
- ‘major’ means greater in size, amount, importance etc. and constituting the majority or larger part.

In the context of this EP, the scope of relevant petroleum activity is limited to installing and pre-commissioning the Barossa subsea infrastructure and FPSO moorings. The EP does not permit commissioning and operating the Barossa facilities required to produce and transport the reservoir hydrocarbons (i.e. natural gas). Notably in relation to s.527E(1)(b) and (2):

- No natural gas is recovered as a result of the Activity. Several subsequent, interposed petroleum activities must be authorised under the OPGGS(E)R and then undertaken before any gas is capable of being recovered.
- Gas consumption/combustion cannot reasonably be said to have been facilitated by a petroleum activity, which has no resource extraction component. Even if some kind of facilitation could be observed, the Activity cannot reasonably be characterised as an important or majority facilitator of that action. These activities are multiple steps removed from such a characterisation. Therefore the Activity is not a primary action to a secondary action involving gas consumption/combustion.
- There is a chain of events before resource (i.e. natural gas) recovery, and then a chain of events afterwards and ahead of any resource being consumed by a third party. From a causal perspective, the link between the Activity and a third-party GHG emission is weak. This petroleum activity cannot reasonably be characterised as having a weighty/big, considerable or significant causal relationship to third-party gas consumption/combustion.

In this context, Santos has concluded that the Activity does not facilitate to a major extent natural gas consumption/combustion and this petroleum activity is not a substantial cause of any associated scope 3 GHG emissions.

Santos will submit Barossa Development EPs to extract, produce and transport the natural gas. Santos will have no ability to extract the natural gas until these petroleum activities have been assessed, meet the criteria in regulation 10A of the OPGGS(E)R and the EPs have been accepted by NOPSEMA.

The causal relationship between production operations petroleum activities and consumption or combustion of gas by a third party is different in those circumstances. Santos will consider such indirect consequences in its future Barossa Production Operations EP.

Appendix C SURF Values & Sensitivities of the Marine Environment

SURF Values & Sensitivities of the Marine Environment

PROJECT / FACILITY	Barossa
REVIEW INTERVAL (MONTHS)	No Review Required
SAFETY CRITICAL DOCUMENT	NO

Rev	Owner	Reviewer	Approver
	Senior Environmental Advisor	Environemtal Approvals Lead	GM Offshore Approvals
0			

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Rev	Rev Date	Author / Editor	Amendment
0			Submission to NOPSEMA with Revision 0 of Barossa Development Drilling and Completions Environment Plan (BAD-200-0003)

ACRONYMS

Abbreviation	Description
°C	Degrees Celsius
3D	3-dimensional
AFANT	Amateur Fishers Association Northern Territory
AFMA	Australian Fisheries Management Authority (Cth)
AHO	Australian Hydrographic Office
AIMS	Australian Institute of Marine Science
ALARP	as low as reasonably practicable
AMP	Australian Marine Park
AMSA	Australian Maritime Safety Authority
AUV	autonomous underwater vehicle
BC Act	*Biodiversity Conservation Act 2016*
BIA	Biological Important Areas
cm	centimetre
CoA	Commonwealth of Australia
CSIRO	Commonwealth Scientific and Industrial Research Organisation
Cth	Commonwealth
DAFF	Department of Agriculture, Fisheries and Forestry (Cth)
DAWE	Department of Agriculture, Water and the Environment (Cth)
DCCEEW	Department of Climate Change, Energy, the Environment and Water (Cth)
DEPWS	Department of Environment, Parks and Water Security (NT)
DEWHA	Department of the Environment, Water, Heritage and the Arts (Cth)
DFAT	Department of Foreign Affairs and Trade (Cth)
DISER	Department of Industry, Science, Energy and Resources (Cth)
DITRDCA	Department of Infrastructure, Transport, Regional Development, Communications and the Arts (Cth)
DNP	Director of National Parks
DoEE	Department of the Environment and Energy (Cth)
DoEH	Department of the Environment and Heritage (Cth)
DPIRD	Department of Primary Industries and Regional Development (WA)
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities (Cth)
e.g.	for example,
ECNT	Environment Centre Northern Territory
EEZ	exclusive economic zone
EMBA	Environment that May Be Affected
EP	environment plan

Abbreviation	Description
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999 (Cth)*
EPBC Regulations	Environment Protection and Biodiversity Regulations 2000
EPO	environmental performance objective
EPS	environmental performance standard
GDA 2020	Geocentric Datum of Australia 2020
h	hour
ha	hectare
i.e.	that is
IMCRA	Integrated Marine and Coastal Regionalisation of Australia
IMO	International Maritime Organization
ITF	Indonesian Throughflow
IUCN	International Union for Conservation of Nature
KEFs	Key ecological features
kg	kilogram
kHz	kilohertz
km	kilometre
km^2	square kilometre
LAT	Lowest astronomical tide
m	metre
m/s	metres per second
m^2	square metre
m^3	cubic metre
MEVA	moderate exposure value area
mg/L	milligrams per litre
MGA	Map Grid of Australia
mm	millimetre
MNES	matters of national environmental significance
MoU	memorandum of understanding
MPNMP	Marine Park Network Management Plan
MSL	mean sea level
N/A	not applicable
NGER Act	*National Greenhouse and Energy Reporting Act 2007 (Cth)*
Nm	nautical mile
NMR	North Marine Region
NOAA	National Oceanic and Atmospheric Administration (US)
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NOPTA	National Offshore Petroleum Titles Administrator

Abbreviation	Description
NSW	New South Wales
NT	Northern Territory
NWMR	North-West Marine Region
OA	Operational Area
OECD	Organisation for Economic Co-operation and Development
OPEP	oil pollution emergency plan
OPGGS Act	*Offshore Petroleum and Greenhouse Gas Storage Act 2006 (Cth)*
OPGGS(E)R	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth)
OPP	Offshore Project Proposal
PMST	Protected Matters Search Tool
POB	persons on board
ppb	parts per billion
ppm	parts per million
Ramsar	Convention on Wetlands of International Importance
ROV	Remote Operated Vehicle
RPS APASA	RPS Asia-Pacific Applied Science Associates (company)
SURF	subsea umbilicals, risers and flowlines
t	tonne
UK	United Kingdom
URF	umbilicals, risers and flowlines
US	United States
UV	ultraviolet
WA	Western Australia
WAM	Western Australian Museum

Santos

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Appendices

1. Introduction

Santos NA Barossa Pty Ltd (Santos) proposes to install a part of the Barossa Gas Project relating to the Barossa subsea umbilicals, risers and flowlines (SURF), manifolds and floating production, storage and offloading (FPSO) moorings installation (collectively referred to as subsea infrastructure) and pre-commissioning activity. This is more simply referred to as the 'Activity'. The Barossa Subsea Infrastructure Installation Environment Plan (EP) (BAA-200 0636), referred to as the SURF EP, provides for the Activity.

This document supports the SURF EP and describes the existing environment that may be affected (EMBA) by the Activity, and includes details of the relevant values and sensitivities of that environment, as required by the *Commonwealth Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (OPGGS (E) Regulations).

Section 3.1 of the SURF EP describes the EMBA and how it was determined for the Activity. It is important to note that the EMBA is used to identify the full range of environmental and socioeconomic receptors, however, it is not considered representative of potential ecological impacts (NOPSEMA, 2019).

This document is informed by the protected matters report (Appendix A), stated values in the Marine Bioregional Plans for the North Marine Region (NMR) and the North-West Marine Region (NWMR) (DSEWPaC, 2012a,b), Barossa environmental studies (Section 1.2), published scientific literature and studies and information obtained through consultation. Marine and coastal species identified in the protected matters report (Appendix A) are described, with a focus on protected species that are threatened and migratory. It is important to note that this document describes the environmental values and sensitivities that occur within the boundaries of the EMBA, whereas the protected matters report incorporates an in-built buffer and hence may report on matters that are actually outside the EMBA.

1.1 Geographical extent

The Activity is proposed within Commonwealth waters, approximately 300 km north-north-west of Darwin, Northern Territory (NT), within the boundaries of the Commonwealth Petroleum Production Licence (NT/L1). A portion of the EMBA is located between the Perth Treaty boundary and the 1972 continental shelf. Under the Perth Treaty, there are areas of overlapping jurisdiction between Australia and Indonesia; Australia exercises seabed jurisdiction including for petroleum exploration, and Indonesia exercises water column jurisdiction including fishing rights (the Perth Treaty area).

The EMBA is almost entirely seaward of Australian coastal waters of Western Australia (WA) and the NT, extending north into Indonesia and Timor-Leste coastal areas (Figure 1-1). The EMBA portion within Australian Commonwealth waters is located in the North Marine Region (NMR) and the North-west Marine Region (NWMR; Figure 1-2).

Four provincial bioregions occur within the Australian waters of the EMBA (Figure 1-2), based on the Integrated Marine and Coastal Regionalisation of Australia (IMCRA) version 4.0. Provincial bioregions are classified based on biological and physical information, including the distribution of fishes, marine plants and invertebrates, sea floor geomorphology, sediments, and oceanographic data (IMCRA v. 4.0). Bioregions within international waters of the EMBA have not been formally classified, however habitats within these waters are described in the scientific literature and industry studies. The provincial bioregions that overlap with the EMBA are as follows.

North-west Marine Region:

- North-West Shelf Transition
- Timor Province.

North Marine Region:

- North-West Shelf Transition

- Timor Transition
- Northern Shelf Province.

To classify broadscale habitat or species distributions within the EMBA, the provincial bioregions of the NMR and NWMR and the international waters of south-west Indonesia and Timor-Leste have been referred to throughout this document where relevant.

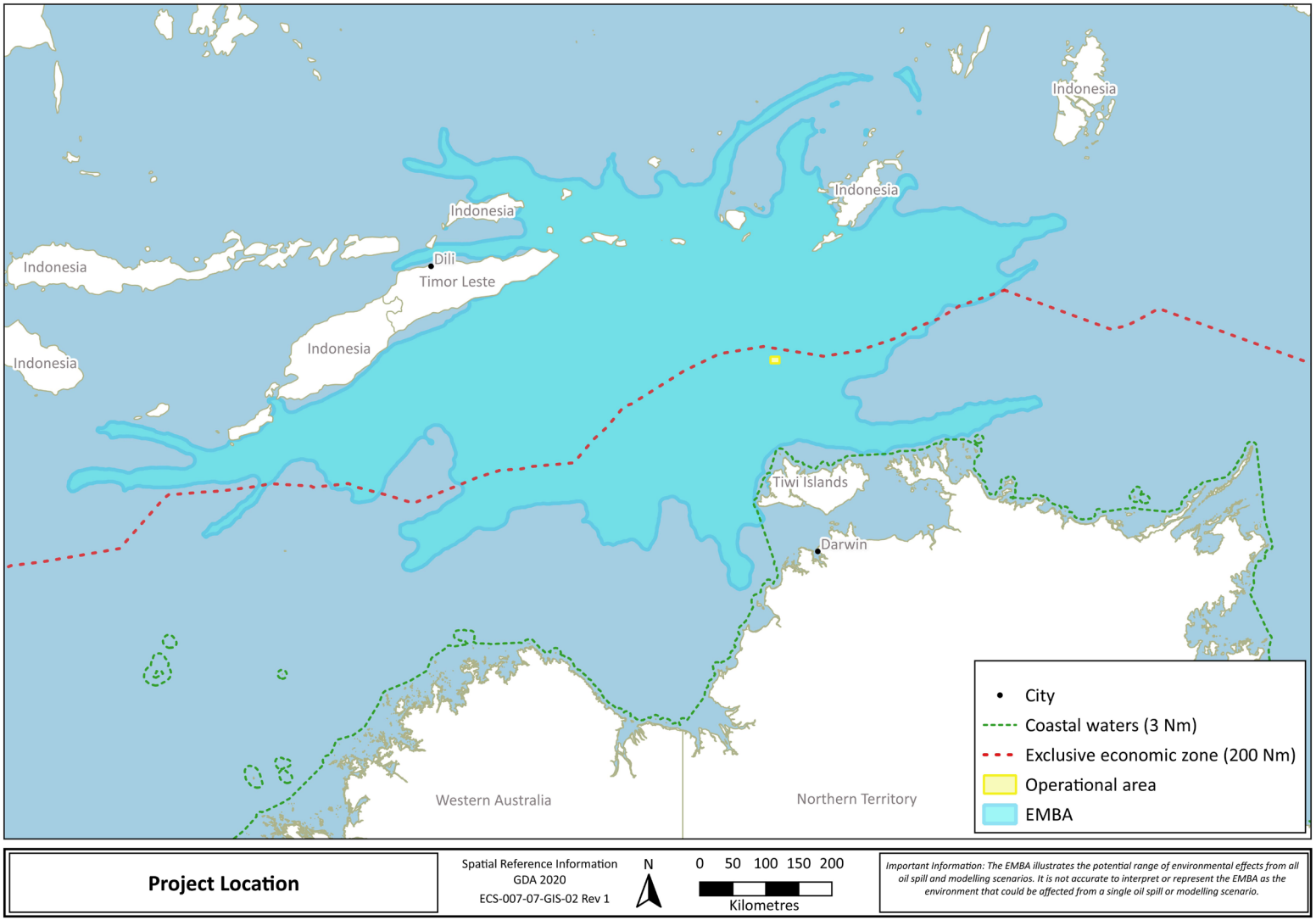


Figure 1-1: Location and Extent of the EMBA

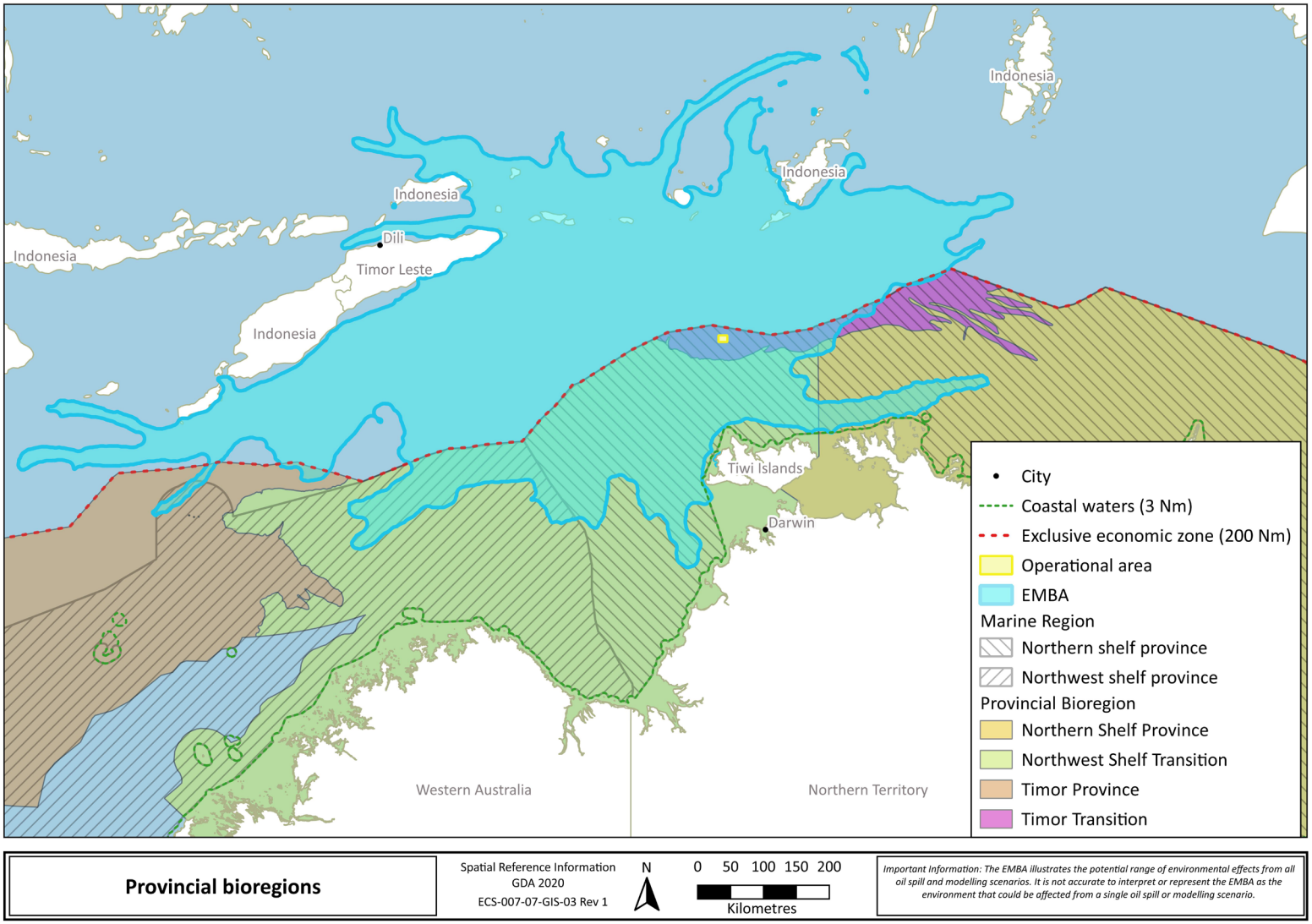


Figure 1-2: IMCRA 4.0 provincial bioregions within the EMBA

1.2 Barossa marine studies program and additional studies

Extensive environmental and socioeconomic studies have been undertaken to characterise the existing environment within and adjacent to the Barossa development. Table 1-1 summarises the Barossa marine studies program which involved the collection of detailed baseline data from July 2014 to July 2015 to capture seasonal variability in the region, as well as desktop modelling studies to contribute to the understanding of the baseline environment. The Barossa marine studies program informed the approved Barossa development area offshore project proposal (ConocoPhillips, 2018), which was prepared in accordance with the requirements of the OPGGS (E) Regulations.

Table 1-2 summarises the relevant Barossa environmental and socioeconomic studies undertaken to inform the understanding of the environment (including socioeconomic) after the initial Barossa marine studies program.

Table 1-1: Summary of Barossa marine studies

Study type	Description of study	Reference
Field-based studies		
Metocean data collection	Collection of metocean data on the surface and through the water column from July 2014 to March 2015, within and near the Barossa field, e.g., current, conductivity, wave and wind data.	Fugro, 2015
Water quality survey	Collection of baseline data on physical and chemical components of water quality near the Barossa field. The surveys were completed in June 2014, January 2015 and April 2015.	Jacobs, 2015a, 2015b, 2015c, 2016a
Sediment quality and infauna survey	Collection of baseline data on sediment quality and infauna communities near the Barossa development.	Jacobs, 2015c
Benthic habitat survey	Collection of baseline data to characterise topographic features, benthic habitats and macrofaunal communities near the Barossa field location and surrounding areas, including around Evans Shoal, Tassie Shoal and Lynedoch Bank by using a specialised remotely operated vehicle (ROV).	Jacobs, 2015c, 2016a
Underwater noise survey	Collection of baseline data on ambient underwater noise (physical, biological and anthropogenic sources) at three locations from July 2014 to July 2015 near the Barossa development and surrounding areas.	JASCO, 2015
Shoals and shelf survey 2015: benthic habitats and fish communities	A seabed biodiversity survey of three shoals to the west of the Barossa field (Evans Shoal, Tassie Shoal and Blackwood Shoal) and two mid-continental shelf regions relevant to the pipeline route corridor. The Australian Institute of Marine Science (AIMS) performed the survey in September/October 2015, which involved characterisation of the seabed habitats, associated biota and fish communities (shoals only).	Heyward et al., 2017
Geophysical survey	This was a preliminary geophysical survey of potential pipeline routes within the pipeline route corridor presented in the accepted offshore project proposal (OPP; Conocco Phillips, 2019).	Fugro, 2016
Oceanic shoals marine park benthic habitat and fish diversity assessment	An AIMS seabed and fish biodiversity survey conducted in September and October 2017. The survey focused on six key sites inside and outside of the Oceanic Shoals Marine Park, including in the Habitat Protection Zone, and Shepparton Shoal. The objective was to use this new data to update the predictive habitat model and statistically compare the proportion and spatial diversity of habitats within and outside the Oceanic Shoals Marine Park.	Radford et al., 2019
Desktop or modelling studies		
Environmental literature review and gap analysis	Collection and collation of publicly available information about the marine environment near the Barossa field, and gap analysis were performed to determine if sufficient information were available to	Jacobs SKM, 2014

	inform an environmental impact assessment and any future regulatory approvals for a potential full field development.	
Hydrodynamic model validation study	Data from both the metocean study and deployment of drifter buoys near the Barossa field and surrounding areas were used to validate the underlying hydrodynamic model utilised to develop the spill and discharge models.	RPS APASA, 2017

Table 1-2: Summary of Barossa additional studies

Study type	Description of study	Reference
Tiwi Islands sensitivity mapping study	Collection of data on environmental, social, cultural and economic sensitivities for the Tiwi Islands. A desktop review of available data (spatial datasets) was followed by workshops with Traditional Owners to identify cultural and environmental sensitivities along the coast of the Tiwi Islands.	ConocoPhillips, 2019a
Desktop study Tiwi turtle programs	This desktop report reviews publicly available literature and research relating to marine turtle activity occurring on, and around, the Tiwi Islands of northern Australia. A total of 19 satellite telemetry studies between 1994-2023 which tracked turtles passing through or foraging in waters near the Tiwi Islands were included in the review.	Pendoley, 2023
Maritime Heritage Assessment – Infield Infrastructure	A maritime archaeological study was conducted over the SURF OA to identify potential maritime archaeological sites which are defined as wrecks (ship or aircraft) and associated material, dumped material, maritime infrastructure, and associated deposits on or under the seabed below the highest astronomical tide.	Cosmos Archaeology, 2023

2. Physical Environment

2.1 Geomorphology

2.1.1 Formation history

Around 550 to 160 million years ago, the northern and western parts of Australia formed part of the northern margin of Gondwana. Around 300 million years ago, crustal stretching, rifting and breakup initiated development of an extensive basin where sediments were deposited (Baker et al., 2008 in DEWHA, 2008a). About 135 million years ago the continent broke up, resulting in the separation of greater India and Australia.

2.1.2 Bathymetry and seabed

Generally, the EMBA consists of a wide continental shelf with a variety of key ecological features (KEFs; Section 11). For the majority of the EMBA (96%), water depths range between 0 and 4,000 m. Although a deep trench reaching depths of 7,000 m runs under a small area at the north-east of the EMBA (Figure 2-1), the seabed is generally flat or gently sloping with an average 500 m depth change over a distance of 5 to 20 km. Within the EMBA there are several submerged and emergent shoals and banks (Section 2.4). Outside Australian territorial waters, areas such as the Timor Trench may be associated with aggregations of marine fauna due to high productivity and the outermost southern area of the Lesser Sunda Ecoregion, south of Rote Island, is characterised by exposed shorelines and contains fringing coral reefs (Wilson et al., 2011; DeVantier et al., 2008). The OA is located on a plain devoid of significant bathymetric features with sediments comprising predominantly fine clayey sand (Figure 2-2 and Figure 2-3 from Fugro, 2016; Jacobs, 2016a).

In general, the benthic habitats observed in the OA are typical of offshore environments and consistent with studies conducted in the area with similar features and comparable geographic location (Table 1-1; Jacobs, 2016c). See Section 3 for further details on the benthic habitats observed in the EMBA.

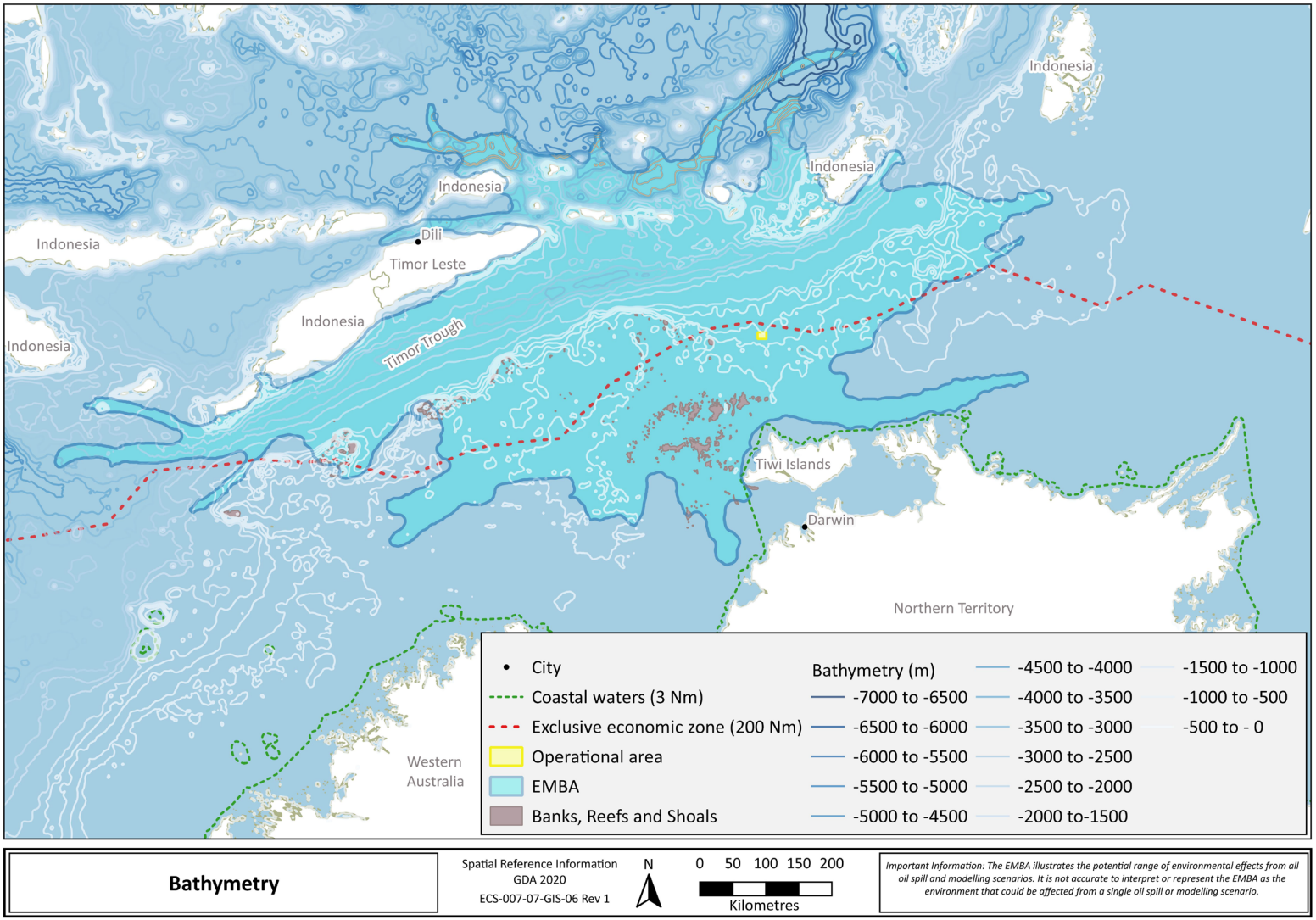


Figure 2-1: Bathymetry in the vicinity of the EMBA

Figure 2-2: Typical seabed terrain in the OA

a) Silty sandy substrate with a burrowing anemone and widespread bioturbation (southern area)

b) Silty sandy substrate with a teleost fish and widespread bioturbation (southern area)

c) Silty sandy substrate with a sea pen (middle area)

d) Silty sandy substrate with gravelly silty sand substrate, a squat lobster and soft coral (middle area)

e) Silty sandy substrate with a teleost (gurnard) (northern area)

f) Silty sandy substrate with a prawn (northern area)

Figure 2-3: Representative images of benthic habitats and macrofauna near the OA

2.2 Climate

Waters within the EMBA predominantly lie in the arid tropics. Monsoonal conditions usually occur from October to March (wet season), with cooler and drier conditions prevailing from April to September (dry season).

Meteorological data for the region, recorded at the Bureau of Meteorology (BoM) weather station at Melville Island (the closest metrological station to the EMBA), shows small seasonal variation in air temperatures. The mean maximum summer and winter air temperatures are 34 °C and 31 °C, respectively, with annual maximum temperatures of 33 °C and minimums of 22 °C. The Timor and Arafura seas region averages one tropical cyclone annually, usually occurring between November and April (BoM, 2023; 2017).

2.3 Oceanography

2.3.1 Regional current system

Large-scale currents of the Timor and Arafura seas are dominated by the Indonesian Throughflow (ITF) current system (Figure 2-4). The ITF brings warm, low-salinity oligotrophic waters through a complex system of currents, linking the Pacific and Indian Oceans via the Indonesian Archipelago (DSD, 2010). The strength of the ITF fluctuates seasonally, reaching maximum strength during the south-east monsoon, and weakening during the north-west monsoon.

The Holloway Current (Figure 2-4), a relatively narrow boundary current that flows along the north-west shelf of Australia between 100 and 200 m depth, also influences the seas in the EMBA. The direction of the current changes seasonally with the monsoon, flowing towards the north-east in summer and the south-west in winter (Fugro, 2015).

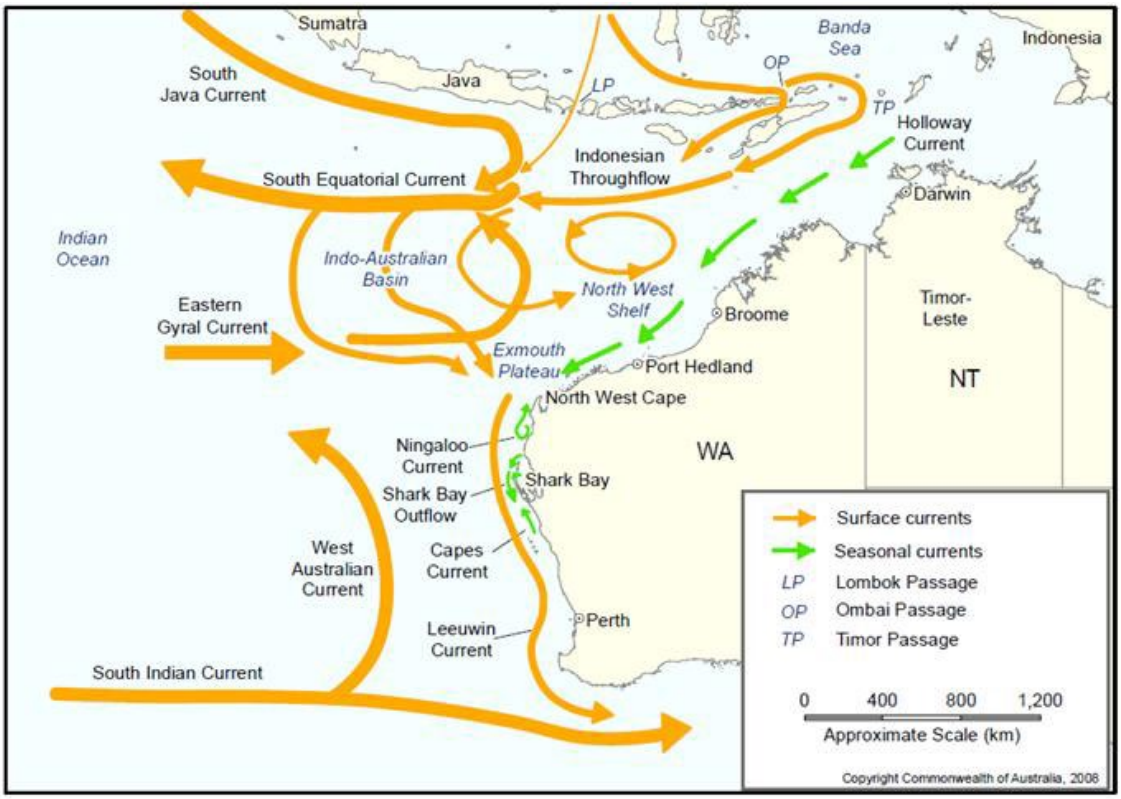


Figure 2-4: Surface currents in the Northern Territory and Western Australia

2.3.2 Currents and tides

Water movement in the EMBA is influenced by wind and tidal activity and less by ocean currents. Smaller-scale surface currents reflect seasonal wind activity, flowing easterly to north-easterly during the wet season, and west to south-west during the dry season (Heyward et al., 1997). Local wind-driven surface currents can reach speeds of 0.6 metres per second (m/s) during monsoonal wind surges, although more typical speeds are in the range of 0.2 to 0.3 m/s (Heyward et al., 1997). Average current speed in the OA ranged from 0.22 m/s at the near surface to 0.14 m/s at 210 m below mean sea level (MSL) during the data collection for the Barossa development (Fugro, 2015).

Tidal activity is typically dominated by semi-diurnal tides, with two daily high tides and two daily low tides. The highest astronomical tide recorded at Tassie Shoal (about 75 km southwest of the OA) is 1.4 m above MSL and the lowest astronomical tide is 1.8 m below MLS (Consulting Environmental Engineers, 2002). The mean tidal range is 2.2 m at spring tides and 0.3 m at neaps (Consulting Environmental Engineers, 2002). Measurements of ocean currents at Tassie Shoal show water movement is strongly tidal, with typical speeds in the range of 0.1 to 0.4 m/s and peak speeds up to 0.8 m/s (Consulting Environmental Engineers, 2002).

2.3.3 Waves

Waves in the EMBA are expected to be composed of locally generated sea waves in response to local wind activity and swell waves created by distant wind activity. Wave height is generally between 0.6 and 0.8 m, coming from the west in the wet season and from the east in the dry season. Waves at Tassie Shoal typically approach from west to south-west throughout the year (Consulting Environmental Engineers, 2002). Cyclones and tropical storms can greatly increase wave heights by up to 8 m in the outer Timor Sea during the cyclone season (Przeslawski et al., 2011).

The wave climate offshore of the north-west shelf of Australia is normally dominated by the passage of storms over the southern Indian Ocean (Fugro, 2015). However, between October and March, the wave climate is controlled by the south-westerly monsoon winds. This combination of wind directions may lead to concurrent swells approaching from different directions. The sea wave climate also reflects the seasonal wind regime, with waves predominantly from the south-west in summer and from the east in winter.

2.3.4 Temperature

Surface water temperatures in the EMBA generally range between 27 and 30 °C with temperatures above the seabed between 11 and 13 °C (Jacobs, 2016a). Sea temperatures in the upper water column within the OA were recorded as reaching a maximum of 31 °C in summer and a minimum of 25 °C in spring (Fugro, 2015). The minimum sea temperature recorded was 11 °C near the seabed within the OA at 253 m below MSL in spring. Mean temperatures ranged from 28 °C at 34 m below MSL to 13 °C at 253 m below MSL in summer (Fugro, 2015).

2.4 Shoals and banks

A number of shoals and banks occur within the EMBA (Table 2-1 and Figure 2-5). Few historic studies of these features exist, with most of the understanding derived from the ‘Big Bank Shoals’ study (Heyward et al., 1997) and PTTEP surveys initiated in response to the Montara incident (Heyward et al., 2010; 2011). Evans Shoal, Tassie Shoal and Lynedoch Bank are the nearest shoals and banks to the OA (Table 2-1 and Figure 2-5).

Table 2-1: Shoals and banks within the EMBA

Geomorphic feature	Water depth range (~m)	Approximate distance and direction from the OA
Lynedoch Bank	60 – 100	56 km south-east
Evans Shoal	20 – 110	67 km west
Tassie Shoal	20 – 90	76 km south-west
Blackwood Shoal	30 – 80	86 km west
Goodrich Bank	20 – 60	88 km south
Franklin Shoal	20 – 90	97 km west
Flinders Shoal	20 – 80	100 km west
Marie Shoal	20 – 50	114 km south
Cootamundra Shoal	30 – 80	132 km south-west
Moss Shoal	30 – 50	141 km south
Martin Shoal	20 – 90	147 km west
Calder Shoal	40 – 70	150 km south-west
Parry Shoal	20 – 60	150 km south
Margaret Harries Bank	40 – 120	164 km south-west
Loxton Shoal	30 – 90	165 km west
Troubadour Shoal	20 – 110	179 km west
Sunset Shoal	30 – 100	184 km west
Afghan Shoal	30 – 50	222 km south
Sunrise Bank	70 – 90	225 km west
Shepparton Shoal	30 – 50	240 km south
Jones Shoal	20 – 30	243 km south-east
Newby Shoal	30 – 60	247 km south-west
The Boxers	40 – 90	256 km south-west
Flat Top Bank	30 – 60	280 km south
Bellona Banks	50 – 120	312 km west
Echo Shoals	30 – 460	352 km west
Big Bank Shoals	10 – 320	457 km south-west
Karmt Shoal	20 – 360	505 km south-west

The shoals and banks within the region, including the EMBA, share a tropical marine biota similar to those found on emergent reef systems of the Indo West Pacific (Heyward et al., 2017). AIMS' analysis of benthic communities showed that neighbouring (i.e., within hundreds of kilometres)

shoals and banks frequently share >80 % of benthic community composition (Heyward et al., 2017). The most influential determinants of the benthic community composition include depth and light intensity, substrate type and complexity, hydrodynamic environment and position on the continental shelf (Heyward et al., 2017). The distribution of over 150 shoal/bank features across the Sahul Shelf KEF, with individual shoals/banks often separated by 5 to 20 km, suggests an extensive series of 'stepping stone' habitats available to recruit larvae and connect these ecosystems (Heyward et al., 2017).

The shoals and banks within the EMBA (Table 2-1) are expected to support comparable levels of biodiversity, but to show variation in the abundance and diversity of dominant benthic species, with subsets of species featuring more prominently on some shoals and banks than others (Heyward et al., 2017). A summary of the results from the Barossa marine studies program (Section 1.2), which included benthic habitat surveys of Evans Shoal, Tassie Shoal and Lynedoch Bank are presented below.

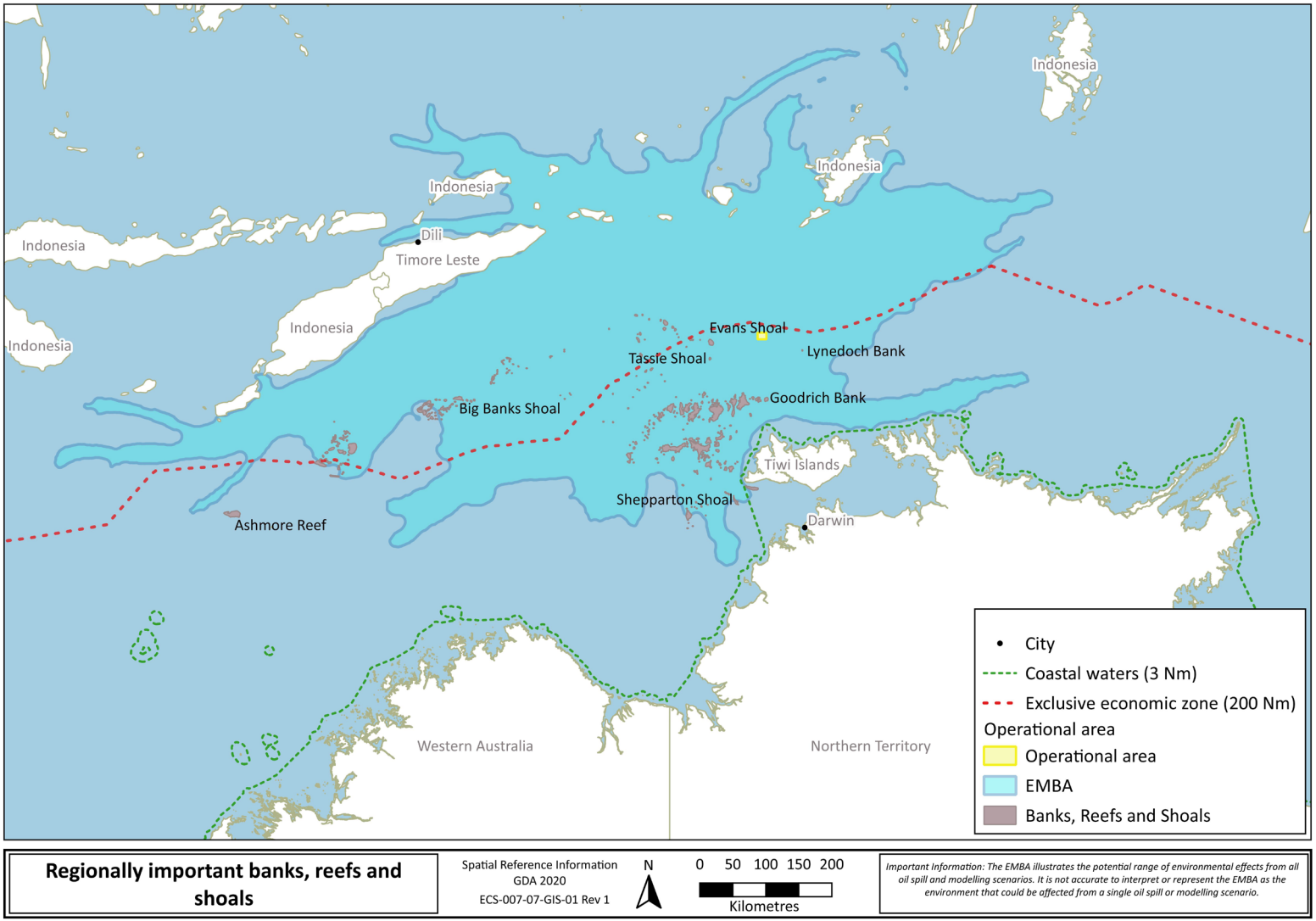


Figure 2-5: Banks, reefs and shoals within the EMBA

2.4.1 Summary of the results from the Barossa marine studies program

Evans Shoal, Tassie Shoal and Lynedoch Bank were surveyed as part of the Barossa marine studies program (Jacobs, 2016c). There was a high degree of similarity between the surveyed sites, based on the consistent diversity observed in habitat features and biota present. One exception to this was the eastern slope of Evans Shoal, which showed a high degree of similarity to a scarp feature (Jacobs, 2016c). This may be due to depth or greater exposure to predominant currents and weather.

In general, the reef flat at Evans Shoal was characterised by sand and algae-covered rubble with communities dominated by hard and soft corals, algae and sponges in varying degrees of diversity and abundance. The plateaus of Evans and Tassie Shoals also had extensive areas of sand and rubble (Jacobs, 2016c; Heyward et al., 2017). Gorgonians and sea whips often dominated the reef crest, whereas the hard substrate of the slope predominantly supported sponges and filter feeders (such as gorgonians, feather stars and sea whips). Filter feeders became more prevalent on rocky outcrops beyond 60 m (Heyward et al., 2017). Of particular note were the northern and southern slopes of Evans Shoal with large areas of dense plate coral (at 40 to 50 m depth) and dense sub-massive coral on the northern slope at 47 m (Jacobs, 2016c).

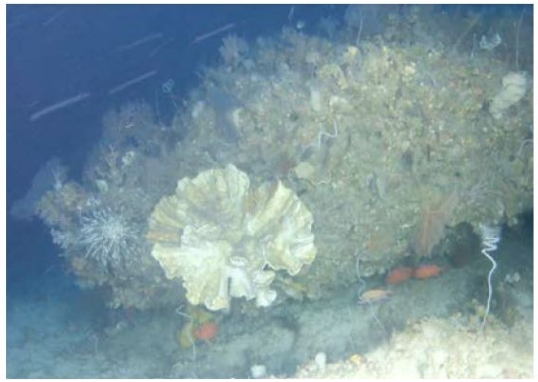
Heyward et al. (2017) also recorded areas of medium- to high-density foliaceous coral (~9% coverage) at Evans Shoal and Tassie Shoal (Heyward et al., 2017).

Seabed habitats at the shoals were broadly consistent with those observed across the region. Heyward et al. (2017) noted that while there were many similarities between the shoals in the region, there were differences likely influenced by the broader physical environment. For example, the status of the benthic communities on each shoal may reflect different disturbance events (e.g. cyclone/storm damage and coral bleaching) and recruitment histories due to variations in biological connectivity.

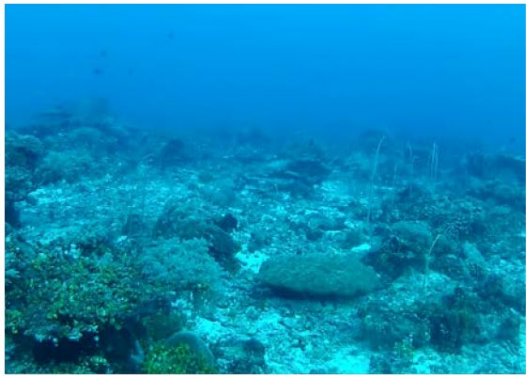
The shoal slopes supported a diverse range of fish species typical of reef-fish assemblages as well as pelagic species. Species richness in the fish community was influenced most by the calcareous reef composition of the substrata, and the percentage cover of hard coral on this substratum type (Heyward et al., 2017). Therefore, species richness decreased with depth as seabeds exhibited bare substrata. AIMS has conducted a detailed characterisation of the fish communities at Evans Shoal and Tassie Shoal. Section 5.1.2 summaries the findings and Table 2-2 summarises the marine studies program for Evans Shoal, Tassie Shoal, Lynedoch Bank, Goodrich Bank, Marie Shoal and Shepparton Shoal (Heyward et al., 2017).

Table 2-2: Summary of the results from the marine studies program

Shoal/bank	Description
Evans Shoal	Evans Shoal, located approximately 67 km to the west of the OA, is a flat-topped shoal that reaches a plateau at 18 to 28 m below the sea surface. The infauna communities were reasonably diverse and abundant (3 to 63 individuals representing 3 to 42 taxa in the coarser sediments) and dominated by molluscs (e.g. laevidentaliidae), crustaceans (e.g. tanaids, amphipods, isopods, callianassids) and annelid worms (e.g. syllids, *Nematonereis* species, lumbrinerids; Jacobs, 2016b). The coarser sediments at Evans Shoal supported higher species diversity and abundance. The relationship between coarse sediments, high infaunal abundances and species richness has been previously identified in the north-west shelf with Huang et al. (2013) noting that greater species richness and total abundance were associated with coarse-grained, heterogeneous sediments (Jacobs, 2016b). The key benthic habitats and dominant fish species observed are discussed below (Jacobs, 2016c). **Reef flat (centre of the shoal)** The transect was located at a water depth of about 28 m. The substrate was predominantly sand with patchy mixed beds of filter feeders (e.g. sponges and soft corals) and macroalgae. Hard corals were observed at a small bommie (Jacobs, 2016c). Heyward et al. (2017) noted that hard corals were generally sparse or absent across large areas of the plateau, but their density increased towards the outer edges of the plateau. Several taxa of fish including species from families Labridae, (wrasse), Pomacanthidae (damselfish and clownfish), Acanthuridae (surgeonfishes, tangs and unicornfishes), Zanclidae (Moorish idols), Balistidae (triggerfishes) and Monacanthidae (leatherjacket).   **Southern slope** Transects on this slope began on the reef flat in 18 m water depth. While the substrate of the reef flat was dominated by sand and rubble, some areas supported high-density coral cover (mostly plate and branching forms but also soft corals) and *Halimeda* species (calcareous algae). A diverse assemblage of reef-fish occurred in these areas and whitetip reef sharks were also observed. The reef crest of the shoal (about 32 m deep) was dominated by plate coral, whereas the upper slope was dominated by sand. As water depth increased the substrate changed from being dominated by plate corals (about 42 m depth) to macroalgae with scattered sponges and sea cucumbers (about 55 m depth).

Shoal/bank	Description
	  **Eastern slope** Transects on this slope began at about 83 m water depth. The reef flat was characterised by sandy substrate with occasional small macroalgae. Silvertip sharks were observed in this habitat. The crest of the shoal (about 88 m deep) supported a rocky overhang with various types of filter feeders. The slope was dominated by steep rock faces and rocky overhangs with small sandy ledges that supported filter feeders (such as gorgonians, feather stars, sea whips and sponges) and reef-fish.   **Northern slope** Transects on the northern slope began at about 45 m water depth. The reef flat on this slope alternated between areas dominated by plate coral, sub-massive coral and macroalgae (including Halimeda species) with sponges. Whitetip reef sharks and one tawny nurse shark were observed on the reef flat, as were individuals from the fish families Labridae, Pomacentridae and Pomacanthidae. Small discrete piles of rubble were also observed and were likely to be triggerfish nests. The crest of the shoal (about 80 m deep) was colonised by sponges, filter feeders and algae. The reef slope was characterised by rocky substrate with small sand-covered ledges and supported communities dominated by sponges and filter feeders (such as gorgonians, feather stars, sea whips and sponges). One moray eel (Muraenidae) and various species of fish (families

Shoal/bank	Description
	Chaetodontidae (butterflyfish), Carangidae (queenfishes, runners, scads and trevallies), Caesionidae (fusiliers), Serranidae (groupers and reef cod) and Holocentridae (squirrelfish) were observed in the rocky overhangs of the reef slope.  
Tassie Shoal	Tassie Shoal, located approximately 76 km to the south-west of the OA, is a flat-topped shoal that reaches a plateau at about 14 to 15 m below the sea surface. The infauna communities were reasonably diverse and abundant (12 to 33 individuals representing 12 to 24 taxa), with species present being dominated by syllid polychaetes, tanaid crustaceans, foraminifera, brittlestars and fibularid echinoderms (urchins; Jacobs, 2016b). The key benthic habitats and dominant fish species associated with the shoal are discussed below (Jacobs, 2016c). **Reef flat** The reef flat was sampled at two sites at a water depth of about 15 m. The substrate consisted of sand, rubble and patchy reef structure. The reef structure was dominated by massive, sub-massive, plate and branching coral forms, and the hard substrate supported a range of sea whips, soft corals, *Halimeda* species, turf algae and sponges. Feather stars, large clams and a decapod crustacean were also recorded. A diverse range of tropical fish species were sighted including representatives from the families Labridae, Pomacentridae, Zanclidae, Pomacanthidae and Acanthuridae. Two whitetip reef sharks were also observed.

Shoal/bank	Description
	  **Eastern slope** The transect began in about 28 m water depth. The reef crest was dominated by hard coral, soft coral and sponges, but also supported *Halimeda* species. Schools of fish (Acanthurids and Carangids) and sea snakes were observed on both the reef flat and upper slope. The top of the reef slope (30 to 50 m) was dominated by sponges and soft corals, such as gorgonians and sea whips. The substrate became dominated by sand and rock at about 50 m and began to flatten out and become dominated by sand around 70 m. A sea snake and a whitetip reef shark were observed at the bottom of the reef slope at about 48 m.  
Lynedoch Bank	Lynedoch Bank, located approximately 56 km to the south-east of the OA, is a flat-topped bank which reaches a plateau at about 14 to 16 m below the sea surface. The infauna communities were reasonably diverse and abundant (56 individuals representing 39 taxa) with species present being dominated by nematodes, tanaid crustaceans, and polychaetes, brittlestars and mud shrimp (Jacobs, 2016b). The key benthic habitats and fish communities of the shoal are discussed below (Jacobs, 2016c). **Reef flat (centre of the shoal)**

Shoal/bank	Description
	The reef flat was sampled at two sites at a water depth of about 16 m. The reef flat was dominated by sand and rubble with hard corals (mostly branching, massive and sub-massive), sponges, soft coral and Halimeda species present. Small reef-fish were common (including individuals from the families Chaetodontidae, Labridae and Zanclidae) with whitetip reef sharks, a sea snake and a moray eel also observed.   **Eastern slope** The transect began on the reef flat in about 26 m water depth, which was observed to be similar to that described above. The reef sloped gently to a depth of about 85 m and was characterised by a sand and rubble substrate. There was a noticeable low abundance of fish, sharks and other motile fauna.   **Western slope** The reef flat was characterised by sand and rubble with hard corals (mostly branching, encrusting and massive forms), sponges and *Halimeda* species present. Small triggerfish (Balistidae) were common, with sharks (most likely silvertip and whitetip reef sharks) and a sea snake also observed. The reef crest (about 40 m water depth) and the slope were dominated by sand and rubble, with occasional sponges, sea stars, sea cucumbers, and reef-fish (Pomacanthidae). The slope flattened out at about 70 m deep and became dominated by sand.

Shoal/bank	Description
	 
Goodrich Bank, Marie Shoal and Shepparton Shoal	Goodrich Bank, Marie Shoal and Shepparton Shoal are located approximately 88 km, 114 km and 240 km south of the OA, respectively. AIMS undertook a seabed biodiversity survey in 2015 at two mid-shelf seabed locations adjacent to Goodrich Bank and Cape Helvetius (Heyward et al., 2017). The benthic habitat surrounding Goodrich Bank supported sparse- to moderate-density filter feeders (dominated by small sponges) on areas of bare rock or sand covered pavement, with larger organisms observed on outcropping low-relief reef or rocks. Hard corals were rare in the waters surrounding Goodrich Bank and were only encountered at depths less than 30 m. The AIMS extended benthic habitat map shows that burrowers/crinoids and filter-feeder communities are expected at Marie and Shepparton shoals. Connectivity between shoal features is expected given the strong surface currents in the region (Heyward et al., 2017). Therefore, it is anticipated that the ecological characteristics of the Goodrich Bank, Marie Shoal and Shepparton Shoal are broadly consistent with the above description of the shoals and banks located within the EMBA, as well as the characteristics described for Evans Shoal, Tassie Shoal and Lynedoch Bank.

2.5 Offshore reefs and islands

The EMBA does not overlap with any of the key offshore reefs and islands in Commonwealth waters of the region. The EMBA approaches the west coast of Bathurst Island and the modelling indicates (see SURF EP Section 7.6) that there is a very low probability that sub-threshold concentrations of hydrocarbons in marine waters could result in shoreline contact above threshold at 3 locations on the island's western coast (Figure 1-1).

Bathurst Island, along with Melville Island and nine smaller uninhabited islands, forms part of the Tiwi Islands, which are situated about 80 km north of Darwin and about 140 km south of the OA. The Tiwi Islands are Aboriginal freehold land owned by the Tiwi Aboriginal Land Trust (NRETAS, 2009a). A mapping exercise has been undertaken with the Tiwi Land Council to identify environmental and socioeconomic values along the Tiwi Islands coastline (ConocoPhillips, 2019).

The sandy beaches on the west coast of Bathurst Island provide habitat for marine turtles, seabirds and shorebirds, but only the flatback and olive ridley turtles have nesting biologically important areas (BIAs) that overlap the beaches within the EMBA (Section 6.1). The nearest important seabird (crested tern) breeding colony on Seagull Island, off the north-west tip of Melville Island, is more than 20 km away (Figure 8-1) and the potentially affected areas are not considered to provide important habitat for shorebirds (Chatto, 2003).

2.6 Other seabed features of interest

2.6.1 Seamounts

The Barossa marine studies program (Jacobs, 2016c) included sampling sites at several seamounts in the broader vicinity of the Barossa development (within 9 to 18 km to the west of the OA). The seamounts are generally raised up from the seabed to water depths between 50 and 80 m and are characterised by predominantly sand and rubble (Jacobs, 2016c). The hard substrate of the seamount slopes support epibenthic communities dominated by sponges and filter feeders such as gorgonians (e.g. sea whips, sea fans and soft corals) and feather stars. Other epibenthic species observed included holothurians (sea cucumbers), sea fans and algae (Jacobs, 2016c).

Triggerfish nesting areas were apparent at the seamounts. The triggerfish (family Balistidae) appeared to make depressions in the sand and rubble at the top of the southernmost seamount surveyed, as they were observed in and around these depressions (Jacobs, 2016c). At a seamount directly west of the OA (about 18 km), small discrete piles of rubble had accumulated that also may have been fish nests or as the result of tidal/current movement. These piles were also observed on the northern slope of Evans Shoal. The seamounts also appeared to support schools of fish (predominantly from the families Lutjanidae, Carangidae and Caesionidae, and including larvae or juveniles) both near the top of the seamount and at depth.

Four grey nurse sharks were observed at one of the seamounts in about 130 to 160 m water depth. This was considered unusual as neither the east nor west coast populations are known to extend that far north and are generally associated with shallower, more coastal waters (DoEE, 2017e). Seamounts are likely to be observed sporadically across the wider EMBA and support epibenthic communities, such as sponges and filter feeders and schools of fish.

2.6.2 Scarps

The Barossa marine studies program (Jacobs, 2016c) included sampling sites at two scarps, 10 km to the south of the OA, which were in water depths ranging between 160 and 190 m. The substrate of the scarps was similar and characterised by a hard bedrock pavement at the top, with a rocky profile along the ridge and sand habitats at the base (Jacobs, 2016c). The scarps provided habitat for gorgonians (e.g. sea whips), feather stars and other filter feeders, sponges, and hydroid/bryozoan turf. A deep-water snapper species (possibly goldband snapper) was also observed in a rocky overhang at the base of the slope and small silver fish and one ray were observed on the sand flat at one of the scarps (Jacobs, 2016c). Scarps are likely to be observed sporadically across the wider EMBA and support epibenthic communities, such as sponges and filter feeders and schools of fish.

3. Benthic habitats and communities

3.1 Benthic communities

In general, the benthic habitats observed in these studies (which included the OA) were typical of those expected in offshore environments and were consistent with studies conducted both in areas with similar features and in areas of a similar geographic location (Jacobs, 2016). Benthic macrofauna groups observed near the permit area include octocorals (particularly sea pens) and motile decapod crustaceans (mostly prawns and squat lobsters), which were recorded in relatively low numbers. Other biota observed included anemones, starfish, brittle star and soft corals (Jacobs, 2016). The frequent bioturbations (burrows, mounds and tracks) observed suggest several burrow-living decapods (such as prawns) may be present (Jacobs, 2016). These species are more active at dawn, dusk or at night in habitats lacking cover and hence, are less likely to be recorded during daylight surveys (Jacobs, 2016).

Infaunal communities near the OA were characterised by burrowing taxa and demersal fish, namely foraminifera (an amoeboid protist), nematodes, Bregmaceros sp. (codlets), tube-forming Onuphid polychaetes and the superb nut shell, Ennucula superba. The communities were characterised by low abundance (five to 15 individuals) and species diversity (five to nine taxa). The most common phyla within the infaunal communities were Annelida (total of eight individuals across the sampling sites), Mollusca and Foraminifera (total of seven individuals) and Crustacea (total of six individuals). Due to the lack of hard substrate, the associated epibenthos was expected to be sparse (Jacobs, 2016c).

Santos is not aware of any information indicating that the OA contains any sensitive habitat or any benthic habitats that are not represented across other areas and/or regions.

There are several submerged and emergent shoals and banks within the EMBA, including Evans Shoal, Tassie Shoal and Lynedoch Bank. There are also some notable geophysical features within non-Australian territorial waters, such as the Timor Trench (a large trench also known as the Timor Trough), which may be associated with high productivity/upwelling of nutrients and thus may feature greater abundance and/or diversity of marine flora and fauna.

3.2 Coral reefs

Within the EMBA the following receptors contain extensive coral reefs:

- Evans Shoal
- Tassie Shoal
- Lynedoch Bank
- Marie Shoal
- Blackwood Shoal

See Table 2-2 for descriptions of the above receptors. In addition, more than 150 shoal/bank features occur across the Carbonate Banks and Terrace System of the Sahul Shelf KEF. The hard substrate of these banks is thought to support diverse organisms including sessile benthic invertebrates, such as sponges, soft and hard corals, gorgonians, bryozoans, ascidians and associated reef fish and elasmobranchs (Brewer et al., 2007).

Coral reef communities within the EMBA are also expected to be widespread in shallower waters adjacent to the coastlines of Indonesia and Timor-Leste. Indonesia has an estimated 75,000 km^2 of coral reef ecosystem distributed throughout the archipelago (Tomascik et al., 1997 cited in Hutumo & Moosa, 2005). Fringing reefs are the most common reef types with scleractinian corals the most dominant and important group. About 452 species of hermatypic scleractinian coral were collected

from Indonesian waters by Tomascik et al. (1997, cited in Hutumo & Moosa, 2005). A study presented by Suharsono (2004, cited in Hutumo & Moosa, 2005) indicated that 590 species of scleractinian corals exist in Indonesian waters. Acropora, Montipora and Porites are the most important reef-building corals in Indonesia.

Corals are both primary producers and filter feeders and thus play a role in the provision of food to marine fauna and in nutrient recycling to support ecosystem functioning (CALM & MPRA, 2005a). The distribution of corals in the area is governed by the availability of hard substrate for attachment and light availability. Corals create settlement substrate and shelter for marine flora and fauna. Studies have shown that declines in the abundance, or even marked changes in species composition of corals, has a marked impact on the biodiversity and productivity of coral reef habitats (Pratchett et al., 2008). As part of the reef-building process, scleractinian corals are also important for the protection of coastlines through accumulation and cementation of sediments and dissipation of wave energy (CALM & MPRA, 2005a).

3.3 Seagrass

Seagrass communities are not present within the OA (Jacobs, 2016c); however, the EMBA overlaps the shallower waters adjacent to the Indonesian and Timor-Leste coastlines. In addition, the EMBA approaches NT waters west of Bathurst Island where seagrass habitat may be present.

Seagrasses are biologically important as they are primary producers, a food resource, a habitat for juvenile and adult invertebrates, fish and other fauna as well as capable of attenuating water movement and trapping sediment (Masini et al., 2009).

More than 30 species of seagrasses have been recorded within Australian waters. Seagrasses inhabit a variety of substrates from mud to rock, but occur most extensively on soft substrates (AIMS, n.d). Seagrass meadows along the northern section of the Tiwi Islands provide habitat for a number of species, including dugongs. However, the EMBA does not overlap the areas that are identified as being significant dugong and seagrass sites (Section 7.3).

3.4 Plankton

Plankton abundance and distribution is patchy, dynamic and strongly linked to localised and seasonal productivity (Evans et al., 2016). Fluctuations in abundance and distribution occur both vertically and horizontally in response to tidal cycles, seasonal variation (light, water temperature and chemistry, currents and nutrients) and cyclonic events. As a key indicator for ecosystem health and change, plankton distribution and abundance has been measured for more than a century in Australia. The compilation of this data has been made publicly available (see Australian Ocean Data Network 2017) and was used in the Australia State of the Environment 2016 report (Evans et al., 2016) to nationally assess marine ecosystem health. According to their findings, warming ocean temperatures have extended the distribution of tropical phytoplankton species (which have a lower productivity) further south, resulting in a decline in primary productivity in oceanic waters north of 35°C, especially the Northwest Shelf. Trends in primary productivity across Australia are variable, with the south-west of Australia experiencing an increase in productivity and northern Australia experiencing no change between 2002 and 2016 (Evans et al., 2016).

During the marine studies program (Jacobs, 2016a), phytoplankton and zooplankton species were sampled along 300-m-long surface water transect tows during three field surveys (June 2014, January 2015 and April 2015) using plankton nets. Four of the sites were near the OA (only three of which were sampled in winter), three were at Evans Shoal (with only two sampled in winter), three were at Tassie Shoal (only one sampled in winter) and two were at Lynedoch Bank (autumn and summer only).

The study found phytoplankton assemblage composition was relatively similar across the seasons. Diatoms (Bacillariophyceae), blue-green algae (Cyanobacteria) and dinoflagellates (Dinophyceae) were recorded in all seasons, cryptomonads (Crytophyceae) in two seasons (summer and autumn),

and silcoflatellates (Dictoyochophyceae) and green algae (Chlorophyceae) in only a single season (winter and autumn respectively) (Jacobs, 2016a).

Blue-green algae were the most abundant phytoplankton assemblage. They were recorded in about 87% of the transect tows and had a mean abundance of 74%. Trichodesmium erythraneum (a blue-green alga) was the most abundant phytoplankton species at the majority of sites during each season.

The zooplankton assemblage composition was relatively similar across the season, with summer and winter being most similar (Jacobs, 2016a). The summer survey recorded the most diverse assemblage (14 classes of organisms), while autumn was the least diverse (either classes) (Jacobs, 2016a).

4. Shoreline habitats

4.1 Mangroves

Within the EMBA the following receptors have mangrove habitat:

- Bathurst Island coastline; and
- Indonesian and Timor-Leste coastlines.

Along the coastline of the Tiwi Islands, mangroves are predominantly within tidal creeks and not exposed along the shoreline. Indonesia has the largest total mangrove coverage of any country, with at least 31,890 km^2. This is slightly more than 20% of the global mangrove forest coverage (UNESCO, 2020). Mangroves occupy a relatively small area of the Timor-Leste coastlines (Alongi, 2013).

Mangroves are important primary producers and have several ecological and economic values. For example, they play a key role in reducing coastal erosion by stabilising sediment with their complex root systems (Kathiresan & Bingham, 2001). They are recognised for their capacity to help protect coastal areas from the damaging effects of erosion during storms and storm surge. Mangroves are important in the filtration of runoff from land, which helps maintain water clarity for the coral reefs that are often found offshore in tropical locations (NOAA, 2010).

The muddy sediments that occur in mangrove forests are home to a variety of epibenthic, infaunal and meiofaunal invertebrates (Kathiresan & Bingham, 2001). Crustaceans known to inhabit the mud in mangrove systems include fiddler crabs, mud crabs, shrimps and barnacles. Within the water channels of the mangrove systems, various finfish are found from the smaller fish such as gobies and mudskippers (which are restricted to life in the mangroves) through to larger fish such as barramundi (*Lates calcarifer*) and the mangrove jack (*Lutjanus argentimaculatus*). Mangroves and their associated invertebrate-rich mudflats are an important habitat for migratory shorebirds from the northern hemisphere, as well as some avifauna that are restricted to mangroves as their sole habitat (Garnet & Crowley, 2000).

4.2 Intertidal mud/sand flats

Within the EMBA the Indonesian and Timor-Leste coastlines have intertidal mud/sandflats.

The Tiwi Islands have been identified as containing tidal flats, however within the EMBA on Bathurst Island, these are not present (Conoco Phillips, 2019). While their extent is not well documented, they are thought to be closely related to the mangrove habitats of the islands (Conoco Phillips, 2019).

Intertidal mudflats form when fine sediment carried by rivers and the ocean is deposited in a low-energy environment. Intertidal mudflats are highly productive components of shelf ecosystems, responsible for recycling organic matter and nutrients through microbial activity. This microbial activity helps stabilise organic fluxes by reducing seasonal variation in primary productivity which ensures a more constant food supply. Intertidal sand and mudflats support a wide range of benthic infauna and epifauna which graze on microscopic algae and bivalves, molluscs, polycheate worms and crustaceans (Zell, 2007).

The high abundance of invertebrates found in intertidal sand and mudflats provides an important food source for finfish and shellfish which swim over the area at high tide. Mudflats have also been shown to be nursery areas for flatfish. During low tide, these intertidal areas are also important foraging areas for indigenous and migratory shorebirds.

4.3 Sandy beaches

Within the EMBA the following receptors have sandy beaches:

- Bathurst Island coastline;

- Indonesian and Timor-Leste coastlines.

Sandy beaches are those areas within the intertidal zone where unconsolidated sediment has been deposited and eroded by wave and tidal action. Sandy beaches can vary from low to high energy zones, the energy experienced influences the beach profile due to varying rates of erosion and accretion.

Sandy habitats are important for both resident and migratory seabirds and shorebirds (see Section 8). While sand flats and beaches generally support fewer species and numbers of birds than mudflats of similar size; some species such as the beach thick knee *(Esacus giganteus*) are commonly associated with sandy beaches (Garnet & Crowley, 2000). Sandy beaches can also provide important habitat for turtle nesting and breeding (Section 6.1).

The sandy beaches on the west coast of Bathurst Island are important areas for marine turtles, with nesting dominated by flatback and olive ridley turtles (peak nesting in March to May; Chatto & Baker, 2008).

The habitats and communities found on the sandy beaches on the west coast of Bathurst Island have been further described in Section 2.5.

4.4 Rocky shorelines

Within the EMBA the Indonesian and Timor-Leste coastlines have rocky shorelines. Rocky shores can include pebble/cobble, boulders and rocky limestone cliffs (often at the landward edge of reef platforms). Rocky outcrops typically consist of hard bedrock, but some of the coastline has characteristic limestone karsted cliffs with an undercut notch. Rocky shorelines can vary from habitats where there is bedrock protruding from soft sediments to cliff-like structures that form headlands. Rocky shorelines are an important foraging area for seabirds and habitat for invertebrates found in the intertidal splash zone.

The Tiwi Islands have been identified as containing rocky shorelines, however within the EMBA on Bathurst Island, these are not present (Conoco Phillips, 2019).

5. Bony fish, sharks and rays

The EMBA supports a variety of bony fish, shark and ray species of high conservation value as well as fisheries of commercial and recreational importance (DSEWPaC, 2012c). A BIA has been developed for whale shark (*Rhincodon typus*; Vulnerable) foraging in the EMBA (Figure 5-1).

The scalloped hammerhead and southern bluefin tuna are *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act) listed as conservation dependent and under threatened listing assessment (at the time of writing). These species were assessed as their listing status may be revised to a threatened species during the Activity.

Threatened and migratory species as well as marine fish species listed under the EPBC Act that may occur in the EMBA were identified with the online Protected Matters Search Tool (PMST). These species are shown in Table 5-1, with threatened and migratory species discussed in Sections 5.1 and 5.2.

Table 5-1: Environmental values and sensitivities within the EMBA for threatened, migratory and listed marine bony fish, sharks and rays

Common name	Scientific name	EPBC Act status	Particular values or sensitivities
Threatened and migratory species			
Bony fish			
Southern bluefin tuna	*Thunnus maccoyii*	Conservation Dependent	Breeding known to occur within area
Sharks			
Grey nurse shark	*Carcharias taurus*	Vulnerable	Reported as occurring within or near the EMBA as part of the Barossa marine studies program
Longfin mako	*Isurus paucus*	Migratory Marine	Species or species habitat likely to occur within area
Shortfin mako, mako shark	*Isurus oxyrinchus*	Migratory Marine	Species or species habitat likely to occur within area
Northern River shark	*Glyphis garricki*	Endangered	Species or species habitat may occur within area
Oceanic whitetip shark	*Carcharhinus longimanus*	Migratory Marine	Species or species habitat may occur within area
Speartooth shark	*Glyphis glyphis*	Critically Endangered	Species or species habitat may occur within area
Scalloped hammerhead	*Sphyrna lewini*	Conservation Dependent	Species or species habitat known to occur within area
Whale shark	*Rhincodon typus*	Vulnerable, Migratory Marine	Foraging, feeding or related behaviour known to occur within area
White shark, great white shark	*Carcharodon carcharias*	Vulnerable, Migratory Marine	Species or species habitat may occur within area
Rays			
Dwarf sawfish, Queensland sawfish	*Pristis clavata*	Vulnerable, Migratory Marine	Species or species habitat known to occur within area
Freshwater sawfish, largetooth sawfish, river sawfish, Leichhardt's sawfish, northern sawfish	*Pristis pristis*	Vulnerable, Migratory Marine	Species or species habitat likely occur within area

Common name	Scientific name	EPBC Act status	Particular values or sensitivities
Giant manta ray	*Mobula birostris*	Migratory Marine	Species or species habitat likely to occur within area
Green sawfish, dindagubba, narrowsnout sawfish	*Pristis zijsron*	Vulnerable, Migratory Marine	Species or species habitat known to occur within area
Narrow sawfish, knifetooth sawfish	*Anoxypristis cuspidata*	Migratory Marine	Species or species habitat known to occur within area
Reef manta ray, coastal manta ray	*Mobula alfredi*	Migratory Marine	Species or species habitat likely to occur within area
Listed marine bony fish species			
Australian Messmate Pipefish, Banded Pipefish	*Corythoichthys intestinalis*	Listed	Species or species habitat may occur within area
Banded Pipefish, Ringed Pipefish	*Doryrhamphus dactyliophorus*	Listed	Species or species habitat may occur within area
Beady Pipefish, Steep-nosed Pipefish	*Hippichthys penicillus*	Listed	Species or species habitat may occur within area
Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish	*Trachyrhamphus bicoarctatus*	Listed	Species or species habitat may occur within area
Blue-speckled Pipefish, Blue-spotted Pipefish	*Hippichthys cyanospilos*	Listed	Species or species habitat may occur within area
Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish	*Doryrhamphus excisus*	Listed	Species or species habitat may occur within area
Brock's Pipefish	*Halicampus brocki*	Listed	Species or species habitat may occur within area
Cleaner Pipefish, Janss' Pipefish	*Doryrhamphus janssi*	Listed	Species or species habitat may occur within area
Corrugated Pipefish, Barbed Pipefish	*Bhanotia fasciolata*	Listed	Species or species habitat may occur within area
Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish	*Syngnathoides biaculeatus*	Listed	Species or species habitat may occur within area
Fijian Banded Pipefish, Brown-banded Pipefish	*Corythoichthys amplexus*	Listed	Species or species habitat may occur within area
Flat-face Seahorse	*Hippocampus planifrons*	Listed	Species or species habitat may occur within area
Girdled Pipefish	*Festucalex cinctus*	Listed	Species or species habitat may occur within area
Gunther's Pipehorse, Indonesian Pipefish	*Solegnathus lettiensis*	Listed	Species or species habitat may occur within area
Hedgehog Seahorse	*Hippocampus spinosissimus*	Listed	Species or species habitat may occur within area
Mud Pipefish, Gray's Pipefish	*Halicampus grayi*	Listed	Species or species habitat may occur within area
Pacific Short-bodied Pipefish, Short-bodied Pipefish	*Choeroichthys brachysoma*	Listed	Species or species habitat may occur within area
Pallid Pipehorse, Hardwick's Pipehorse	*Solegnathus hardwickii*	Listed	Species or species habitat may occur within area

Common name	Scientific name	EPBC Act status	Particular values or sensitivities
Pig-snouted Pipefish	*Choeroichthys suillus*	Listed	Species or species habitat may occur within area
Red-hair Pipefish, Duncker's Pipefish	*Halicampus dunckeri*	Listed	Species or species habitat may occur within area
Reef-top Pipefish	*Corythoichthys haematopterus*	Listed	Species or species habitat may occur within area
Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish	*Corythoichthys flavofasciatus*	Listed	Species or species habitat may occur within area
Ribboned Pipehorse, Ribboned Seadragon	*Haliichthys taeniophorus*	Listed	Species or species habitat may occur within area
Robust Ghostpipefish, Blue-finned Ghost Pipefish,	*Solenostomus cyanopterus*	Listed	Species or species habitat may occur within area
Roughridge Pipefish	*Cosmocampus banneri*	Listed	Species or species habitat may occur within area
Schultz's Pipefish	*Corythoichthys schultzi*	Listed	Species or species habitat may occur within area
Short-keel Pipefish, Short-keeled Pipefish	*Hippichthys parvicarinatus*	Listed	Species or species habitat may occur within area
Spiny Seahorse, Thorny Seahorse	*Hippocampus histrix*	Listed	Species or species habitat may occur within area
Spiny-snout Pipefish	*Halicampus spinirostris*	Listed	Species or species habitat may occur within area
Spotted Seahorse, Yellow Seahorse	*Hippocampus kuda*	Listed	Species or species habitat may occur within area
Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish	*Trachyrhamphus longirostris*	Listed	Species or species habitat may occur within area
Three-keel Pipefish	*Campichthys tricarinatus*	Listed	Species or species habitat may occur within area
Tidepool Pipefish	*Micrognathus micronotopterus*	Listed	Species or species habitat may occur within area
Tiger Pipefish	*Filicampus tigris*	Listed	Species or species habitat may occur within area

5.1 Bony fish

5.1.1 Southern bluefin tuna

Southern bluefin tuna (*Thunnus maccoyii;* conservation dependent – under threatened listing assessment, migratory) are highly migratory fish that are mainly found in the eastern Indian Ocean and in the south-west Pacific Ocean. With a varied diet including crustaceans, cephalopods, fishes and other marine animals, these fish can be found to depths of 500 m (DoE, 2023a). Southern bluefin tuna school by size, with juveniles under two years of age found in WA and SA inshore waters (DoE, 2023a; TSSC, 2010). Adults inhabit offshore waters from northern WA across southern Australia, including Tasmania, to northern NSW. Breeding takes place in tropical waters between Java, Indonesia, and northern WA from September to April, and the young move down the WA coast from the spawning grounds (CCBST, 2023; Honda et al., 2010). Although there is a southern bluefin tuna spawning location in the region, it does not overlap with the EMBA.

5.1.2 Fish communities at Evans Shoal and Tassie Shoal

In October 2015 the Australian Institute of Marine Science (AIMS) conducted biodiversity surveys of benthos and associated fish as part of the Barossa marine studies program. Locations sampled included Evans Shoals and Tassie Shoal, located approximately 67 km and 76 km west of the OA, respectively.

The fish fauna on both shoals comprised shelf-based reef species along with some oceanic species, with red emperor and gold-band snapper in small numbers in deeper waters. Shovelnose rays and hammerhead sharks were also relatively rare (Heyward et al., 2017).

In total of 7,282 fish from 304 species were recorded from Evans Shoal and Tassie Shoal. The study recorded a diverse range of demersal and semi-pelagic fishes, elasmobranchs (sharks and rays) and sea snakes. The most numerous were bony fishes dominated by perch-like fishes (7,175 and 6,565 individuals, respectively), followed by elasmobranchs (of the 81 individuals 65 were requiem sharks) and sea snakes (26 individuals; Heyward et al., 2017).

Although Evans Shoal is much larger than Tassie Shoal, both areas supported three distinct fish assemblages and diversity increased sharply with coral cover and decreasing depth. Heyward et al (2017) noted that Tassie Shoal has outstanding fish abundance and diversity when compared to other Australian shoals and reef bases at similar depths. However, both Evans and Tassie shoals have higher fish diversity but lower shark abundance than other shoals in the region (McLean et al., 2021).

5.2 Sharks and rays

The region has a rich fauna of sharks and rays due to the diverse marine habitats within the area (DSEWPaC, 2012d). A search of the EPBC Act Protected Matters database identified 15 listed threatened and/or migratory shark and ray species that may occur in or have habitat in the EMBA. Listed threatened shark and ray species (five of which are also listed as migratory) were the:

- grey nurse shark (*Carcharias taurus*; Vulnerable)
- northern river shark (*Glyphis garricki*; Endangered)
- scalloped hammerhead shark (*Sphyrna l*ewini; conservation dependent)
- whale shark (*Rhincodon typus*; Vulnerable; Migratory marine)
- white shark (*Carcharodon carcharias*; Vulnerable; Migratory marine)
- speartooth shark (*Glyphis glyphis*; Critically Endangered)
- dwarf sawfish (*Pristis clavate*; Vulnerable; Migratory marine)
- freshwater sawfish (*Pristis pristis*; Vulnerable; Migratory marine)
- green sawfish (*Pristis zijsron*; Vulnerable; Migratory marine)

The listed migratory shark and ray species that may occur within the EMBA include the:

- longfin mako shark (*Isurus paucus*)
- shortfin mako shark (*Isurus oxyrinchus*)
- oceanic whitetip shark (*Carcharhinus longimanus*)
- narrow sawfish (*Anoxypristis custpidata*)
- reef manta ray (*Mobula alfredi*)
- giant manta ray (*Mobula birostris*)

5.2.1 Grey nurse shark

The grey nurse shark (*Carcharias taurus*; Vulnerable) has a wide but patchy tropical and temperate distribution in the Indo-West Pacific and Atlantic oceans. There are two distinct subpopulations in Australia on the east and west coast. The west coast population inhabits coastal and continental shelf waters from south west WA (Albany) up to the North West Shelf (DoE, 2023b; FRDC, 2019) and although one aggregation site has been documented, date on their distribution along the WA and NT coastline is lacking (Hoschke et al., 2023). Grey nurse sharks undertake large-scale movements to potentially capitalise on seasonal prey aggregations, with individuals migrating 1,294 km along the WA coast from SW WA to Ningaloo, and 1,500 km on the east coast (Dwyer et al., 2023; DoE, 2023b; Jakobs et al., 2019). Grey nurse sharks are thought to move further north along the coast when from May to December with lower sea temperatures. Individuals have been caught near Browse Island and off Bali, Indonesia (Hoschke et al., 2023; Momigliano & Jaiteh 2015). During the Barossa marine studies program, four grey nurse sharks were observed at seamounts in waters 130 m deep, one possibly pregnant (Jacobs, 2016). This was considered unusual as neither of the subpopulations are known to extend that far north and are generally associated with shallower, more coastal waters (DoE, 2023b). Given grey nurse sharks have been observed at seamounts and oceanic coral reefs in the Timor Sea, the species is likely to be present around reefs, banks and seamounts in the EMBA, though likely only in transit.

5.2.2 Mako sharks

Shortfin mako (*Isurus oxyrinchus*; Migratory) and longfin mako (*I. paucus*; Migratory) sharks are both highly migratory epipelagic species. The shortfin mako is a common shark in tropical and temperate waters above 16 °C (DoE, 2023c; Groeneveld et al., 2014), and as such widespread throughout Australian waters except for the Torres Strait, Arafura Sea and Gulf of Carpentaria (FRDC 2019; Birkmanis et al., 2020; Kyne et al., 2021a). Shortfin mako sharks exhibit sexual and developmental segregation; juveniles spend 90% of their time near the surface whereas adults dive much deeper (Groeneveld et al., 2014). In contrast, the wide but patchy distribution and biology of the rarely encountered longfin mako is less well documented (DoE, 2023d; Kyne et al., 2021a). This epipelagic shark also inhabits tropical and warm-temperature waters and in Australia longfin mako sharks are found from Geraldton in WA across the Northern Territory and Queensland down to Port Stevens in NSW (FRDC, 2019; Rigby et al., 2019). These species may be encountered, albeit rarely, within the EMBA.

5.2.3 Oceanic whitetip shark

The oceanic whitetip shark (*Carcharhinus longimanus*; Migratory) is a highly mobile globally widespread species throughout tropical and warm temperate waters 30° N to 35° S (DoE, 2023e; Kyne et al., 2021a). This pelagic species occurs in waters between 18 to 28°C from the surface to at least 180 m and ventures close to shore where the continental shelf is narrow. Within Australian waters, this rarely encountered species is found in warmer waters from Cape Leeuwin in WA across northern Australia down to Sydney, but the limit of their southern distribution is unclear as a single specimen was recorded in South Australia (DoE, 2023e; Kyne et al., 2021a). Oceanic whitetip sharks have been globally assessed as Critically Endangered by the IUCN, Overfished by SAFS and listed on CITES Appendix II (FRDC, 2019). It is considered possible that individuals may be encountered in low numbers within the EMBA.

5.2.4 River sharks

Sharks of the Glyphis genus are considered river sharks and are among the most threatened shark species worldwide with small estimated population sizes. Two species occur in macrotidal rivers and estuaries of northern Australia and southern Papua New Guinea (Kyne et al., 2021b; Stevens et al., 2005).

5.2.4.1 Northern river shark

Northern river sharks (*Glyphis garricki*; Endangered) are rare and although their distribution is uncertain, they are known to occur in the Ord and King Rivers, King Sound and Joseph Bonaparte Gulf in WA along with the South and East Alligator Rivers and the Wessel islands in NT (Udyawer et al., 2021; FRDC, 2019; DSEWPaC, 2010a). It is thought that these sharks segregate during developmental stages and occupy rivers, estuarine systems, macrotidal embayments as well as inshore marine habitats (Kyne et al., 2021a; FRDC, 2019; DSEWPaC, 2010a). Although the northern river shark has been recorded in offshore waters, the frequency of this occurrence is unknown.

The Sawfish and river sharks' multispecies recovery plan (DoE, 2015a) notes observations of adults and juveniles in marine waters north of Derby, WA while pupping and juveniles occur in King Sound Cambridge Gulf. Under the recovery plan, all aggregations and areas of biologically important behaviours (such as breeding, foraging, resting or migrating) are considered critical to the survival of the species. Individuals may be encountered in low numbers within the EMBA.

5.2.4.2 Speartooth shark

The speartooth shark (*Glyphis glyphis*; Critically Endangered) has been recorded as occurring in macrotidal rivers and estuaries environments, with juveniles and sub-adults utilising large tropical river systems as their primary habitat (Kyne et al., 2021b; DSEWPaC, 2010b Stevens et al., 2005). It is thought that their marine distribution may be limited to the coastal marine environment outside of rivers (Udyawer et al., 2021; FRDC, 2019; DSEWPaC, 2010b). While the speartooth shark is known to inhabit the Wenlock/Ducie/Port Musgrave river system in Qld and various rivers of the Van Diemen Gulf in the NT, new populations of this species were recently discovered in the Daly River, NT and the Ord River, WA (Kyne et al., 2021b). It has been recorded in tidal rivers and estuaries with turbid waters with fine muddy substrates in temperatures ranging from 27 to 33 °C (Pillans et al., 2009).

Remaining populations throughout Australia are considered isolated and their viability is therefore questionable. Both species were listed as threatened in 2001 due to their limited geographical distribution and low population estimates, and the population decline is likely to continue (DSEWPaC, 2010b). Of the locations where the speartooth shark is known to occur, only the Van Diemen Gulf is close to the EMBA.

5.2.5 Scalloped hammerhead shark

The Scalloped Hammerhead shark (*Sphyrna lewini*; conservation dependent) is a coastal and semi-oceanic species globally distributed in tropical and warm-temperate waters from the intertidal zone to at least 275 m in depth, with newborns found in coastal zones (Kyne et al., 2021; FRDC, 2019). Recent studies suggest that the Indo-Pacific population (including Australia) is genetically distinct from the Atlantic and Caribbean populations. There is likely to be two subpopulations in Australian waters (WA and the rest of Australia), with the non-WA subpopulation connected to Papua New Guinea and Indonesia by shallow water habitats along northern Australia (Green et al., 2022). Across northern Australia, the pupping season peaks from October to January (TSSC, 2018). This mobile species has a broad Australian range from NSW and Qld across the NT to WA (DoE 2023o; Bartes et al., 2021; Kyne et al., 2021; FRDC, 2019). Scalloped Hammerhead sharks are known to occur within the EMBA.

5.2.6 Whale shark

The whale shark (*Rhincodon typus*; Vulnerable, Migratory) is globally distributed in tropical and warm temperate seas, except the Mediterranean. There are two distinct subpopulations, with approximately 75% of the global population in the Indo-Pacific, and the remaining 25% in the Atlantic Ocean (Vignaud et al., 2014 in FRDC, 2019). Ningaloo Reef in WA is a known aggregation site, and whale sharks congregate off Christmas Island from December to January. These aggregations are thought to be linked to seasonal prey fluctuations (DoE, 2015l; DEH, 2005a). The species is an

epipelagic filter feeder with a diet of planktonic and nektonic species, including small crustaceans and smaller schooling fish species (DoE, 2023f). Whale sharks are known to be highly migratory with migrations of over 20,000 km recorded (Guzman et al., 2018). Migration along the northern WA coastline broadly follows the 200 m isobath and typically occurs between July and November (DoE, 2015b).

A BIA for whale sharks is located in northern WA, offshore of the Pilbara and Kimberley coastline, and broadly follows the 200 m isobath (Figure 5-1; DoE, 2023f). The BIA is listed as a foraging habitat, however the Conservation Advice (DoE, 2015b) for this species indicates this BIA represents a migration corridor rather than significant foraging habitat, consistent with tagging studies. Wilson et al. (2006) recorded six whale sharks departing Ningaloo Reef and traveling north-east into the Indian Ocean. Meekan and Radford (2010) showed that whale sharks migrated up the coast from Ningaloo Reef and individually dispersed over a broad area; either north-west into the open Indian Ocean, northward towards Sumatra and Java, or north-east towards the Timor Sea; and Thomson et al (2021) more recently recorded whale sharks tagged in Ningaloo Reef traveling to the North West Shelf. Due to their widespread distribution, highly migratory whale sharks may occur in low numbers within the EMBA and a BIA for whale shark foraging is located in the south-west of the EMBA (Figure 5-1).

5.2.7 White shark

The white shark (*Carcharodon carcharias*; Vulnerable, Migratory) is a rare, primarily temperate species with a wide Australian range and two subpopulations; eastern Australasia (from Papua New Guinea along Australia's east coast and Macquarie Island to the south-western Pacific, including waters off New Caledonia, Vanuatu and Tonga) and the southern-western population (from western Victoria across southern Australia and up the WA coast; DSEWPaC, 2013a; FRDC, 2019; Kyne et al., 2021a). Although the species has been recorded south from central Queensland to up to Ningaloo Reef and may occur further north on both coasts (McAuley et al 2017), white sharks are not known to aggregate within the NWMR or NMR and are most likely to be found south of North West Cape (DSEWPaC, 2012a; 2012d). Ongoing research into the movements of this species suggests that female white sharks travel further offshore than males, cover a broader longitudinal range and dive deeper (Bradford et al., 2020). Off the WA coast, the direction and timing of the movement of individual sharks are highly variable, with white sharks travelling along the coast in both directions at most times of the year. The reasons for movements to north-western WA are unknown and little information is available on their reproduction in Australian waters (McAuley et al., 2016; DSEWPaC, 2012d). White sharks are unlikely to be seen in the EMBA.

5.2.8 Sawfish

Three listed threatened (Vulnerable, Migratory) sawfish species, dwarf sawfish (*Pristis clavata*), green sawfish (*P. zijsron*) and largetooth sawfish (*P. pristis*), occur mainly in inshore coastal waters and riverine environments in northern Australia. Adults of both green and largetooth sawfish are thought to use deepwater habitats, but this has not been confirmed for dwarf sawfish (DoE 2015c). Considering declining global populations of these sawfishes, northern and north-west Australia may contain the last significant populations of these species (Yan et al., 2021; DoE, 2015c; DSEWPaC, 2012d). Sawfishes feed close on a variety of teleost fishes and benthic invertebrates, including cephalopods, crustaceans and molluscs (Lear et al., 2023; Thorburn et al., 2007; 2008; Pogonoski et al., 2002). Based on their habitat preferences, it is considered highly unlikely for these sawfish to occur within the deeper offshore waters of the EMBA. A fourth sawfish species, the narrow sawfish (*Anoxypristis cuspidate*; Migratory), is currently being assessed for EPBC threatened species listing (DoE, 2023g), and may be found within the EMBA.

5.2.8.1 Dwarf sawfish

The dwarf sawfish is primarily found in shallow coastal and estuarine areas, from Cairns in Queensland around the north of Australia to the Pilbara coastline in WA, with juveniles thought to remain in estuarine waters (FRDC, 2019; DEWHA, 2009a).

5.2.8.2 Green sawfish

The green sawfish does not occupy freshwater habitats and although are most common in shallow coastal and estuarine areas, this species has been recorded in depths of up to 70 m from Cairns in Queensland across to Broome in WA (FRDC, 2019; DEWHA, 2008a). Green sawfish appear to have limited tidally influenced movements, occupying only a few square kilometres within the coastal fringe, and strongly associated with mangroves and adjacent mudflats (Lear et al., 2023). Baseline surveys for Chevron's Wheatstone project identified green sawfish habitat and juvenile nursery areas within the north-eastern lagoon of the Ashburton Delta and in Hooley Creek near Onslow. Although their spatial and temporal distribution in these creeks is variable with changing tidal and environmental conditions, they typically return to inshore waters to breed and pup during the wet season (i.e. January; Chevron, 2011).

5.2.8.3 Largetooth sawfish

Largetooth sawfish inhabit the sandy or muddy bottoms of river, estuarine and marine environments within north-west Australia and has a patch distribution including the Fitzroy, Durack, Robinson and Ord rivers in WA. Newborns and juveniles occur primarily in the freshwater areas of rivers and in estuaries, while adults mostly occupy marine and estuarine environments (FRDC, 2019; DoE, 2015d; DSEWPaC, 2012d).

5.2.8.4 Narrow sawfish

The narrow sawfish (*Anoxypristis cuspidata*; Migratory), is currently being assessed for EPBC threatened species listing (DoE, 2023g). Narrow sawfish are a bentho-pelagic species found throughout the Indo-West Pacific and is still found throughout much of its historic range, albeit in substantially reduced numbers (FRDC, 2019). Narrow sawfish occur across northern Australia from the Pilbara Coast in WA to Broad Sound in Queensland in waters up to 40 m deep on the continental shelf and in estuaries (Kyne et al., 2021a; FRDC, 2019). Juveniles and pupping females require inshore and estuarine habitats, while adults predominantly occur offshore (FRDC, 2019). Narrow sawfish may be found within the EMBA.

5.2.9 Manta rays

The giant manta ray (*Mobula birostris*; Migratory) and reef manta ray (*Mobula alfredi*; Migratory) are globally distributed in both tropical and temperate waters. Giant manta rays are considered to be the more migratory and oceanic species of the two, and individuals of this highly mobile species, in Australia, waters are not expected to be resident (Kyne et al., 2021a; Couturier et al., 2015). While considered more solitary and less frequently sighted than reef manta rays, giant manta rays can be found in large numbers engaging in foraging, mating or cleaning activities and exhibit seasonal habitat preferences frequenting offshore seamounts and islands (Marshall et al., 2022a).

The reef manta ray typically utilises productive nearshore habitats, including island groups, atolls and continental coastlines (Marshall et al., 2022b), and is coastally distributed across the north of Australia to approximately 30°S on both coasts (Armstrong et al., 2020). While reef manta rays demonstrate a high degree of site fidelity in tropical and subtropical waters, this species has also been shown to travel up to 700 km, undertake seasonal migrations and traverse international waters (Couturier et al., 2015). Reef manta rays are species is also often sighted in high numbers, predominately when undertaking foraging activities or migrating. There are no known foraging or breeding aggregation areas for these species within the EMBA. Based on the habitat preferences of

these rays and the location of the Barossa development, it is unlikely that either species would occur in large numbers although individuals may transit through the area.

5.3 Biologically Important Areas (BIAs) and Critical habitat for bony fish, sharks and rays

A known BIA developed for whale shark foraging intersects the EMBA (Figure 5-1).

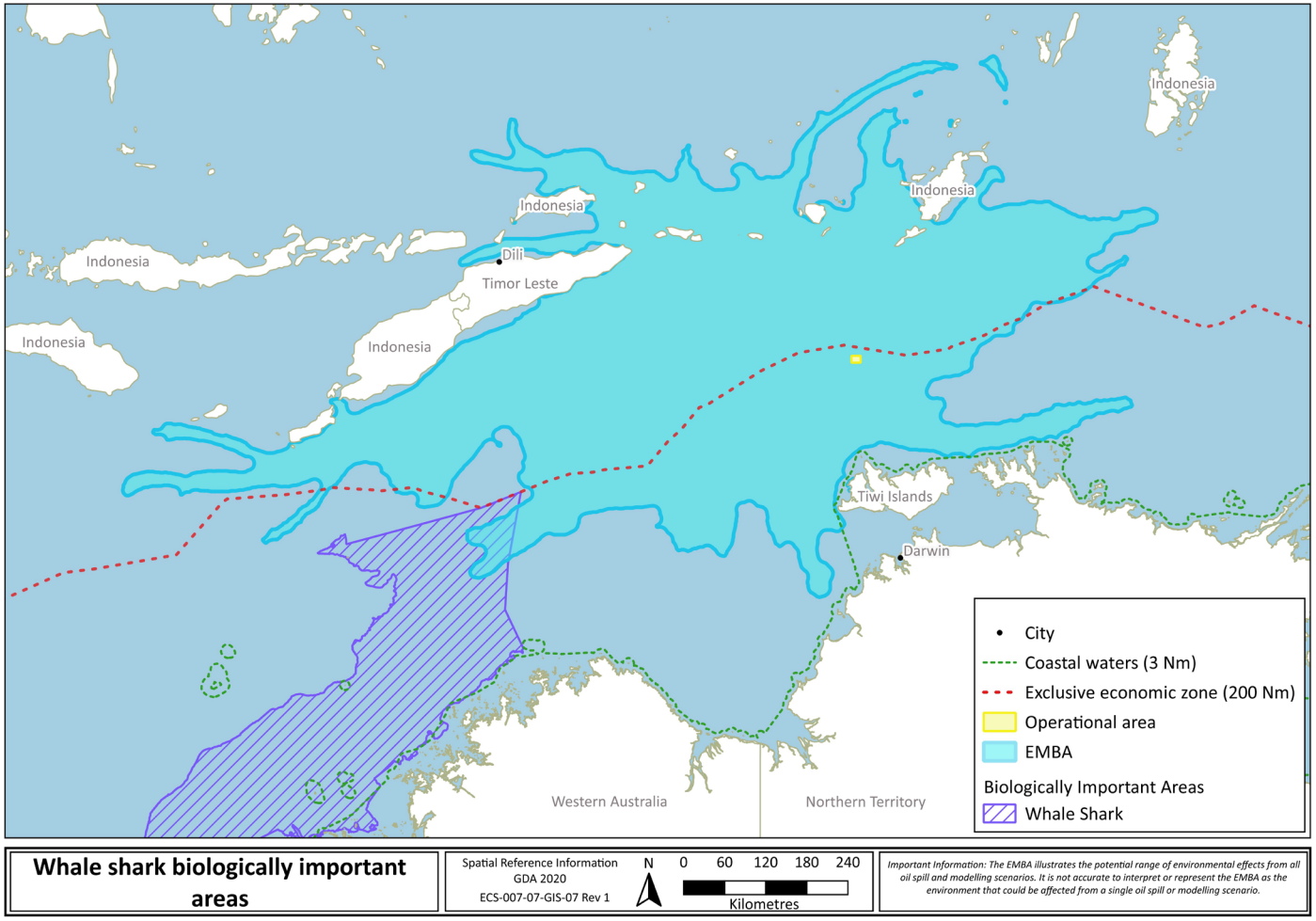


Figure 5-1: Whale shark BIAs proximal to the EMBA

6. Marine reptiles

The EMBA supports a variety of marine reptile species of high conservation value (DSEWPaC, 2012a; 2012b; 2012e). Threatened and migratory species as well as marine reptile species listed under the EPBC Act that may occur in the EMBA were identified with the PMST. These species are shown in Table 6-1, with threatened and migratory species discussed in Sections 6.1 to 6.3. Note that terrestrial species without habitat along shorelines have been excluded.

Table 6-1: Environmental values and sensitivities within the EMBA for threatened, migratory and listed marine reptiles

Common name	Scientific name	EPBC Act status	Particular values or sensitivities
Threatened and migratory species			
Marine turtles			
Flatback turtle	*Natator depressus*	Vulnerable, Migratory Marine	Breeding known to occur within area
Green turtle	*Chelonia mydas*	Vulnerable, Migratory Marine	Breeding known to occur within area
Hawksbill turtle	*Eretmochelys imbricata*	Vulnerable, Migratory Marine,	Foraging, feeding or related behaviour known to occur within area
Leatherback turtle, leathery turtle, luth	*Dermochelys coriacea*	Endangered, Migratory Marine	Congregation or aggregation known to occur within area
Loggerhead turtle	*Caretta caretta*	Endangered, Migratory Marine	Foraging, feeding or related behaviour known to occur within area
Olive ridley turtle, Pacific ridley turtle	*Lepidochelys olivacea*	Endangered, Migratory Marine	Breeding known to occur within area
Sea snakes			
Short-nosed sea snake	*Aipysurus apraefrontalis*	Critically Endangered, Marine	Species or species habitat likely to occur within area
Leaf-scaled sea snake	*Aipysurus foliosquama*	Critically Endangered, Marine	Species or species habitat may occur within area
Crocodiles			
Salt-water crocodile, estuarine crocodile	*Crocodylus porosus*	Migratory Marine	Species or species habitat likely to occur within area
Listed species			
Beaked sea snake	*Enhydrina schistosa*	Listed	Species or species habitat may occur within area
Black-headed sea snake, slender-necked sea snake	*Leioselasma coggeri*	Listed	Species or species habitat may occur within area
Black-headed sea snake	*Hydrophis atriceps*	Listed	Species or species habitat may occur within area
Black-ringed sea snake	*Hydrelaps darwiniensis*	Listed	Species or species habitat may occur within area
Dubois' sea snake	*Aipysurus duboisii*	Listed	Species or species habitat may occur within area
Elegant sea snake	*Hydrophis elegans*	Listed	Species or species habitat may occur within area

Common name	Scientific name	EPBC Act status	Particular values or sensitivities
Fine-spined sea snake, geometrical sea snake	*Leioselasma czeblukovi*	Listed	Species or species habitat may occur within area
Flatback turtle	*Natator depressus*	Listed	Breeding known to occur within area
Green turtle	*Chelonia mydas*	Listed	Breeding known to occur within area
Hawksbill turtle	*Eretmochelys imbricata*	Listed	Foraging, feeding or related behaviour known to occur within area
Horned sea snake	*Acalyptophis peronii*	Listed	Species or species habitat may occur within area
Large-headed sea snake, Pacific sea snake	*Leioselasma pacifica*	Listed	Species or species habitat may occur within area
Leaf-scaled sea snake	*Aipysurus foliosquama*	Listed	Species or species habitat may occur within area
Leatherback turtle, leathery turtle	*Dermochelys coriacea*	Listed	Congregation or aggregation known to occur within area
Loggerhead turtle	*Caretta caretta*	Listed	Foraging, feeding or related behaviour known to occur within area
Northern mangrove sea snake	*Parahydrophis mertoni*	Listed	Species or species habitat may occur within area
Olive ridley turtle, Pacific ridley turtle	*Lepidochelys olivacea*	Listed	Breeding known to occur within area
Olive sea snake	*Aipysurus laevis*	Listed	Species or species habitat may occur within area
Olive-headed sea snake	*Disteira major*	Listed	Species or species habitat may occur within area
Plain sea snake	*Chitulia inornata*	Listed	Species or species habitat may occur within area
Salt-water crocodile, estuarine crocodile	*Crocodylus porosus*	Listed	Species or species habitat likely to occur within area
Short-nosed sea snake	*Aipysurus apraefrontalis*	Listed	Species or species habitat likely to occur within area
Small-headed sea snake	*Hydrophis macdowelli*	Listed	Species or species habitat may occur within area
Spectacled sea snake	*Disteira kingii*	Listed	Species or species habitat may occur within area
Spine-bellied sea snake	*Lapemis curtus*	Listed	Species or species habitat may occur within area
Spine-tailed sea snake	*Aipysurus eydouxii*	Listed	Species or species habitat may occur within area
Spotted sea snake, ornate reef sea snake	*Chitulia ornata*	Listed	Species or species habitat may occur within area
Stokes' sea snake	*Astrotia stokesii*	Listed	Species or species habitat may occur within area
Turtle-headed sea snake	*Emydocephalus annulatus*	Listed	Species or species habitat may occur within area
Yellow-bellied sea snake	*Pelamis platurus*	Listed	Species or species habitat may occur within area

6.1 Marine turtles

No known BIAs or habitat critical to the survival of a marine turtle species occur within the OA. Critical habitats and BIA behaviours (such as breeding, resting, nesting, distribution or migratory routes) that overlap the EMBA are listed in Table 6-2 and shown in Figure 6-5 to Figure 6-4.

A search of the EPBC Act Protected Matters database identified six listed threatened and/or migratory marine turtle species that may occur in or have habitat in the EMBA, these species are discussed below:

- Flatback turtle (*Natator depressus;* Vulnerable, Migratory)
- Green turtle (*Chelonia mydas;* Vulnerable, Migratory)
- Hawksbill turtle (*Eretmochelys imbricata,* Vulnerable, Migratory)
- Leatherback turtle (*Dermochelys coriacea;* Endangered, Migratory)
- Loggerhead turtle (*Caretta caretta;* Endangered, Migratory)
- Olive Ridley turtle (*Lepidochelys olivacea;* Endangered, Migratory)

6.1.1 Flatback turtle

Flatback turtles (*Natator depressus;* Vulnerable, Migratory) are known to occur along the WA, NT, Qld coastlines, and forage widely across the Australian continental shelf and into the continental waters off Indonesia and Papua New Guinea (Commonwealth of Australia, 2017). Flatback turtles are primarily carnivorous, feeding predominantly on soft-bodied invertebrates. This species breeds in the region, with the highest density rookeries found to be winter at Cape Domett and summer at Eighty Mile Beach, while moderate to lesser density nesting in winter occurred in the North Kimberley offshore islands (Tucker et al., 2021). Flatback turtles that nest within the Pilbara region typically migrate along the continental shelf to foraging grounds as far north as Darwin at the end of the nesting season, returning to breed at varying intervals of a year or more (Thums et al., 2020; Commonwealth of Australia, 2017).

Flatback turtles nesting within the NT are from the Arafura Sea breeding and genetic stock, with unknown long-term trends for this stock (Commonwealth of Australia, 2017). Nesting has been recorded on the Tiwi Islands, with the greatest proportion of activity occurring on the west coast of Bathurst Island (Chatto & Baker, 2008a) with nesting females numbering around 11 to 100 per year, this is comparable to or smaller than other nesting sites of the Arafura Sea genetic stock. Nesting and inter-nesting occurs year-round with a peak during June and August, and hatchling emergence peaking between July and September (Commonwealth of Australia, 2017).

The Recovery plan for marine turtles in Australia defines a 60 km inter-nesting buffer around the Tiwi Islands (Commonwealth of Australia, 2017). Whittock et al. (2016) defined suitable inter-nesting habitat as waters up to 16 m deep within 5 to 10 km of the coastline and also defined unsuitable inter-nesting habitat as waters over 25 m deep and more than 27 km from the coastline. They also tracked inter-nesting flatback turtles from five different mainland and island rookeries and found that these turtles not only stayed in water depths less than 44 m but were associated with a mean depth of less than 10 m (Whittock et al., 2016). To date there is no evidence indicating flatback turtles in deep offshore waters during the inter-nesting period (Pendoley, 2019).

There are BIAs for flatback turtles intersecting the EMBA in the Northern Kimberley (Holothuria Banks) for foraging, as well as nesting habitats around the Tiwi Islands (Figure 6-1).

6.1.2 Green turtle

Green turtles (*Chelonia mydas;* Vulnerable, Migratory) are predominately found off the WA, NT and Queensland coastlines (Commonwealth of Australia, 2017). The green turtle is the most common marine turtle breeding in the NWMR, with WA supporting one of the largest remaining populations worldwide (DSEWPaC, 2012e). The species is primarily herbivorous and forages on algae, seagrass

and mangroves, including where these habitats exist at offshore coral reef habitats across most of northwestern Australia (Ferreira et al 2021; Commonwealth of Australia 2017). Green turtles are also known to travel large distances of up to 3,100 km between nesting and feeding areas (Ferreira et al., 2021; DSEWPaC, 2012e). This species breeds all year around, with nesting in the Kimberley region peaking in summer. The highest density rookery was found to be the Lacepede Islands for green turtles, with moderate to lesser density nesting by green turtles in the North Kimberley offshore islands (Tucker et al., 2021).

In the NT nesting sites occur mostly from the western end of Melville Island to near the border with Queensland (Northern Territory Government, n.d). The Cobourg Peninsula green turtle genetic stock is the closest to those on the Tiwi Islands and they nest between October and April, with peak nesting period between December and January Nesting sites for the species in the Bonaparte or Van Diemen bioregions are Black/Smith Point and Lawson Island, east of the Tiwi Islands near Cobourg Peninsula (Chatto & Baker, 2008).

Green turtles are likely to be encountered within the EMBA, mainly within reef areas, with internesting expected between October and April (Commonwealth of Australia, 2017). There are BIAs for green turtles on the north coast of the Tiwi Islands with an inter-nesting buffer 20 km from the Tiwi Islands. BIAs and critical habitat for green turtles are located in waters surrounding the islands north-east of Cobourg Peninsula (Figure 6-2).

6.1.3 Hawksbill turtle

Hawksbill turtles (*Eretmochelys imbricata,* Vulnerable, Migratory) predominately occur along the northern WA, NT and Queensland coastlines, with three recognised stocks: north Queensland stock located in the north Great Barrier Reef and Torres Strait; north-east Arnhem Land stock in the NT; and WA stock located on the North West Shelf. On a global scale, WA provides one of the largest remaining hotspots for this species, and these migrating hawksbill turtles traverse shallow continental-shelf waters less than 200 m deep following the coastline and a migratory corridor along the Pilbara coast (Fossette et al., 2021). Hawksbill turtles are omnivorous and feed on algae, sponges, soft corals and soft bodied invertebrates foraging in waters ranging from 1.5 to 84 m deep (Fossette et al., 2021). This species is typically associated with rocky and coral reef habitats, often returning to a small foraging area, and is expected to be found within these habitats along the WA coastline, from Shark Bay to the northern extent of the NWMR, migrating over 4,600 km from their nesting site (Crommenacker et al., 2022; Barr et al., 2021; Commonwealth of Australia, 2017). In the NT, nesting occurs on islands concentrated around north-eastern Arnhem land and Groote Eylandt (Northern Territory Government, n.d) and is reported to occur from July to December (Chatto, 1997; 1998; DSEWPaC, 2012d).

Hawksbill turtles are unlikely to occur within the deeper waters of the OA but may forage on banks and shoals within the EMBA. There are BIAs and critical habitat for hawksbill turtles in waters off the Cobourg Peninsula (Figure 6-3).

6.1.4 Leatherback turtle

Leatherback turtles (*Dermochelys coriacea;* Endangered, Migratory) are known to forage and migrate throughout the open offshore waters of Australia, with foraging more common along the east coast and Bass Strait. Records of leatherback turtles nesting in Australia are sparse, and limited to Qld, NSW and NT (DoE, 2023h; Commonwealth of Australia, 2017). Leatherback turtles are pelagic throughout their life and almost exclusively feed on jellyfish There have been no confirmed accounts of nesting on WA beaches (Tucker et al., 2021), although they have been recorded in coastal waters of south-western WA. (DoE, 2023h; Commonwealth of Australia, 2017). There have been scattered isolated nesting (one to three nests per year) in Qld and the NT (Limpus & McLachlin, 1994).

Due to the lack of nesting sites in Australian waters, leatherback turtles are likely migrants from neighbouring countries foraging in Australia (Limpus, 2009c). A BIA for leatherback turtle nesting intersects the EMBA near the Cobourg Peninsula (Figure 6-4).

6.1.5 Loggerhead turtle

Loggerhead turtle (*Caretta caretta;* Endangered, Migratory) range along most of the Australian coastline and throughout the NWMR (Commonwealth of Australia, 2017). This species is carnivorous and mainly feeds on benthic invertebrates in a wide range of habitats from nearshore to waters 55 m deep (Commonwealth of Australia, 2017). Breeding aggregations occur on Australia's east (Qld, NSW) and west coasts. Loggerhead turtles have one genetic breeding stock within WA with approximately 3,000 females supporting the third-largest population in the world (Commonwealth of Australia, 2017; Limpus, 2009; Baldwin et al., 2003).

Capable of large migrations, individual loggerhead turtles from eastern Australian have been recorded foraging in the NT and further afield in Indonesia and Papua New Guinea (Perez et al., 2022). In the Kimberley region, loggerhead turtles are thought to be transient or end-of-migration foragers with no documented nesting sites in the area (Tucker et al., 2021). Although loggerhead turtles forage in the Oceanic Shoals Marine Park, the Arafura Sea and the Gulf of Carpentaria, they are not known to breed in the region. Loggerheads found within the EMBA are most likely to come from the WA population, nesting outside the EMBA (Commonwealth of Australia, 2017). A BIA for loggerhead turtle foraging intersects the EMBA in the Western Joseph Bonaparte Depression (Figure 6-5).

6.1.6 Olive ridley turtle

Olive ridley turtles (*Lepidochelys olivacea;* Endangered, Migratory) are known to nest in the NT and on western Cape York (Qld), with low density nesting recorded on the Kimberley coast, in the Dampier Peninsula and along Camden Sound (Tucker et al., 2021; Commonwealth of Australia, 2017b). This species is primarily carnivorous and feeds on soft-bodied invertebrates in waters between 15 m and 200 m in depth. Olive ridley turtles can migrate through oceanic waters and have been recorded travelling up to 1,130 km between their nesting and foraging grounds (Cáceres-Farias et al., 2022; Commonwealth of Australia, 2017; Whiting et al., 2005).

Olive ridley turtles are known to nest on the Tiwi Islands on the west coast of Bathurst Island and the north coast of Melville Island. These turtles are part of the NT genetic stock, significant at both a national and international level, although long-term trends are unknown (Commonwealth of Australia, 2017). The NT genetic stock nests throughout the year, with peaks between April and June, and most hatchlings emerge between June and August (Commonwealth of Australia, 2017).

Inter-nesting habitat for this species encompasses nearshore waters along the north, west and east coasts of the Tiwi Islands. Tracking studies showed these turtles remain close to shore in waters less than 55 m deep within 37 km of the nesting beach during the inter-nesting interval (Whiting et al., 2007a; 2005). Olive ridley turtles may be encountered in the shallow waters of the Tiwi Islands, with a BIA for this species located along the north coast of Melville and Bathurst Islands and the

Cobourg Peninsula, and foraging habitat in the Joseph Bonaparte Gulf, both interesting the EMBA (Figure 6-5).

6.2 Sea snakes

Sea snakes generally have a tropical distribution. Several key aggregation/feeding areas for sea snakes are known within the EMBA. Sea snakes typically occur in shallow inshore regions that provide suitable seabed habitat and clear waters. However, they are also found further offshore at atolls, including the shoals/banks in the Timor Sea (Guinea, 2013a). Historical data indicates that sea snakes are numerous in northern Australia (Shuntov, 1970), moving to the southern shallow regions of the Gulf of Carpentaria in the summer months and into deeper waters at other times of the year (Redfield et al., 1978, cited in DSEWPaC, 2012a). Most sea snakes are known to breed in shallow embayments along the NT coastline around December to February, however the spine-bellied sea snake breeds from June to August (DSEWPaC, 2012a). Sea snakes are generally observed in waters from 10 to 50 m deep (RPS, 2010) and non-pelagic species seldom dive deeper than 100 m (Heatwole, 1975; Shuntov, 1970). Very few species inhabit deep pelagic environments (Guinea, 2006). Sea snake distribution and movement patterns are species-dependent, with the pelagic yellow-bellied sea snake travelling large distances, while the olive sea snake usually resides in a particular area. Reef dwelling sea snakes have very small home ranges, do not actively disperse or migrate between reefs and occur year-round at most reefs on the Sahul Shelf (Guinea, 2013; Guinea & Whiting, 2005). For non-reef dwelling species, migrations between reefs within a broader home range is likely influenced by ocean currents, but their home ranges and migration through open water are unknown.

During the Barossa marine studies program olive and turtle-headed sea snakes were observed at Evans Shoal, Tassie Shoal, Lynedoch Bank and a seamount in the area, with opportunistic sightings of unknown species in open offshore waters of the Timor Sea. (Heywood et al., 2017; Jacobs, 2016). Based on the known distribution, habitat preference and sightings during the Barossa marine studies program, sea snakes are considered likely to transit the OA and EMBA.

6.2.1 Leaf-scaled and short-nosed sea snakes

The EPBC Act protected matters report (Appendix A) identified 23 sea snake species as potentially occurring in the EMBA, including two which are listed as threatened; the leaf-scaled sea snake (*Aipysurus foliosquama*; Critically Endangered) and short-nosed sea snake (*Aipysurus apraefrontalis*; Critically Endangered; Table 6-1).

These species prefer the reef flats or shallow waters along the outer reef edge in waters up to 10 m deep. Whilst once relatively common at Ashmore and Hibernia reefs (outside of the EMBA), these species have not been recorded there since the late 1990s/2001 (DSEWPaC 2010a; 2010b; Guinea & Whiting, 2005) with the decline thought to be due to a number of factors including environmental changes and increased boat traffic (Somaweera et al., 2021). The leaf-scaled sea snake may also be found on the reefs of the Sahul Shelf (refer to Figure 11-1) (Minton & Heatwole, 1975). Guinea and Whiting (2005) reported that very few short-nosed sea snakes moved even as far as 50 m away from the reef flat and were therefore unlikely to be found in high numbers in offshore, deeper waters.

6.3 Crocodiles

The EPBC Protected Matter search identified one species of crocodile likely to occur in the EMBA, the salt-water crocodile (*Crocodylus porosus*; Migratory). Salt-water crocodiles were originally listed under the EPBC Act to regulate commercial hunting, which caused significant population declines (DoE, 2023i).

Salt-water crocodiles are found across northern Australia from Rockhampton in Queensland across the NT to Broome in WA and occurs within the nearshore marine and estuarine waters of the Kimberley coast (DoE, 2023i). Larger populations within the major river systems of the Kimberley occur in the rivers draining into the Cambridge Gulf, the Prince Regent and Roe River systems of

the east and northwest Kimberley (DEC, 2009). There is limited availability of nesting habitat for this species within its distribution, with only the Ord, King and Roe River systems typically providing suitable nesting vegetation for the species (DEC, 2009). There are no BIAs for the salt-water crocodile within the EMBA, but given their widespread distribution, they are likely to be present within the EMBA.

6.4 Biologically Important Areas and habitat critical for marine reptiles

Known BIAs for marine turtles are summarised in Table 6-2 and shown in Figure 6-1, to Figure 6-5.

Table 6-2: Biologically important areas for marine turtles identified within the EMBA

Species	BIA behaviour	Distance to OA (km)	Habitat critical to the survival of marine turtles within EMBA and distance to OA
Leatherback turtle	Internesting	242	200 km
Loggerhead turtle	Foraging	363	NA
Green turtle	Foraging	813	76 km
	Internesting buffer	800	
	Internesting	123	
Hawksbill turtle	Internesting buffer	254	298 km
	Internesting	800	
Flatback turtle	Foraging	363	222 km
	Internesting	54	
Olive ridley turtle	Foraging	255	116 km
	Internesting	255	

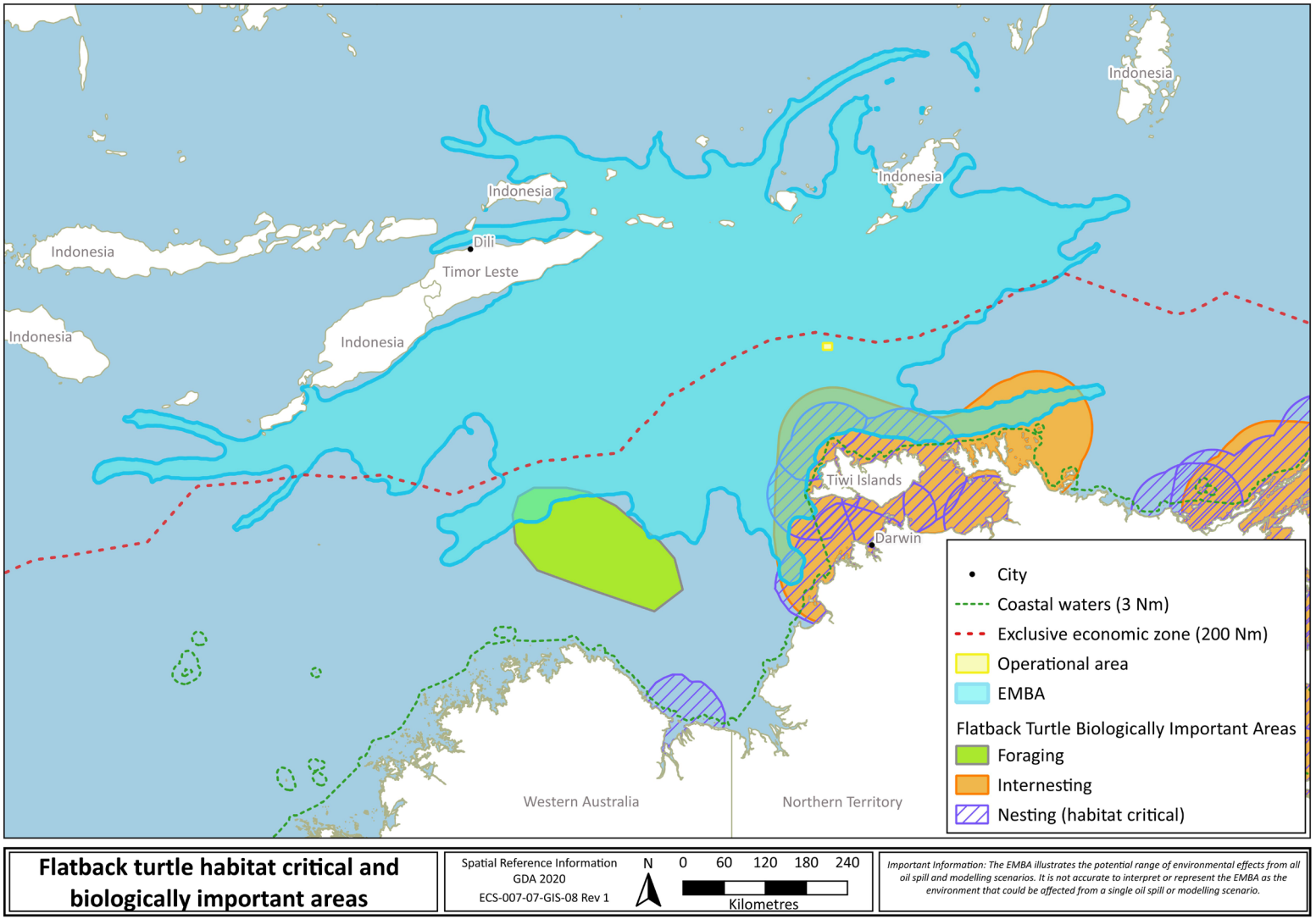


Figure 6-1: Flatback turtle critical habitat and BIAs overlapping or proximal to the EMBA

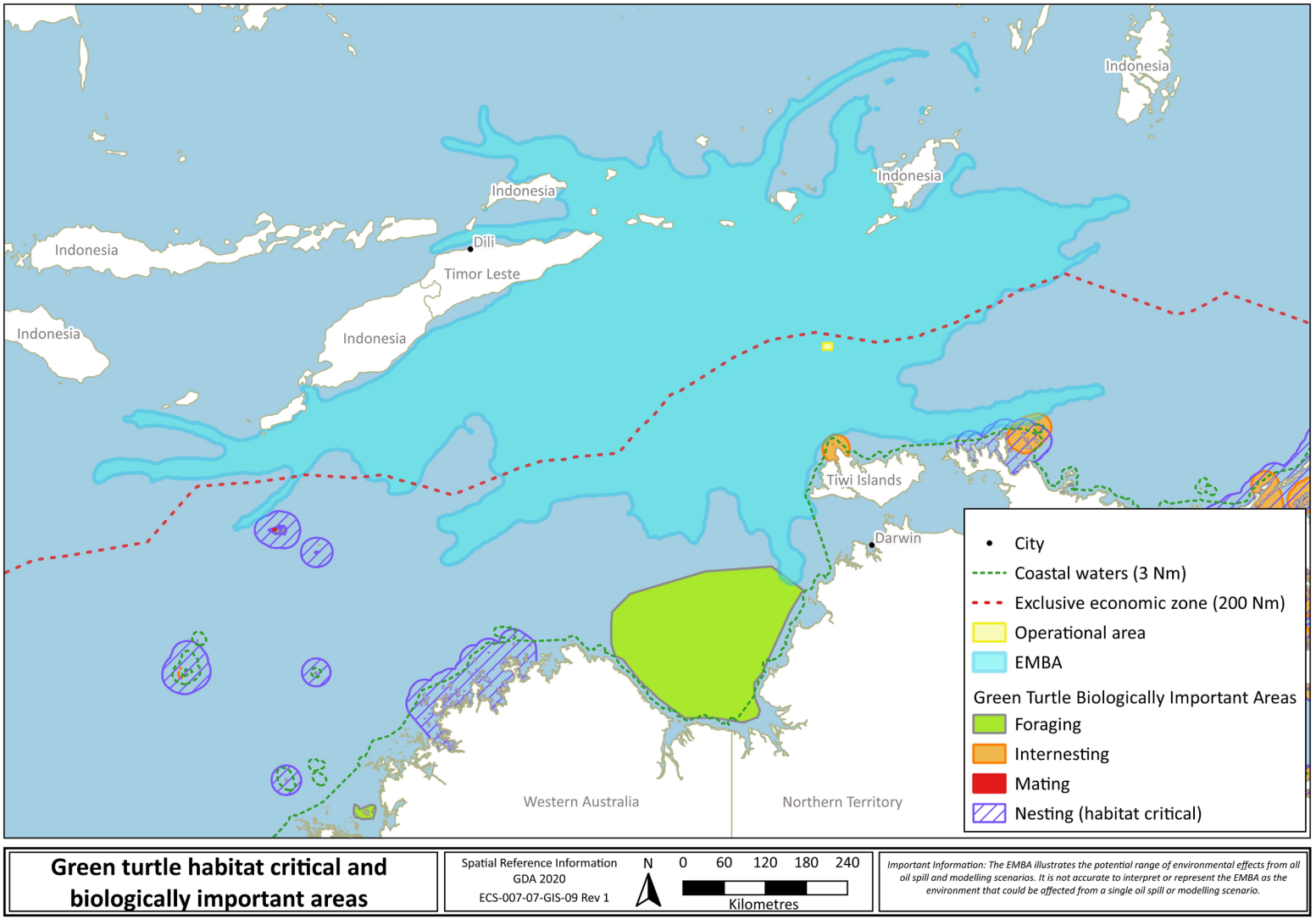


Figure 6-2: Green turtle critical habitat and BIAs overlapping the EMBA

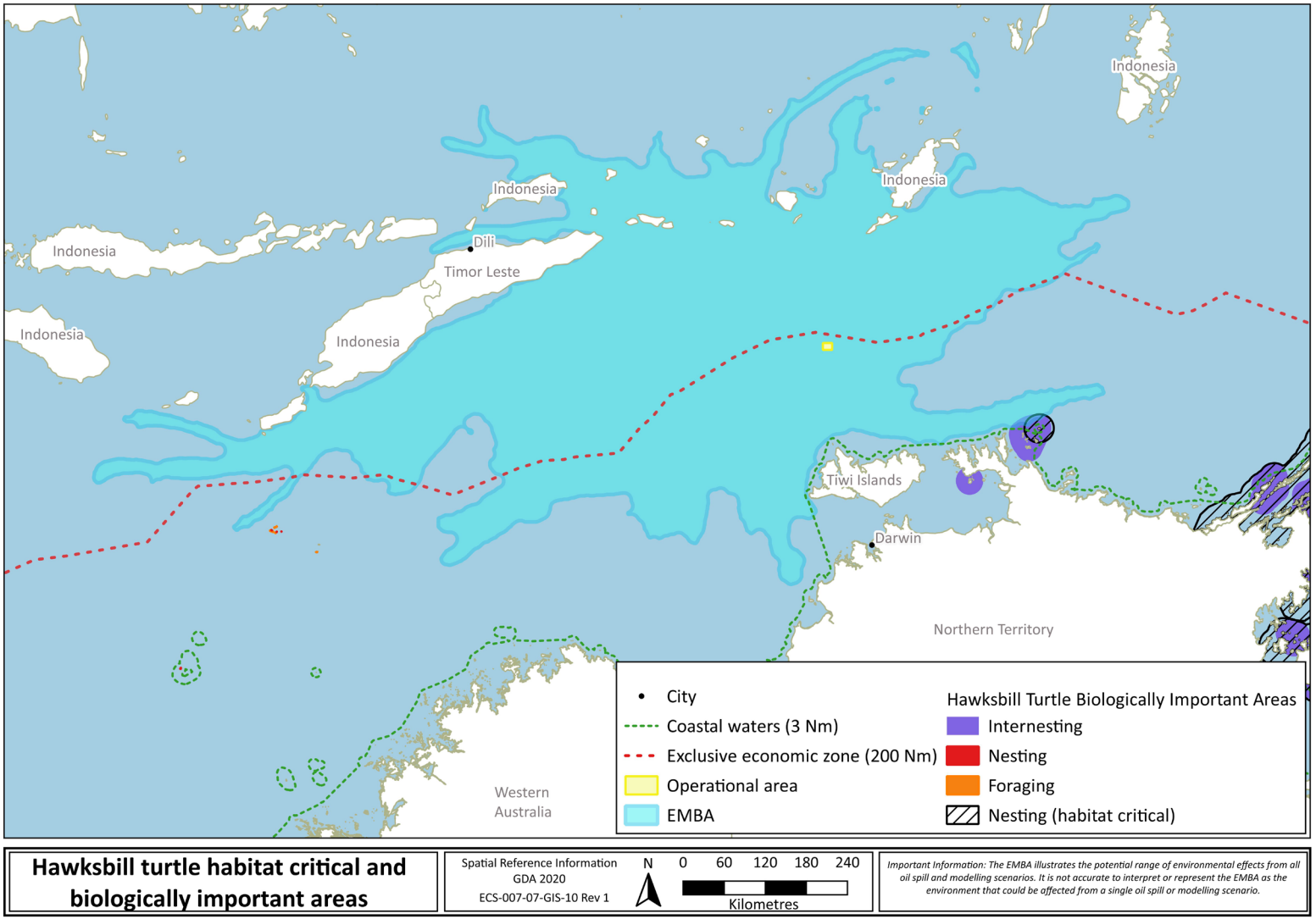


Figure 6-3: Hawksbill turtle critical habitat and BIAs overlapping or proximal to the EMBA

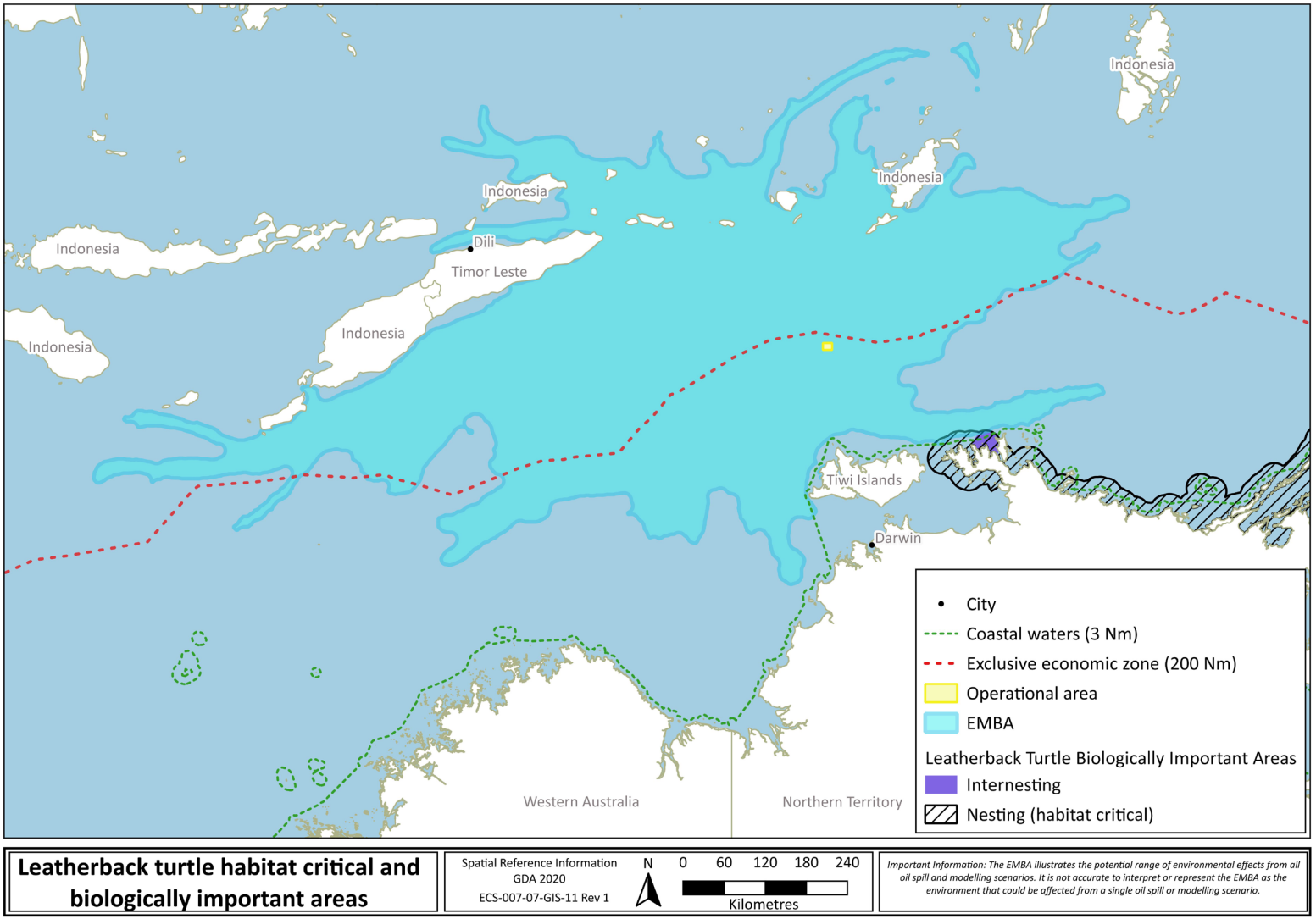


Figure 6-4: Leatherback turtle critical habitat and BIAs overlapping or proximal to the EMBA

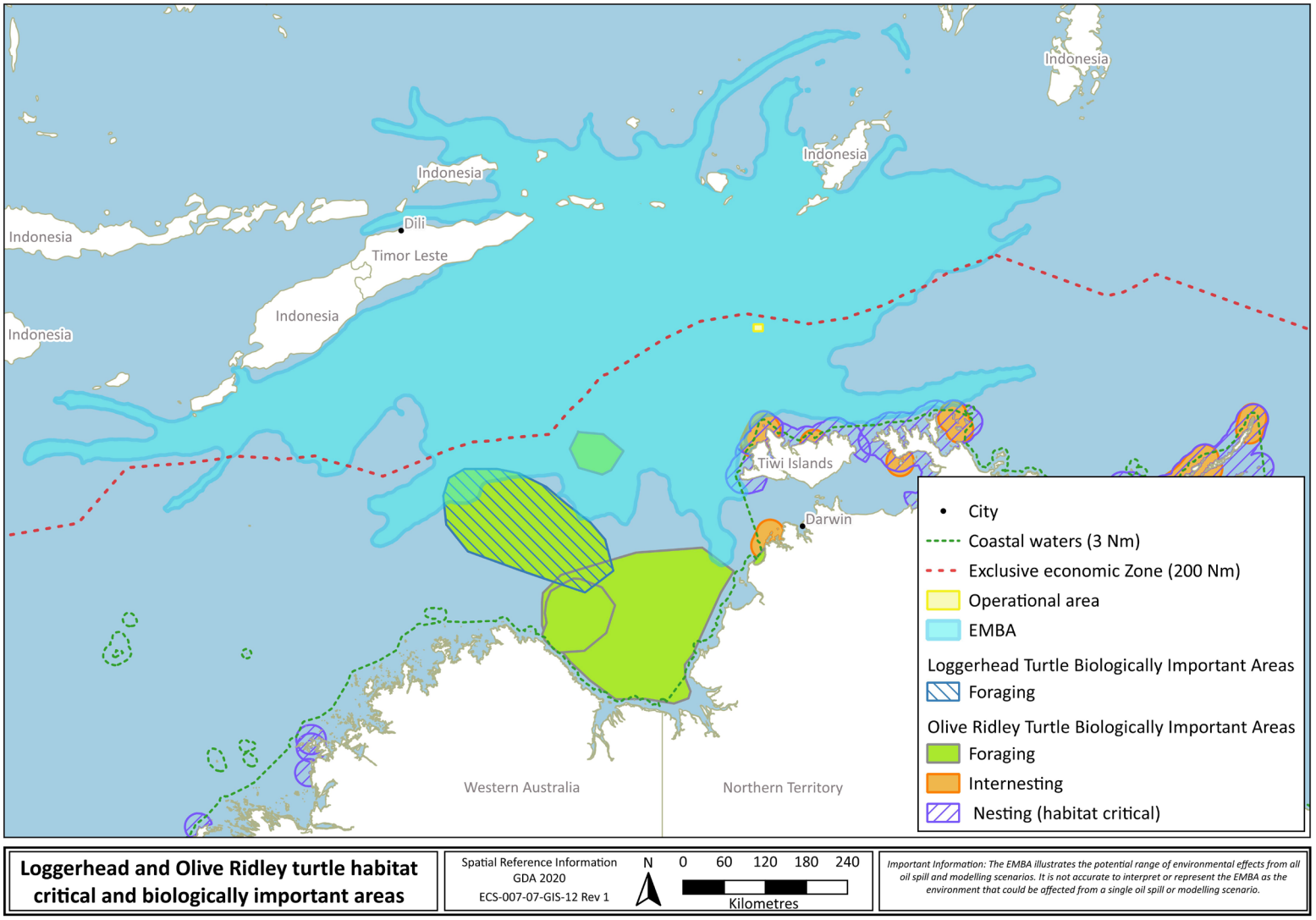


Figure 6-5: Loggerhead and olive ridley turtle critical habitat and BIAs overlapping or proximal to the EMBA

7. Marine mammals

Marine mammals are typically widely distributed and highly mobile animals. In general, distribution patterns reflect seasonal feeding areas, characterised by high productivity, and migration routes associated with reproductive patterns.

Eleven migratory species listed under the EPBC Act, including baleen whales, toothed whales and dolphins, and dugong were identified as potentially occurring or having habitat within the EMBA. This includes three threatened species; the blue whale (*Balaenoptera musculus*; Endangered), fin whale (*Balaenoptera physalus*; Vulnerable) and sei whale (*Balaenoptera borealis*; Vulnerable). Of these, only the pygmy blue whale (*Balaenoptera musculus brevicauda*; Endangered) has a BIA in the EMBA (Section 7.4). Further detail on threatened and migratory EPBC Act listed species is provided in the following sections.

Table 7-1: Environmental values and sensitivities within the EMBA for threatened, migratory and listed marine mammals

Common name	*Scientific name*	EPBC Act status	Particular values or sensitivities
Threatened and migratory species			
Blue whale	*Balaenoptera musculus*	Endangered, Migratory Marine	Migration route known to occur within area
Bryde's whale	*Balaenoptera edeni*	Migratory Marine	Species or species habitat likely to occur within area
Fin whale	*Balaenoptera physalus*	Vulnerable, Migratory Marine	Species or species habitat likely to occur within area
Humpback whale	*Megaptera novaeangliae*	Migratory Marine	Species or species habitat likely to occur within area
Sei whale	*Balaenoptera borealis*	Vulnerable, Migratory Marine	Species or species habitat likely to occur within area
Sperm whale	*Physeter macrocephalus*	Migratory Marine	Species or species habitat may occur within area
Spotted bottlenose dolphin (Arafura/Timor Sea populations)	*Tursiops aduncus (Arafura/Timor Sea populations)*	Migratory Marine	Species or species habitat known to occur within area
Australian Humpback Dolphin	*Sousa sahulensis*	Migratory Marine	Species or species habitat known occur within area
Australian snubfin dolphin	*Orcaella heinsohni*	Migratory Marine	Species or species habitat known occur within area
Killer whale, orca	*Orcinus orca*	Migratory Marine	Species or species habitat may occur within area
Dugong	*Dugong dugon*	Migratory Marine	Species or species habitat known to occur within area
Listed cetacean species			
Blainville's Beaked Whale, Dense-beaked Whale	*Mesoplodon densirostris*	Cetacean	Species or species habitat may occur within area
Bottlenose Dolphin	*Tursiops truncatus s. str.*	Cetacean	Species or species habitat may occur within area
Common Dolphin, Short-beaked Common Dolphin	*Delphinus delphis*	Cetacean	Species or species habitat may occur within area
Cuvier's Beaked Whale, Goose-beaked Whale	*Ziphius cavirostris*	Cetacean	Species or species habitat may occur within area

Common name	*Scientific name*	EPBC Act status	Particular values or sensitivities
Dwarf Sperm Whale	*Kogia sima*	Cetacean	Species or species habitat may occur within area
False Killer Whale	*Pseudorca crassidens*	Cetacean	PMST report indicates species or species habitat likely to occur within area. Reported as occurring within the EMBA by Palmer et al 2023.
Fraser's Dolphin, Sarawak Dolphin	*Lagenodelphis hosei*	Cetacean	Species or species habitat may occur within area
Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin	*Tursiops aduncus*	Cetacean	Species or species habitat likely to occur within area
Long-snouted Spinner Dolphin	*Stenella longirostris*	Cetacean	Species or species habitat may occur within area
Melon-headed Whale	*Peponocephala electra*	Cetacean	Species or species habitat may occur within area
Pygmy Killer Whale	*Feresa attenuata*	Cetacean	Species or species habitat may occur within area
Pygmy Sperm Whale	*Kogia breviceps*	Cetacean	Species or species habitat may occur within area
Risso's Dolphin, Grampus	*Grampus griseus*	Cetacean	Species or species habitat may occur within area
Rough-toothed Dolphin	*Steno bredanensis*	Cetacean	Species or species habitat may occur within area
Short-finned Pilot Whale	*Globicephala macrorhynchus*	Cetacean	Species or species habitat may occur within area
Spotted Dolphin, Pantropical Spotted Dolphin	*Stenella attenuata*	Cetacean	Species or species habitat may occur within area
Striped Dolphin, Euphrosyne Dolphin	*Stenella coeruleoalba*	Cetacean	Species or species habitat may occur within area

7.1 Whales

7.1.1 Blue whale

The blue whale (*Balaenoptera musculus*; Endangered, Migratory) has four distinct sub-species, of which two are found in the southern hemisphere; the pygmy blue whale (*B. m. brevicauda*; Indo-Australian and Tasman-Pacific populations) and the Antarctic blue whale (*B. m. intermedia*; DoE, 2015e). As southern blue whales occur in waters south of 60°S and pygmy blue whales north of 55°S, blue whales in the region of interest are assumed to be pygmy blue whales (DEWHA, 2008c). As such only this subspecies is discussed below.

The pygmy blue whale is known to migrate along the WA shelf edge at depths between the 500 m and 1,000 m depth contours from the NW Cape south to Geographe Bay (Figure 7-1; DoE, 2023j; 2015e). A biologically important migration corridor is recognised in the deep offshore waters off WA (IUCN-MMPATF, 2023a; DCCEEW, 2023a). The northerly migration toward the calving grounds near the equator occurs in March/April to June (Thums et al., 2021; DoE, 2023j; 2015e). Noise monitoring for the Barossa project in the Timor Sea detected the presence of blue whales over 400 km north-east of the migration BIA for the species in the months of May to August during their north-bound seasonal migration. No detections of the species were made during the period of their southward migration (McPherson et al., 2016). The southerly migration to the feeding grounds in the high latitudes of the southern hemisphere occurs in September/October to December (DoE, 2023j;

2015e). Pygmy blue whales appear to travel as individuals or in small groups when making their migrations (Woodside, 2014).

Generally, this species travels alone or in small groups based on acoustic data. Pygmy blue whale calls from noise loggers deployed around Scott Reef from 2006 to 2009 for the Woodside Browse project found 78% of calls to be from single whales, 18% from whale pairs and 4% from three or more whales (McCauley, 2011; Woodside, 2014).

There are no known breeding areas of significance to blue whales in the EMBA. Given BIAs have been identified within the EMBA, pygmy blue whales are likely to transit through, and forage within the EMBA.

7.1.2 Bryde's whale

Bryde's whales (*Balaenoptera edeni*; Migratory) are distributed across tropical and warm temperate waters with individuals recorded in all Australian states, except the NT (Ceccarelli et al., 2011). The species typically moves between 40 °N and 40 °S, with these movements seeming to be primarily linked to prey availability (DoE, 2023k). Bryde's whales are thought to be divided into offshore and onshore forms with the distinction between the two based on prey preference (DoE, 2023k; Ceccarelli et al., 2011). The offshore form is found in deeper waters (500 m to 1,000 m) and is thought to migrate seasonally in favour of warmer waters in winter months. The onshore form generally inhabits waters over 200 m and displays no distinct migratory movements (DoE, 2023k). A noise monitoring study undertaken for the Barossa project detected Bryde's whales almost year-round from January to October (McPherson et al., 2016) and this species has been encountered off Browse Island (Ceccarelli et al., 2011). Bryde's whales may occasionally transit through the EMBA in small numbers.

7.1.3 Fin whale

Fin whales (*Balaenoptera physalus*; Vulnerable, Migratory) are widely distributed from polar to tropical waters and have been recorded in all Australian states, other than NSW and the NT (Bannister et al. 1996). Fin whales feed on planktonic crustacea, such as Antarctic krill, and primarily forage in high latitudes.

The species rarely occupies inshore waters and displays well defined migratory movements (essentially north south) between polar, temperate and tropical waters and may migrate through the region (DoE 2023l; Ceccarelli et al 2011; Bannister et al. 1996). Research by Aulich et al. (2022; 2019) found that fin whales travel up the WA coast as far north as Dampier (19°S). After arriving at Cape Leeuwin in April, the species migrates north along the coast to feed in Perth Canyon from May to October. This is thought to be a migratory pathway from Antarctica, and it has been suggested that there are separate fin whale sub-populations on the east and west coasts of Australia (Aulich et al., 2022; 2019). Within Australian waters, the Bonney Upwelling is thought to be an important foraging ground for this species (DoE, 2023l; DoE, 2015f; Bannister et al., 1996).

The Australian fin whale distribution is unclear due to limited observations, but the species is thought to be present from Exmouth along the southern coastline to Qld. There are no known mating or calving areas in Australian waters and no BIAs have been developed for fin whales (DoE, 2023l; 2015f). Given their distribution and movements individual fin whales may pass through the EMBA in low numbers.

7.1.4 Humpback whale

The humpback whale (*Megaptera novaeangliae*; Migratory) has a wide distribution (Figure 7-2), with recordings throughout Australian Antarctic waters and offshore from all Australian states (IUCN-MMPATF, 2023b; Bannister et al., 1996). These whales migrate between summer feeding grounds in Antarctica and winter breeding and calving grounds in the sub-tropical and tropical inshore waters of north-west Australia (Jenner et al., 2001). Although the exact timing of migration varies annually due to a number of factors including water temperature, the northbound migration peaks between

late July and early August, and the southbound migration peaks between late August and early September (DoE, 2023m; Jenner et al., 2001).

Humpback whales breed and calve in the NWMR between Broome and the northern end of Camden Sound in the months of June to September each year (DoE, 2023m; 2015g) but calving grounds may extend to NW Cape, 1,000 km southwest of the currently recognized calving area (Irvine et al., 2018; 2018a). A biologically important breeding and calving area for humpback whales is recognised in nearshore waters adjacent to the northern half of the Dampier Peninsula and encompasses Camden Sound (Figure 7-2; DoE, 2023m). Relatively few humpback whales have been known to travel north of Camden Sound (Jenner et al., 2001) and noise monitoring undertaken for the Barossa project did not detect any humpback whale calls in the Timor Sea (McPherson et al., 2016). Southbound humpback whales and their calves rest at select locations along the WA coast, with peak usage of biologically important nursing/nesting areas at Exmouth Gulf and Shark Bay between June and October (Sprogis & Parra, 2022; Irving & Kent, 2018).

There has been a steady recovery in the humpback whale population that migrates along the WA coast since the closure of commercial whaling, and as a result the species was removed from the EPBC Act threatened species list in 2022 (DAWE, 2022).

No BIAs or other EPBC-listed critical habitats exist for this species within the EMBA. As relatively few humpback whales are known to travel north of their calving grounds in Camden Sound (Jenner et al., 2001) and no calls were recorded in the 12 months of noise monitoring during the Barossa marine studies program (McPherson et al., 2016), this species is considered unlikely to occur within the EMBA.

7.1.5 Sei whale

Sei whales (*Balaenoptera borealis*; Vulnerable, Migratory) are thought to have a wide distribution, but their distribution limits are unclear as this species is often confused with Bryde's whales. Sightings are rare, but the species may be seen in coastal and offshore waters throughout Australia (DoE, 2023n; Bannister et al., 1996). The species is able to utilise a diverse range of marine habitats, which has been attributed to a combination of dynamic physical and prey processes (DoE, 2023n).

Sei whale migratory movements are well defined with distinct north-south movements as the species migrates between polar, temperate and tropical waters for foraging and breeding. The species feeds intensively between the Antarctic and sub-tropical convergences on planktonic crustacea (DoE, 2023n; Ceccarelli et al., 2011; Bannister et al., 1996). The sei whale does not dive, rather it sinks, and tends to swim at shallower depths comparative to other species (DoE, 2023n). There are no known mating or calving areas in Australian waters and the species is thought to infrequently occur in the NW region (Ceccarelli et al., 2011).

There are no known mating or calving areas, nor any BIAs developed for this species in Australian waters (DCCEEW, 2023a; 2023b). However, it is possible that individual sei whales may occasionally occur within the EMBA.

7.1.6 Sperm whale

Sperm whales (*Physeter macrocephalus*; Migratory) occur in deep waters in all oceans, typically remaining at depths of 300 m or greater, and are known to occur throughout Australian waters (Ceccarelli et al., 2011; Bannister et al., 1996). Migration patterns vary between sex. Mature females and juveniles are thought to be resident in tropical and subtropical waters throughout the year, whereas mature males are thought to migrate between the tropics and Antarctic (DoE, 2023o; Ceccarelli et al., 2011; Bannister et al., 1996).

Key areas for sperm whales are known to occur in WA waters between Cape Leeuwin and Esperance and along the continental shelf approximately 20 to 30 nautical miles offshore. Sperm whales have a diverse diet, although they primarily feed on oceanic squid (DoE, 2023o; Bannister et al., 1996). Historically, sperm whales aggregated in the area of Wallaby Saddle (Bannister et al.,

2007). This species has been identified as a conservation value in the South-west marine Regions, with BIAs in that region (DoE, 2023o).

There are no BIAs for sperm whales within the EMBA and as the area is unlikely to encompass highly suitable habitat for this species, only very low numbers of individuals may transit through the EMBA.

7.2 Dolphins

7.2.1 Australian snubfin dolphin

The Australian snubfin dolphin (*Orcaella heinsohni*; Migratory), previously known and only recently differentiated from the closely related Irrawaddy dolphin (*O. brevirostris*), is a poorly known species inhabiting shallow coastal and estuarine waters and tidal rivers typically in waters less than 20 m in depth in the vicinity of freshwater outflows. However, this species has also been recorded up to 23 km offshore (DoE, 2023p; Bouchet et al., 2021). The Australian snubfin dolphin is likely to occur in higher densities in areas of complex habitat type which provide a variety of prey types (Palmer et al., 2014; DSEWPaC, 2012f).

In Australia, this species occurs in coastal waters of Qld, NT and north-western Australia. The population in Australian waters is thought to be continuous with the Papua New Guinea species but separate from populations in Asia. Within the NWMR the species is likely to migrate and forage off the eastern and western sides of the Cambridge Gulf; to the north and north-west of Cape Londonderry and Cape Talbot; west of Augustus Island; west and north-west of the Buccaneer Archipelago; and Cape Leveque to Broome (DSEWPaC, 2012f). Breeding is thought to occur throughout the year for this species. As the majority of records for the Australian snubfin dolphin are from relatively shallow estuarine areas, individuals may occasionally occur in shallow coastal waters. As Australian snubfin dolphins prefer relatively shallow nearshore waters, individuals may occur in small numbers in the shallow waters of the EMBA, most likely around the Tiwi Islands.

7.2.2 Australian humpback dolphin

The Australian humpback dolphin (*Sousa sahulensis*; Migratory, previously/also known as the Indo-pacific humpback dolphin, *S. chinensis*) occurs in water of the Sahul Shelf, from northern Australia to the Kikori Delta in Papua New Guinea, and Bird's Head Seascape in West Papua (Jefferson & Rosenbaum, 2014 in DoE, 2023q; Beasley et al., 2016). Although distribution, life history and habitat preferences of this species are poorly understood, the Australian humpback dolphin is thought to be associated with shallow coastal, estuarine and tidal river waters less than 20 m in depth (DoE, 2023q; Hanf et al., 2016; Palmer et al., 2014).

In Australia, humpback dolphins occur along the northern Australian coastline from Shark Bay in WA to southern Qld (DoE, 2023q; Raudino et al., 2018; Hanf et al., 2016). In the NWMR, this species is thought to inhabit coastal waters up to the 30 m isobath (Hanf et al., 2016), but Australian humpback dolphins have been recorded up to 60 km offshore near Barrow Island, the Montebello Islands (approximately 80 km from the mainland coast and 20 km from Barrow Island), and the western Lowendal Islands (Raudino et al., 2018). Available abundance estimates indicate that this species occurs in small populations with an average of up to 89 individuals and a maximum of 0.19 individuals per km² (Parra & Cagnazzi 2016). There are no BIAs nor other EPBC-listed critical habitats for Australian humpback dolphins within the EMBA.

7.2.3 Killer whale

The largest member of the dolphin family, killer whales or orca (*Orcinus orca*; Migratory) are a cosmopolitan species with a vast global distribution across a wide range of habitats. However, they appear to be primarily concentrated in coastal waters and cooler regions of high productivity as they are carnivores with a diet that diet varies seasonally and regionally (DoE, 2023r; Bannister et al., 1996). Globally, killer whales are known to migrate; however, specific routes and seasonal

movement patterns are not known in detail and are thought to relate to prey availability (Bannister et al., 1996).

In Australian waters, killer whales are typically observed moving along the continental slope and shelf, and near seal colonies (Bannister et al., 1996) and is distributed throughout Australian waters, in particular off Tasmania and Macquarie Island (1,500 km south-south-east of Tasmania) (Bannister et al., 1996). Migration movements within Australian waters include a summer migration from subantarctic islands to Macquarie Island (DoE, 2023r). This species has been recorded sporadically from all states and territories, with higher concentrations reported off southern Australia, from southern NSW to western Victoria, and from the far south-east to mid-north WA coast. Two distinct populations have been identified of the WA coast; one inhabits shallow, nearshore waters, off the Ningaloo Coast, and a second larger population occurring in temperate waters off the WA south coast (Reeves et al., 2022; Totterdell et al., 2022; Wellard et al., 2016) and killer whales may be associated with humpback aggregation areas and have been seen in Collier Bay (Ceccarelli et al., 2011).

Killer whales are often observed around seal colonies, with the closest significant seal colony to the EMBA being at the Abrolhos Islands (over 2,000 km south-west of the EMBA). While killer whales are known to undertake seasonal migrations and follow regular migratory routes, little is known about these movements (DoEE, 2019). No BIAs, EPBC-listed critical habitat or verified migration routes have been identified for this species within the EMBA, although they may be present in low numbers.

7.2.4 Spotted bottlenose dolphin (Indo-pacific bottlenose dolphin)

The spotted bottlenose dolphin (Arafura/Timor Sea populations; *Tursiops aduncus*; Migratory) is primarily found in nearshore continental shelf waters less than 200 m deep, with rocky or coral reefs, sandy, soft sediments, or seagrass beds (DSEWPaC, 2012f). Small populations also occur in the inshore waters of some oceanic islands (Ceccarelli et al 2011).

In Australia, migration patterns for the species are variable, including year-round residency in small areas, long-range movements and migration (DoE, 2023s). The species occurs in NT open coastal waters, primarily within the continental shelf and around oceanic islands. Spotted bottlenose dolphins forage in a wide range of habitats and in deeper waters than most dolphins. Groups are resident at Browse Island, Rowley Shoals and other island and reef complexes in offshore waters and are known across the Pilbara coast and the western Kimberley (Allen et al., 2012; Ceccarelli et al., 2011).

No BIAs for the Indo-Pacific bottlenose dolphin have been developed within the EMBA, although a breeding/calving BIA is located in Darwin Harbour during the dry season (usually April to September). Given spotted bottlenose dolphin use relatively deeper waters and potentially travel large distances, it is likely this species will occasionally transit through the EMBA.

7.3 Dugong

Dugongs (*Dugong dugon*; Migratory) occur in tropical and sub-tropical coastal and island waters. They are commonly found in shallow intertidal zone areas to 25 m but have been observed in waters up to 37 m deep (DoE, 2023ab; DEWHA, 2008c). Dugong feeding aggregations tend to occur in large seagrass meadows within wide shallow protected bays, shallow mangrove channels and in the lee of large inshore islands. Although the movements of most individuals are limited to tens of kilometres in the vicinity of seagrass beds some individuals travel up to 1,000 km (Hobbs & Willshaw, 2015; Whiting, 2008).

In northern Australia, the Darwin region supports a dugong population travelling over 300 km between rocky reef habitats and the north coast of the Tiwi Islands is a key site for dugong conservation (Whiting, 2008; PWSNT, 2003). A well-known aggregation of approximately 4,400 individuals occurs in waters within approximately 50 km of the Tiwi Islands and ranks in the top eight dugong populations in Australia (PWSNT, 2003). Dugongs in the Torres Strait have strikingly large home-range sizes when compared to other regions, likely due to the vast areas of seagrass in the

Torres Strait, including over 13,000 km^2 of deep-water seagrass, the largest continuous area in Australia (Deutsch et al., 2022). This along with large seagrass beds in shallow water around reefs enables dugongs to travel long distances while staying relatively close to accessible forage (Deutsch et al., 2022). Dugongs tracked in the INPEX Ichthys Project baseline surveys were recorded around the Vernon Islands, south of Melville Island, and spent time in Darwin Harbour and around the Tiwi Islands (INPEX, 2010). Routine sightings occur in various locations along the NT coastline, including within Darwin Harbour and to the south of Melville Island.

7.4 Biologically Important Areas (BIAs) and Critical habitat for marine mammals

BIAs for Pygmy blue whale distribution and migration have been developed within the EMBA, located 63 km and 179 km from the OA, respectively (Figure 7-1). The distribution and critical habitat for Humpback whales is shown in Figure 7-2.

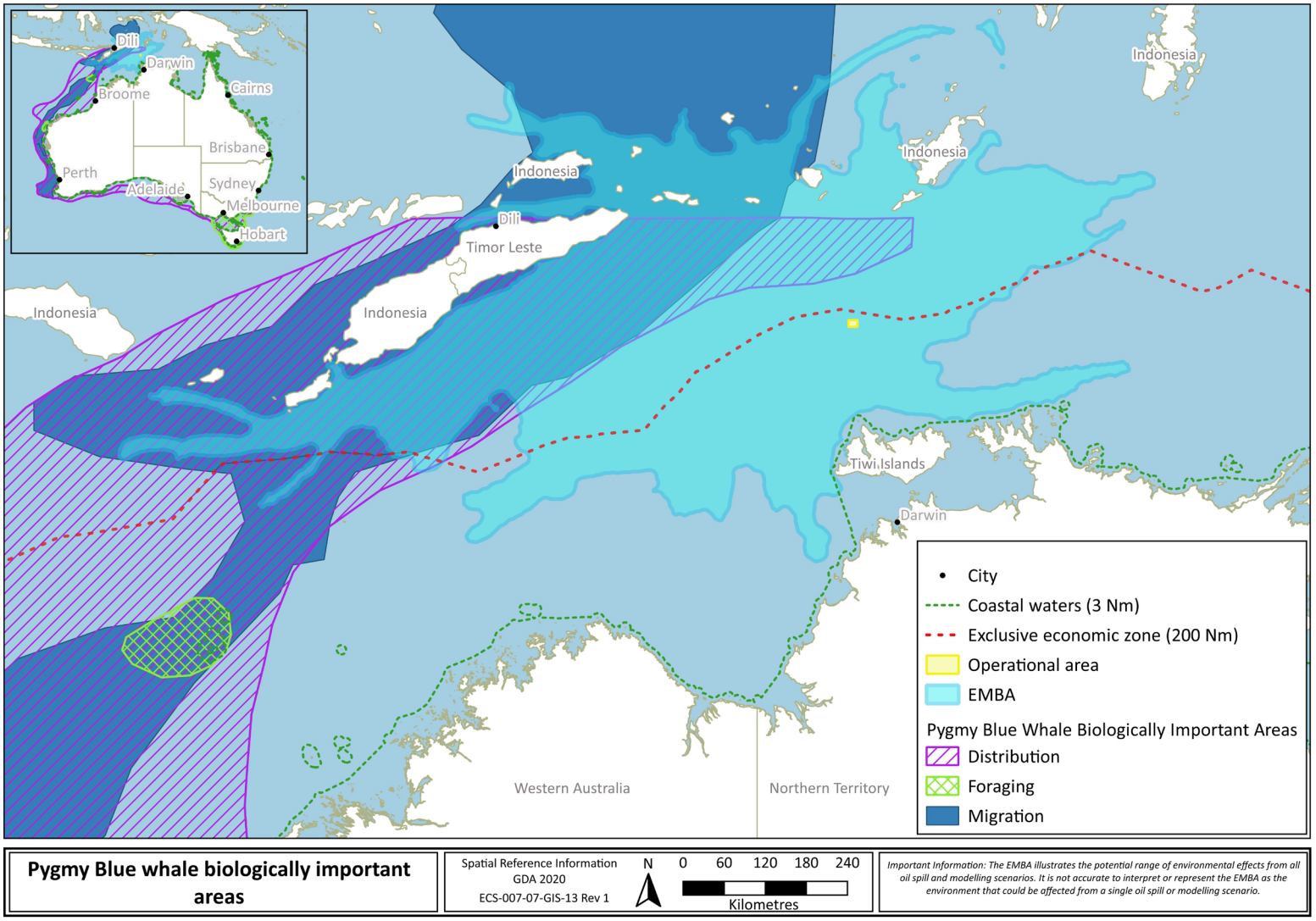


Figure 7-1: Pygmy blue whale distribution and BIAs overlapping or proximal to the EMBA

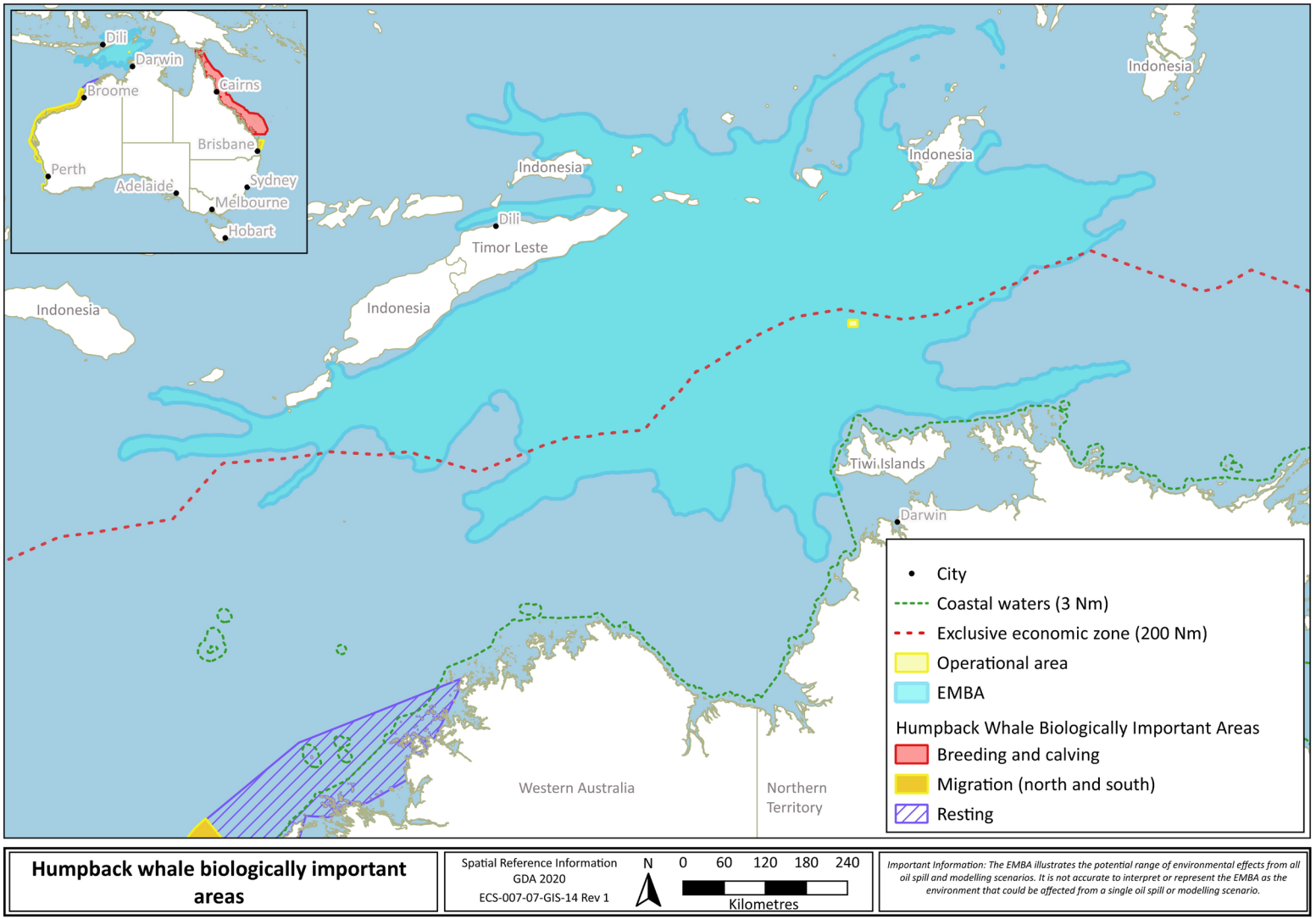


Figure 7-2: Humpback whale distribution and BIAs overlapping or proximal to the EMBA

8. Birds

A number of marine bird species are known to occur within the region as they forage large distances over the open ocean (DSEWPaC, 2012fg). See the EPBC Protected Matters search for the full list of bird species that may occur in the EMBA (Appendix A). Species that are not expected to occur in significant numbers within the marine and coastal environments of the EMBA due to their terrestrial or southern distributions according to the Species Profile and Threats database and The Action Plan for Australian Birds (Garnet, 2011) are not discussed further. Species listed under the EPBC Act as migratory and/or threatened that may occur in the EMBA are outlined in Table 8-1, with species listed as threatened described in the following sections.

Table 8-1: Environmental values and sensitivities within the EMBA for threatened, migratory and listed marine birds

Common name	Scientific name	EPBC Act status	Particular values or sensitivities
Threatened and migratory species			
Abbott's booby	*Papasula abbotti*	Endangered, Marine	Species or species habitat may occur within area
Australian lesser noddy	*Anous tenuirostris melanops*	Vulnerable, Marine	Breeding known to occur within area
Australian painted snipe	*Rostratula australis*	Endangered, Overfly Marine	Species or species habitat may occur within area
Bar-tailed godwit	*Limosa lapponica*	Migratory Wetlands	Species or species habitat may occur within area
Barn swallow	*Hirundo rustica*	Migratory Terrestrial, Overfly Marine	Species or species habitat may occur within area
Brown booby	*Sula leucogaster*	Migratory Marine	Breeding known to occur within area
Common noddy	*Anous stolidus*	Migratory Marine	Foraging, feeding or related behaviour known to occur within area
Common sandpiper	*Actitis hypoleucos*	Migratory Wetlands	Species or species habitat may occur within area
Curlew sandpiper	*Calidris ferruginea*	Critically Endangered, Migratory Wetlands, Overfly Marine	Species or species habitat may occur within area
Eastern curlew, far eastern curlew	*Numenius madagascariensis*	Critically Endangered, Migratory Wetlands, Marine	Species or species habitat may occur within area
Fork-tailed swift	*Apus pacificus*	Migratory Marine, Overfly Marine	Species or species habitat likely to occur within area
Great frigatebird, greater frigatebird	*Fregata minor*	Migratory Marine	Species or species habitat likely to occur within area
Greater crested tern	*Thalasseus bergii*	Migratory Wetlands	Breeding likely to occur within area
Greater sand plover, large sand plover	*Charadrius leschenaultii*	Vulnerable, Migratory Wetlands, Marine	Species or species habitat likely to occur within area
Lesser frigatebird, least frigatebird	*Fregata ariel*	Migratory Marine	Species or species habitat likely to occur within area
Little tern	*Sternula albifrons*	Migratory Marine	Congregation or aggregation known to occur within area
Nunivak bar-tailed godwit, Western Alaskan bar-tailed godwit	*Limosa lapponica baueri*	Vulnerable	Species or species habitat known to occur within area

Common name	Scientific name	EPBC Act status	Particular values or sensitivities
Oriental plover, oriental dotterel	*Charadrius veredus*	Migratory wetlands, Overfly Marine	Species or species habitat may occur within area
Oriental pratincole	*Glareola maldivarum*	Migratory wetlands, Overfly Marine	Species or species habitat may occur within area
Oriental reed-warbler	*Acrocephalus orientalis*	Migratory Wetlands	Species or species habitat may occur within area
Osprey	*Pandion haliaetus*	Migratory Wetlands	Species or species habitat known to occur within area
Pectoral sandpiper	*Calidris melanotos*	Migratory Wetlands	Species or species habitat may occur within area
Red knot, knot	*Calidris canutus*	Endangered, Migratory Wetlands, Overfly marine	Species or species habitat likely to occur within area
Red-footed booby	*Sula sula*	Migratory Marine	Breeding known to occur within area
Red-rumped swallow	*Cecropis daurica*	Migratory Terrestrial, Overfly Marine	Species or species habitat may occur within area
Roseate tern	*Sterna dougallii*	Migratory Marine	Foraging, feeding or related behaviour likely to occur within area
Rufous fantail	*Rhipidura rufifrons*	Migratory Terrestrial, Overfly Marine	Species or species habitat likely to occur within area
Sharp-tailed sandpiper	*Calidris acuminata*	Migratory Wetlands	Species or species habitat may occur within area
Streaked shearwater	*Calonectris leucomelas*	Migratory Marine	Species or species habitat known to occur within area
White-tailed tropicbird	*Phaethon lepturus*	Migratory Marine	Species or species habitat likely to occur within area
Listed marine species			
Cattle Egret	*Bubulcus ibis*	Listed – overfly marine area (as *Ardea ibis*)	Species or species habitat may occur within area
Lesser Crested Tern	*Thalasseus bengalensis*	Listed (as *Sterna bengalensis*)	Breeding known to occur within area
Rainbow Bee-eater	*Merops ornatus*	Listed – overfly marine area	Species or species habitat may occur within area
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	Listed	Species or species habitat likely to occur within area

8.1 Threatened species

8.1.1 Abbott's booby

The Abbott's booby (*Papasula abbotti*; Endangered) spends most its life at sea, and generally only comes ashore to breed. Within Australia, this species breeds exclusively in the forests of Christmas Island and foraging in the surrounding waters (TSSC, 2020) with the population estimated to be 2,500 breeding pairs (Menkhorst et al., 2017). However, individuals may travel hundreds of kilometres from Christmas Island to forage (DoE, 2023t). The PMST report states that this species or habitat is likely to occur within the EMBA. While Abbott's booby may over-fly the waters of the EMBA from time-to-time while in transit or foraging, they neither breed nor rest in the EMBA, and no critical habitat has been identified within the EMBA.

8.1.2 Australian lesser noddy

The Australian lesser noddy (*Anous tenuirostris melanops*; Vulnerable) is a tropical species of tern endemic to Australia that occupies coral-limestone islands densely fringed with white mangrove (*Avicennia marina)*, and occasionally shingle or sandy beaches (DoE, 2023u; TSSC, 2015). While the Australian lesser noddy has a broad range, the species primarily breeds in a small area of the Houtman Abrolhos Islands from mid-August to early April (DoE, 2023u; Surman et al., 2018; TSSC, 2015; Storr et al. 1986). The species is also known to breed in small numbers at Ashmore Reef and generally remain close to their breeding islands throughout the year (Surman et al., 2018; Menkhorst et al., 2017). Individuals may leave their nesting islands for short periods during the non-breeding season, and likely forage widely. The Australian lesser noddy occupies coral-limestone islands densely fringed with white mangrove (*Avicennia marina)*, and occasionally shingle or sandy beaches (DoE, 2023u). Although the PMST report states that foraging, feeding or related behaviour is known to occur within the area, Australian lesser noddies are likely to remain in the general vicinity of or south of the Houtman Abrolhos Islands and are not expected to occur in significant numbers throughout the EMBA.

8.1.3 Australian painted snipe

The Australian painted snipe (*Rostratula australis*; Endangered) is a wading bird that has been recorded in wetlands of all Australian states, most frequently recorded in the Murray-Darling Basin and in smaller numbers and less frequently at scattered locations in WA and NT (DoE, 2023v; DEPWS, 2021; DoE, 2013). The most northerly breeding records are from near Derby and Taylor's Lagoon, near Broome and at Tarrabool Lake on the Barkly Tablelands. Although this species is only occasionally recorded in northern Australia, it has been recorded in northern WA and NT from McMinns Lagoon near Darwin and Yellow Waters in Kakadu (DoE 2023v; DEPWS, 2021; Trainor et al., 2017; Knuckey et al., 2013). While this species generally inhabits shallow terrestrial freshwater and occasionally brackish wetlands and other waterlogged areas, the Australian painted snipe requires shallow wetlands with areas of bare wet mud and canopy cover nearby for breeding (DoE, 2023v; DCCEEW, 2022). The PMST report states that this species or habitat may occur within the area. However, as the Australian painted snipe primarily inhabits freshwater wetlands, it is unlikely to occur in the EMBA.

8.1.4 Bar-tailed godwit (Western Alaskan and Northern Siberian subspecies)

The bar-tailed godwit (*Limosa lapponica baueri*; Vulnerable) breeds in the northern hemisphere and migrates southwards for the boreal winter. The majority of breeding individuals leave south-eastern Australia by the end of the first week of April, with mostly immature individuals remaining (Bamford et al., 2008). This species has been recorded along the coastline of all Australian states and mainly occurs along Australia's north and east coasts. This species is widespread from Eyre to Derby in WA and from Darwin east to the Gulf of Carpentaria (DoE, 2023w; Clarke, 2011). Nunivak bar-tailed godwits eat molluscs, worms, crustaceans and insects caught when foraging in shallow water or along the edge of water with a preference for exposed sandy or soft mud substrates on intertidal flats, banks and beaches (Chan et al., 2022; DoE, 2023w; TSSC, 2016). The PMST report states that this species or habitat may occur within the area and are likely to fly over the EMBA.

8.1.5 Curlew sandpiper

The curlew sandpiper (*Calidris ferruginea*; Critically Endangered, Migratory) has a broad distribution and has been recorded along the coasts of all Australian states and territories (DoE, 2023x). In WA, curlew sandpipers occur in large numbers at Port Hedland Saltworks, 80 Mile Beach, Roebuck Bay and Lake Macleod, but is rarely recorded in the north-west Kimberley. In NT, curlew sandpipers mostly occur around Darwin, north to Melville Island and Cobourg Peninsula, and east and south-east to Gove Peninsula, Groote Eylandt and Sir Edward Pellew Island (DoE, 2023x; TSSC, 2016). Although the species prefers intertidal mudflats in sheltered coastal areas to forage in nearshore waters or mud at the edge of wetlands, they are also widespread inland in smaller numbers (DoE,

2023x). The curlew sandpiper migrates along the East Asian-Australasian Flyway (Flyway) from their breeding grounds in Siberia to Australia, generally arriving from late August/early September and departing by mid-April. Some non-breeding individuals may stay in Australia (DoE, 2023x). The PMST report states that this species or habitat may occur within the area and individuals may be present within the EMBA based on their known NT distribution.

8.1.6 Eastern curlew

The eastern curlew (*Numenius madagascariensis*; Critically Endangered, Migratory) is the world's largest species of shorebird (DoE, 2023y; Menkhorst et al., 2017). Eastern curlews migrate annually to breeding grounds in Russia and north-eastern China before returning to Australia in August to forage primarily on crabs in intertidal mudflats (DoE, 2023y; Menkhorst et al., 2017; Bamford et al., 2008). In Australia, the species has a continuous distribution from Barrow Island and Dampier Archipelago in WA through the Kimberley and along the NT, Qld, NSW coasts including the Torres Strait islands (TSSC, 2015a). There has been an increase at two sites in the Darwin region between 2009 and 2015, at Lee Point numbers have increased by 9 % per year and 17 % per year at East Arm Wharf in Darwin Harbour (Lilleyman et al., 2016). This local increase may be due to changes in roosting behaviour and an increase in suitable high tide roosting habitat. The PMST report states that this species or habitat may occur within the area, and individuals may fly over and be present within the EMBA.

8.1.7 Greater sand plover, large sand plover

Greater sand plovers (*Charadrius leschenaultia*, Vulnerable, Migratory) are shorebirds that migrate from breeding areas in Mongolia, Siberia and China to coastal areas of all Australian states with the area around Darwin an internationally important site. This species occurs in the greatest numbers in northwestern Australia and is widespread between Northwest Cape and Roebuck Bay in WA, with scattered records between Roebuck Bay and Darwin. Greater sand plovers are recorded from most of the coastline of the NT, with significant areas around the Joseph Bonaparte Gulf, from Anson Bay to Murgenella Creek (including the south coast of the Tiwi Islands), the northern Arnhem coast, and the Port McArthur area (DoE, 2023z; TSSC, 2016a). In Australia, greater sand plovers are almost entirely coastal, inhabiting sheltered muddy, sandy or shelly beaches, large intertidal mudflats, saltmarshes, estuaries, sandbanks, coral reefs, rocky islands rock platforms, tidal lagoons and coastal dunes. Greater sand plovers feed on molluscs, worms, crustaceans and insects they find in wet sand or mud on open intertidal flats (DoE 2023z; TSSC, 2016a). The PMST report states that this species or habitat is likely to occur within the area, and individuals may fly over and be present within the EMBA.

8.1.8 Red knot (New Siberian Islands and north-eastern Siberia)

The red knot (*Calidris canutus*; Endangered) is a migratory omnivorous shorebird which utilises the intertidal mudflats, sandflats and sandy beaches of sheltered coastal areas, estuaries, bays and other similar marine habitats (DoE, 2023aa; TSSC, 2016c). The red knot is present throughout coastal and offshore Australia, with large numbers regularly recorded in the north-west of Australia (DoE, 2023aa; Clarke, 2011; Bamford et al., 2008). The red knot breeds in Siberia and spends the non-breeding season in Australia and New Zealand, arriving in northern Australia in late August to early September and also settles in eastern Australia and New Zealand (TSSC, 2016c; Watkins, 1993). During the non-breeding season, the red knot occurs on tidal mudflats or sandflats feeding on invertebrates, especially shellfish (Garnet et al., 2011). Both north-western and south-eastern Australia are key areas for red knots. The Gulf of Carpentaria is an important staging area for migrating birds headed to south-eastern Australia and New Zealand. The NT region between the Daly River and Bynoe Harbour, along with the northern Arnhem Land coast from Boucaut Bay to Buckingham Bay are important areas (Chatto, 2003). Individual birds may fly over and feed in coastal zones within the EMBA.

8.2 Migratory species

Most migrant birds are expected to fly over the regional area as part of their large-scale transitory movements and are unlikely to land on the sea for significant periods of time (ConocoPhillips, 2018). Considering this, and the general absence of landing areas at a regional offshore scale, the majority of seabird activity is likely to comprise foraging and migration pathways. While seabirds spend much of their lives at sea, migratory shorebirds overfly offshore areas during migratory periods and typically do not interact with the sea surface (ConocoPhillips, 2018; DSEWPaC, 2012g; 2012h). Migratory wetland species do not interact with open offshore waters but may land on offshore infrastructure while flying between land masses (ConocoPhillips, 2018).

Shorebird migration patterns are seasonal and vary according to species (DSEWPaC, 2012h), but generally shorebirds migrate to northern Australia from August to November. The majority of birds remain in northern Australia, while others disperse southwards (Bennelongia, 2011). On northern beaches migratory shorebirds peak in November then again in March as the majority of birds begin their return to the northern hemisphere between March and May. Most migratory shorebirds do not breed in Australia and juvenile birds may spend several years in Australia before reaching maturity and returning north to breed (DEWHA, 2008c). Species listed as migratory under the EPBC Act that may occur in the EMBA are outlined in Table 8-1.

8.3 Biologically Important Areas (BIAs)

BIAs for a number of seabird species have been developed in the area, with the species, behaviour and distance to the OA summarised in Table 8-2, and presented in Figure 8-1.

Table 8-2: Biologically important areas for marine birds identified within the EMBA

Species	BIA behaviour	Distance to OA (km)
Bridled tern	Breeding	240
Brown booby	Breeding	774
Crested tern	Breeding	115
	Breeding (high numbers)	235
Greater frigatebird	Breeding	712
Lesser frigatebird	Breeding	719
Lesser crested tern	Breeding	794
Little tern	Resting	804
Red-footed booby	Breeding	712
Roseate tern	Breeding	794
Wedge-tailed shearwater	Breeding	718

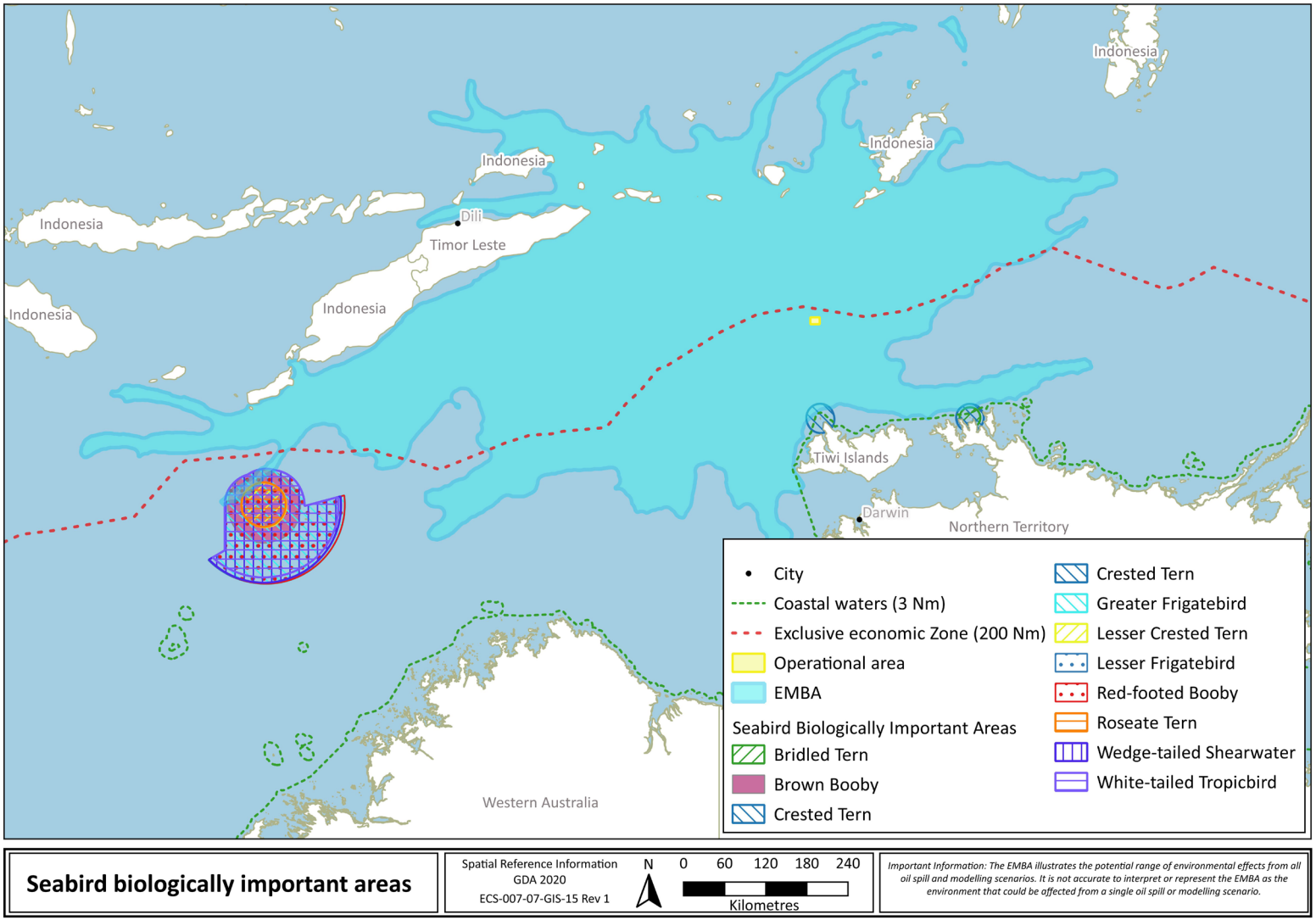


Figure 8-1: Seabird BIAs overlapping or proximal to the EMBA

9. Conservation advice and Recovery plans

To protect, maintain and enhance the recovery of threatened species and ecological communities, DCCEEW may prepare conservation management plans in the form of conservation advice or recovery plans.

When a native species or ecological community is listed as threatened under the EPBC Act, conservation advice is developed to assist its recovery. Conservation advice provides guidance on the immediate recovery and threat abatement activities to undertake to ensure the conservation of a listed species or ecological community.

The aim of a recovery plan is to maximise the long-term survival in the wild of a threatened species or ecological community. The Australian Minister for the Environment may make or adopt and implement recovery plans for threatened fauna, flora (other than conservation dependent species) and ecological communities listed under the EPBC Act. Recovery plans set out the research and management actions necessary to stop the decline and support the recovery of listed threatened species or ecological communities.

The EP summarises the actions relevant to the Barossa petroleum activities with more information on the specific requirements of the relevant plans of management (including conservation advice, recovery plans and management plans for marine fauna) that would be applicable and demonstrates where current management requirements have been considered.

The EPBC Management/Recovery Plans and Conservation Advice for the species identified in the EPBC protected matters report (Appendix A) are summarised in Table 9-1..

Table 9-1: Relevant recovery plans, conservation advice and management plans for species that may occur within the EMBA

Name	Recovery plan/ Conservation advice/ Management plan	Relevant objectives
All		
All vertebrate fauna	Threat Abatement Plan for the impacts of marine debris on vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018)	There are 4 main objectives: + contribute to the long-term prevention of the incidence of harmful marine debris + remove existing harmful marine debris from the marine environment + mitigate the impacts of harmful marine debris on marine species and ecological communities + monitor the quantities, origins and impacts of marine debris and assess the effectiveness of management arrangements over time for the strategic reduction of debris.
Fish and sharks		
All sawfish and river sharks including: + green sawfish + largetooth sawfish + speartoothshark + northern river shark	Sawfish and River Sharks Multispecies Recovery Plan (CoA, 2015b)	The primary objective of this recovery plan is to assist the recovery of sawfish and river sharks with a view to: + improving the population status leading to the removal of the sawfish and river shark species from the threatened species list of the EPBC Act + ensuring that anthropogenic activities do not hinder recovery in the near future or impact the conservation status of the species in the future. The specific objectives of the recovery plan (relevant to industry) are: + Objective 5: Reduce and, where possible, eliminate adverse impacts of habitat degradation and modification on sawfish and river shark species + Objective 6: Reduce and, where possible, eliminate any adverse impacts of marine debris on sawfish and river shark species noting the linkages with the Threat Abatement Plan for the impact of marine debris on vertebrate marine life (DoEE, 2018).
Dwarf Sawfish	Approved Conservation Advice for *Pristis clavata* (Dwarf Sawfish) (DEWHA, 2009)	No explicit relevant objectives

Name	Recovery plan/ Conservation advice/ Management plan	Relevant objectives
Green sawfish	Approved conservation advice for Green Sawfish (DEWHA, 2008a)	No explicit relevant objectives
Largetooth sawfish	Approved Conservation Advice for *Pristis pristis* (Largetooth Sawfish) (TSSC, 2014b)	No explicit relevant objectives
Northern river shark	Approved Conservation Advice for *Glyphis garricki* (northern river shark) (TSSC, 2014a)	No explicit relevant objectives
Speartooth shark	Approved Conservation Advice for *Glyphis glyphis* (speartooth shark) (DoE, 2014)	No explicit relevant objectives
Grey nurse shark (west coast population)	Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) (DoE, 2014a)	The overarching objective of this recovery plan is to assist the recovery of the grey nurse shark in the wild with a view to: + improving the population status + ensuring that anthropogenic activities do not hinder the recovery of the grey nurse shark.
White shark	Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013)	The overarching objective of this recovery plan is to assist the recovery of the white shark in the wild throughout its range with a view to: + improving the population status leading to future removal of the white shark from the threatened species list of the EPBC Act + ensuring that anthropogenic activities do not hinder recovery in the near future or impact the conservation status of the species in the future.

Name	Recovery plan/ Conservation advice/ Management plan	Relevant objectives
		+ The specific objective of the recovery plan (relevant to industry) is: + Objective 7: Continue to identify and protect habitat critical to the survival of the white shark and minimise the impact of threatening processes within these areas.
Whale shark	Conservation Advice for *Rhinocodon typus* (whale shark) (TSSC, 2015g)	To maintain existing levels of protection for the whale shark in Australia while working to increase the level of protection afforded to the whale shark within the Indian Ocean and Southeast Asian region to enable population growth so that the species can be removed from the threatened species list of the EPBC Act.
Marine mammals		
Cetaceans and other marine megafauna	National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (CoA, 2017)	The overarching goal of the strategy is to provide guidance on understanding and reducing the risk of vessel collisions and the impacts they may have on marine megafauna. The specific objective of the strategy (relevant to industry) is: + Objective 3: Mitigation – reduce the likelihood and severity of megafauna vessel collision.
Blue whale (includes pygmy blue whale)	Conservation Management Plan for the Blue Whale 2015–2025 (CoA, 2015a)	The long-term recovery objective is to minimise anthropogenic threats to allow the conservation status of the blue whale to improve so that it can be removed from the threatened species list under the EPBC Act.

Name	Recovery plan/ Conservation advice/ Management plan	Relevant objectives
Fin whale	Conservation Advice for *Balaenoptera physalus* (fin whale) (TSSC, 2015c)	Determine population abundance, trends and population structure for fin whales, and establish a long-term monitoring program.
Sei whale	Conservation Advice for *Balaenoptera borealis* (sei whale) (TSSC, 2015b)	Determine population abundance, trends and population structure for sei whales, and establish a long-term monitoring program.
Reptiles		
All marine turtles (flatback, green, hawksbill, leatherback, loggerhead, olive ridley)	National Light Pollution Guidelines for Wildlife (DCCEEW, 2023d)	Lighting objectives will need to consider the regulatory requirements and Australian standards relevant to the activity, location and wildlife present. Objectives should be described in terms of specific locations and times for which artificial light is necessary. Consideration should be given to whether colour differentiation is required and if some areas should remain dark, either to contrast with lit areas or to avoid light spill. Where relevant, wildlife requirements should form part of the lighting objectives.

Name	Recovery plan/ Conservation advice/ Management plan	Relevant objectives
		A lighting installation will be deemed a success if it meets the lighting objectives (including wildlife needs) and areas of interest can be seen by humans clearly, easily, safely and without discomfort.
	Recovery Plan for Marine Turtles in Australia 2017–2027 (CoA, 2017b)	Long-term recovery objective: + minimise anthropogenic threats to allow for the conservation status of marine turtles to improve so that they can be removed from the EPBC Act threatened species list. Interim objective 3: + anthropogenic threats are demonstrably minimised.
Leatherback turtle	Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle) (DEWHA, 2008b)	No explicit relevant objectives
Short-nosed sea snake	Approved Conservation Advice on *Aipysurus apraefrontalis* (Short-nosed seas snake) (DSEWPaC, 2011a)	No explicit relevant objectives
Leaf-scaled sea snake	Approved Conservation Advice on *Aipysurus foliosquama* (Leaf-scaled sea snake) (DSEWPaC, 2011b)	No explicit relevant objectives
Seabirds and shorebirds		
All seabirds and shorebirds	National Light Pollution Guidelines for Wildlife (DCCEEW, 2023d)	Lighting objectives will need to consider the regulatory requirements and Australian standards relevant to the activity, location and wildlife present. Objectives should be described in terms of specific locations and times for which artificial light is necessary. Consideration should be

Name	Recovery plan/ Conservation advice/ Management plan	Relevant objectives
		given to whether colour differentiation is required and if some areas should remain dark, either to contrast with lit areas or to avoid light spill. Where relevant, wildlife requirements should form part of the lighting objectives. A lighting installation will be deemed a success if it meets the lighting objectives (including wildlife needs) and areas of interest can be seen by humans clearly, easily, safely and without discomfort.
Black noddy Bridled tern Brown booby Caspian tern Common noddy Great frigatebird Greater crested tern Lesser crested tern Lesser frigatebird Little tern Masked booby Osprey Red-footed booby Red-tailed tropicbird Roseate tern Streaked shearwater Wedge-tailed shearwater White-tailed tropicbird	Wildlife Conservation Plan for Seabirds (CoA, 2020)	Seabirds and their habitats are protected and managed in Australia.
Bar-tailed godwit Curlew sandpiper Eastern curlew Red knot Streaked shearwater	Wildlife Conservation Plan for Migratory Shorebirds (CoA, 2015c)	Anthropogenic threats to migratory shorebirds in Australia are minimised or, where possible, eliminated.

Name	Recovery plan/ Conservation advice/ Management plan	Relevant objectives
Abbott's booby	Conservation Advice for the Abbott's booby *Papasula abbotti* (TSSC, 2020a)	Long-term objective is to reduce anthropogenic threats to allow the conservation status of Papasula abbotti (Abbott's booby) to improve so that it can be removed from the threatened species list of the EPBC Act.
Australian lesser noddy	Conservation Advice *Anous tenuirostris melanops* Australian lesser noddy (TSSC, 2015a)	No explicit relevant objectives
Australian painted snipe	Approved Conservation Advice for *Rostratula australis* (Australian painted snipe) (TSSC, 2013)	No explicit relevant objectives
Curlew sandpiper	Approved Conservation Advice for *Calidris ferruginea* (Curlew Sandpiper) (TSSC, 2015e)	Australian objective: + reduce disturbance at key roosting and feeding sites.
Eastern curlew	Approved Conservation Advice for *Numenius madagascariensis* (Eastern Curlew) (TSSC, 2015f)	Australian objectives: + achieve a stable or increasing population + maintain and enhance important habitat + reduce disturbance at key roosting and feeding sites.
Greater sand plover	Conservation Advice *Charadrius leschenaultii* (Greater sand plover) (TSSC, 2016)	No explicit relevant objectives
Northern Siberian bar-tailed godwit	Conservation Advice *Limosa lapponica menzbieri* (Bar-tailed godwit [Northern Siberian]) (TSSC, 2016c)	No explicit relevant objectives
Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit	Conservation Advice *Limosa lapponica baueri* (Bar-tailed godwit [western Alaska]) (TSSC, 2016d)	No explicit relevant objectives
Red knot	Approved Conservation Advice for *Calidris canutus* (Red knot) (TSSC, 2016b)	No explicit relevant objectives

10. Protected areas

There are no declared World Heritage properties, wetlands of international importance (Ramsar), wetlands of national importance or listed national or Commonwealth heritage places in the EMBA. Marine parks/reserves are discussed in Section 12, and KEFs described in Section 11.

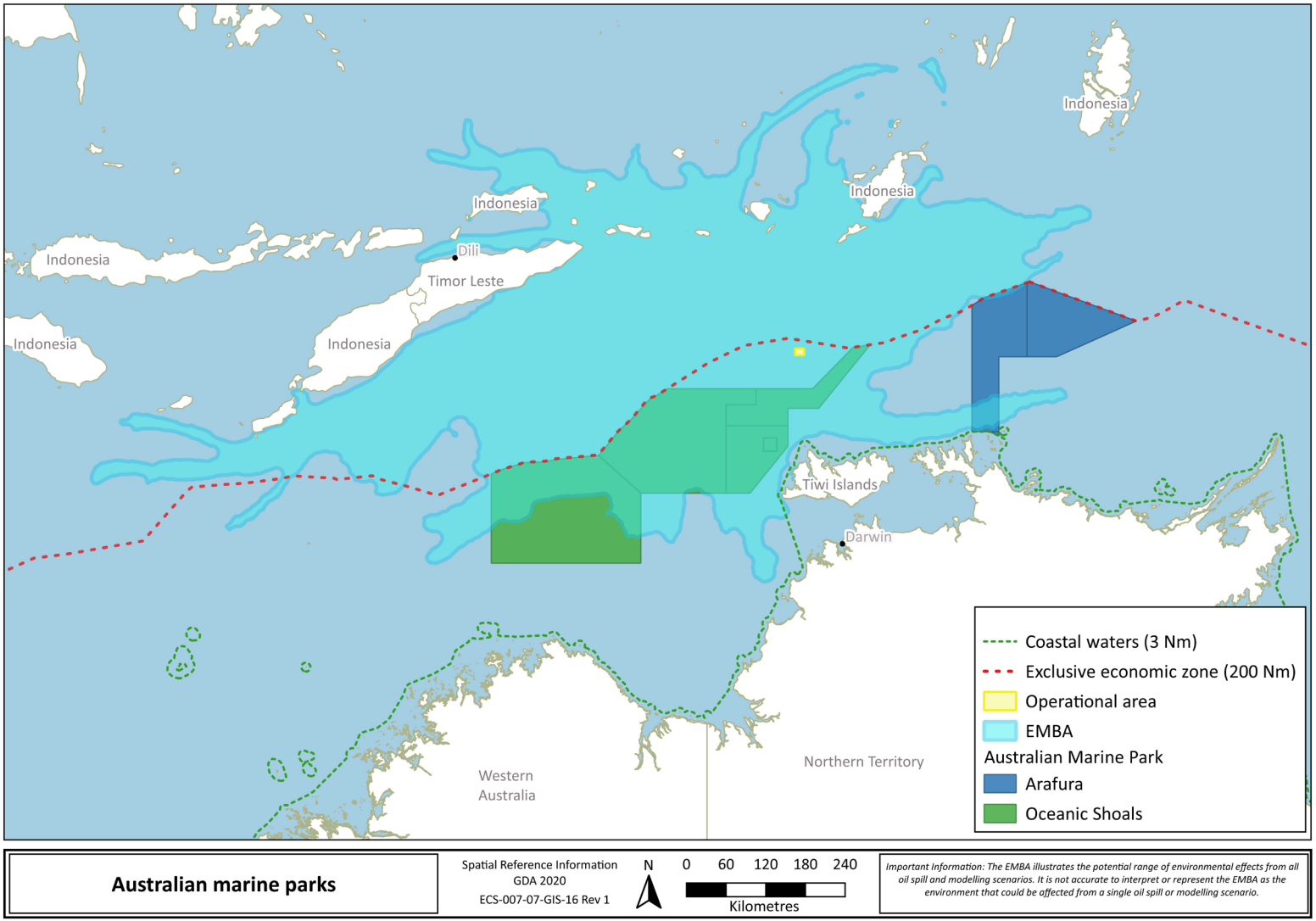


Figure 10-1: Australian marine parks overlapping the EMBA

11. Key ecological features

Key ecological features (KEFs) are elements of the Commonwealth marine environment defined as important for either a region's biodiversity or its ecosystem function and integrity. KEFs meet one or more of the following criteria (DSEWPaC, 2012a):

- a species, group of species or a community with a regionally important ecological role
- a species, group of species or a community that is nationally or regionally important for biodiversity
- an area or habitat that is nationally or regionally important for:
  - enhanced or high biological productivity
  - aggregations of marine life
  - biodiversity and/or endemism
- a unique seafloor feature with ecological properties of regional significance.

The six KEFs that occur in the EMBA are shown in Figure 11-1 and discussed below. Distances of each KEF from the OA is described in Section 3.2.2 of the EP. The OA occurs within the bounds of the Shelf Break and Slope of the Arafura Shelf KEF.

11.1 Carbonate bank and terrace system of the Sahul Shelf

The carbonate bank and terrace system of the Sahul Shelf is located in the western Joseph Bonaparte Gulf, north of Cape Bougainville and Cape Londonderry. The banks consist of a hard substrate with flat tops at depths of 150 to 300 m. Each bank occupies an area generally less than 10 km^2 and is separated from the next bank by narrow sinuous channels up to 150 m deep. The area contains predictably high levels of productivity especially when compared to the generally low productivity of the region (DSEWPaC, 2012a).

The banks are foraging areas for loggerhead, olive ridley and flatback turtles and provide habitat for humpback whales, as well as green and freshwater sawfish (Donovan et al., 2008 in DSEWPaC, 2012a). The hard substrate of the banks is thought to support diverse organisms including sessile benthic invertebrates such as sponges, soft and hard corals, gorgonians, bryozoans, ascidians along with associated reef fish and elasmobranchs (Brewer et al. 2007). Cetaceans, green and fresh sawfish are also likely to occur in the area, as well as possibly the Australian snubfin dolphin, a migratory species occurring mostly on the northern extent of the Sahul Shelf (DSEWPaC, 2012a).

According to DSEWPaC (2012a) the carbonate banks and terrace system of the Sahul Shelf are regionally important because of their role in enhancing productivity. Although little is known about the banks, terraces and associated channels, they are believed to be areas of enhanced productivity and biodiversity due to the upwellings of cold nutrient-rich water at the heads of the channels and the availability of hard substrate (Brewer et al., 2007). The Carbonate bank and terrace system of the Sahul Shelf KEF overlaps approximately 3.46% of the EMBA (Figure 11-1).

11.2 Carbonate bank and terrace system of the Van Diemen Rise

The bank and terrace system of the Van Diemen Rise covers about 31,278 km^2 and forms part of the larger system associated with the Shaul Banks to the north and Londonderry Rise to the east. The value of this KEF is 'unique seafloor feature with ecological properties of regional significance' (DEWHA, 2012a) and it is considered important both for its role in enhancing biodiversity and local productivity relative to its surrounds and for supporting relatively high species diversity. The KEF is characterised by carbonate terrace, banks, channels and valleys, with variability in water depth and substrate composition contributing to unique ecosystems in the channels.

The carbonate banks and shoals found within the Van Diemen Rise make up 80 % of the banks and shoals, 79 % of the channels and valleys, and 63 % of the terrace found across the NMR. The carbonate banks and shoals rise from depths of 100 to 200 m to within 10 m of the surface (Anderson et al., 2011).

A 2010 survey by Geoscience Australia and AIMS mapped the seabed environments of the Van Diemen Rise (Anderson et al., 2011). The study surveyed 784 km² towed video transects at 77 sites including banks, terraces, valleys and plains within the Van Diemen Rise. The shallow banks sampled contained complex benthic features with diverse and often dense epibenthic assemblages. A total of 175 video characterisations were recorded from 13 bank sampling sites in the study area from depths of 11 to 54 m (mean depth of 34 m). The sites were characterised by mostly low-lying rock outcrops with hard corals and octocorals (18 % and 99% occurrence, respectively) along with smaller colonies of bryozoa and ascidians. The rocky outcrops were interspersed by small areas of relatively barren coarse-grained soft sediments (Anderson et al., 2011).

The KEF provides habitat for a high diversity of sponges, soft corals and other sessile filter feeders, epifauna and infauna, along with olive ridley turtles, sea snakes and sharks. Rich sponge gardens and octocorals have been identified on the eastern Joseph Bonaparte Gulf along the banks, ridges and some terraces. Plains in deep hole/valleys are characterised by scattered epifauna and infauna that include polychaetes and ascidians. Epibenthic communities such as the sponges found in the channels are likely to support fish and second-order consumers. Pelagic fish such as mackerel, red snapper and a distinct gene pool of gold band snapper are found in the Van Diemen Rise. The Carbonate bank and terrace system of the Van Diemen Rise KEF overlaps approximately 7.8% of the EMBA (Figure 11-1).

11.3 Continental slope demersal fish communities

The Australian continental slope provides important habitat for demersal fish communities, characterised by high endemism and species diversity. Specifically, the continental slope between Northwest Cape and the Montebello Trough is the most diverse slope bioregion in Australia with more than 500 fish species, 76 of which are endemic (Last et al., 2005 in DSEWPaC, 2012a).

The continental slope KEF consists of two distinct community types, associated with the upper and mid slope, 225 to 500 m and 750 to 1,000 m, respectively. The Timor Province and Northwest Transition bioregions are the second-richest areas for demersal fish across the entire continental slope (DSEWPaC, 2012a). The bacteria and fauna that is present in the form the basis for the food web. This system has been poorly researched, though it has been suggested that it is a detritus-based system, where infauna and epifauna become prey for a range of teleost fish, molluscs and crustaceans (Brewer et al., 2007). The higher order consumers supported by this system are likely to be carnivorous bony fish, deep water sharks, large squid and toothed whales. The pelagic production is known to be phytoplankton based, with hotspots located around oceanic reefs and islands (Brewer et al., 2007).

It is believed that the loss of the benthic habitat along this continental shelf region would likely lead to a decline in the species diversity and endemism in the area (DoEE, 2019a). As data on the endemism of the region is scarce, what interactions exist between the physical processes and trophic structures that lead to this high diversity of fish is currently unknown (DoEE, 2016a). The Continental slope demersal fish communities KEF overlaps approximately 0.15% of the EMBA

11.4 Pinnacles of the Bonaparte Basin

The limestone pinnacles of the Bonaparte Basin are located in the mid-outer shelf of the western Joseph Bonaparte Gulf and comprise of 61 % of the limestone pinnacles in the Northwest Marine Region and 8 % of the total limestone pinnacles found within the Australian Exclusive Economic Zone (EEZ; Baker et al., 2008). The pinnacles are found in waters 30 to 80 m deep and provide hard substrate for sessile species. The pinnacles are thought to be remnants of the calcareous shelf and

coastal features from previous low sea-level stands and have been recorded to be up to 50 m in height and range from 50 to 100 km long (Baker et al., 2008; Heyward et al., 1997).

Diverse communities of sessile benthic invertebrates including hard and soft corals, sponges, whips, fans, bryozoans and aggregations of demersal fish species such as snappers, emperors and groupers have been recorded (Brewer et al., 2007). Foraging and general use has been recorded within the pinnacles by marine turtles and the area has also been suggested to be used by freshwater and green sawfish as well as humpback whales (Donovan et al., 2008). The pinnacles have been recognised as a sponge biodiversity hotspot supporting greater diversity and communities than the surrounding seafloor (NERP MBH, 2014).

The Pinnacles of the Bonaparte Basin are defined as a KEF as they are a unique seafloor feature with ecological properties of regional significance. Their biodiversity value relates to both the benthic and pelagic habitats (DSEWPaC, 2012a). The hard substrate of the pinnacles is likely to support a high number of species, although a better understanding of the species richness and diversity associated with these structures is required. The Pinnacles of the Bonaparte Basin KEF overlaps approximately 0.05% of the EMBA (Figure 11-1).

11.5 Shelf break and slope of the Arafura Shelf

The shelf break and slope of the Arafura Shelf KEF provides a unique seafloor which enhances biological productivity on the edge of the shelf and attracts feeding aggregations of pelagic marine organisms. The productivity of this area has been recognised as nationally and/or regionally important (Last et al., 2005). Although the ecosystem processes in this area are largely unknown, it is thought that the oceanographic processes associated with the Indonesian Throughflow current and monsoonal winds are strong influence (DEWHA, 2007). The physical characteristics of this shelf break and slope comprise of continental slope, patch reefs and hard substrate pinnacles (Harris et al., 2005).

Phytoplankton and invertebrates have been sampled at this KEF and phytoplankton is thought to be the basis for offshore food webs in the area (DEWHA, 2007). Records show about 284 demersal fish species in the area (Last et al. 2005) and other marine species that have been recorded include marine turtles, whale sharks and predatory fish species including sharks (DEWHA, 2008c).

The OA falls within the boundaries of this KEF. However, the ecological values associated with this unique seafloor feature (i.e., patch reefs and hard substrate pinnacles) were not observed during the Barossa marine studies program, nor are these topographically distinct features evident from the data derived from multiple surveys undertaken across this area. The Shelf break and slope of the Arafura Shelf KEF covers approximately 2.7% of the EMBA.

11.6 Tributary canyons of the Arafura Depression

The tributary canyons of the Arafura Depression KEF is characterised by high nutrients from upwellings of deep ocean water, which enhance productivity of the area (DEWHA, 2008c). This is thought to occur as a result of water movement through the canyons and surface water circulating as a result of monsoonal winds (Wilson, 2005).

Surveys of the area identified around 245 macroscopic species including a variety of invertebrates and six small fish species (Wilson, 2005). The area also contains coral communities and aggregations of marine life (DEWHA, 2008c). Larger species found at this KEF include predatory fish, whale sharks, sawfish and marine turtles (mostly olive ridley; DEWHA, 2008c). The tributary canyons of the Arafura Depression cover approximately 0.0001% of the EMBA. (Figure 11-1).

The national and/or regional importance of the tributary canyons is associated with its high productivity, high levels of biodiversity and endemism.

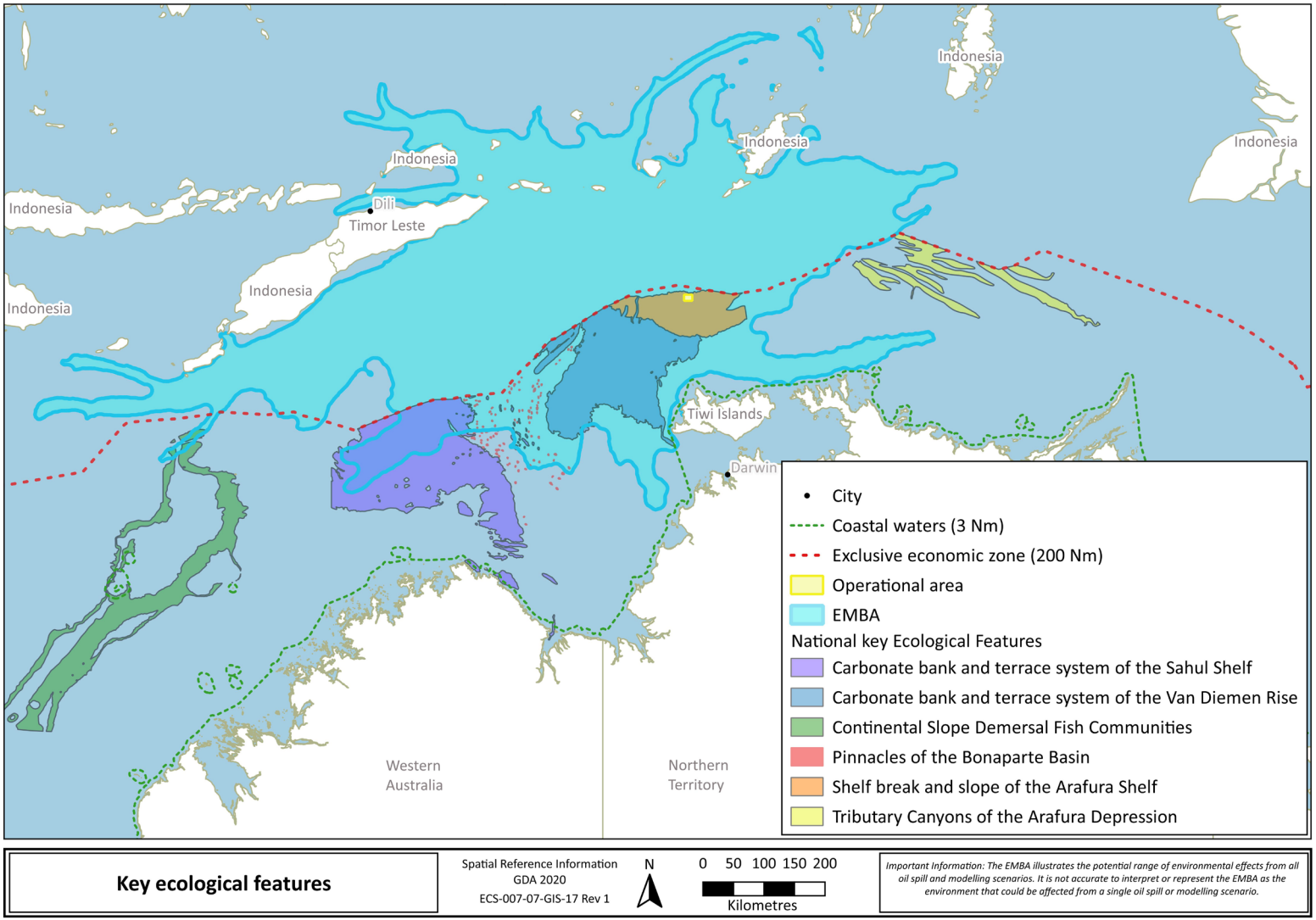


Figure 11-1: Key ecological features overlapping and proximal to the EMBA

12. Marine Conservation Reserves

12.1 Australian Marine Parks

In agreement with the states and NT governments, the Australian Government has committed to establish Commonwealth marine parks as a component of the National Representative System of Marine Protected Areas (Director of National Parks, 2012). In November 2012, the Commonwealth Marine Reserves Network was proclaimed with the purpose of protecting the biological diversity and sustainable use of the marine environment. Commonwealth marine reserves were renamed as Australian Marine Parks in October 2017 and there are six marine regions in the Australian Marine Parks Network, namely the Coral Sea, South-west, Temperate East, South-east, North and North-west. The remaining networks' 10-year management plans were approved and came into effect on 1 July 2018. The management plans establish the management and zoning of the designated marine parks. The EMBA overlaps with the boundaries of two marine parks, both within the North Marine Parks Network.

12.1.1 North Marine Parks Network

The North Marine Parks Network is aligned to the North Marine Region. The network covers 157,480 km^2 (Director of National Parks, 2018). Broad values of this network include:

- natural values
- cultural values
- heritage values
- socio-economic values.

The North Marine Parks Network contains two marine parks that occur within the EMBA, Oceanic Shoals Marine Park (Section 12.1.1.1) and Arafura Marine Park (Section 12.1.1.2).

12.1.1.1 Oceanic Shoals Marine Park

The Oceanic Shoals Marine Park encompasses 71,743 km^2, predominantly comprising a Multiple Use Zone (IUCN Category VI, 39,964 km^2) and a Special Purpose Zone for Trawling (IUCN VI, 24,444 km^2). The marine park also includes a National Park Zone (IUCN Category II, 406 km^2) and Habitat Protection Zone (Category IV, 6,929 km^2). The EMBA overlaps with a substantial portion of this marine park, including within the National Park Zone (IUCN II), and the Habitat Protection, Multiple Use and Special Purpose Zones (Trawl) all of which are IUCN VI (Figure 10-1).

The Oceanic Shoals Marine Park protects the following natural values (Director of National Parks, 2018):

- a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act
- BIAs that include foraging, nesting and internesting habitat for marine turtles
- examples of the ecosystems of two provincial bioregions: the Northwest Shelf Transition Province (which includes the Bonaparte, Oceanic Shoals and Tiwi meso-scale bioregions) and the Timor Transition Province.

KEFs represented in the Oceanic Shoals Marine Park (Director of National Parks, 2018) are:

- Carbonate bank and terrace system of the Van Diemen Rise (unique sea-floor feature)
- Carbonate bank and terrace system of the Sahul Shelf (unique sea-floor feature)
- Pinnacles of the Bonaparte Basin (enhanced productivity, unique sea-floor feature)

- Shelf break and slope of the Arafura Shelf (unique sea-floor feature).

Sea country is valued for Indigenous cultural identity and Indigenous people have been sustainably using and managing their sea country, including that within the Oceanic Shoals Marine Park, for tens of thousands of years. (Director of National Parks, 2018). No heritage listings apply to the marine park. Commercial fishing and mining are important socio-economic values for the park (Director of National Parks, 2018).

Benthic habitat model of the Oceanic Shoals Marine Park

Benthic habitat modelling (Radford et al., 2019; Heyward et al., 2017) and field surveys (Radford et al., 2019) undertaken by AIMS within the Oceanic Shoals Marine Park indicate that benthic communities are broadly similar to those within the wider region. Unconsolidated sediments were the most common benthic habitat type within the Oceanic Shoals Marine Park, with sparse filter feeding assemblages being the second most common habitat type (Radford et al., 2019). Benthic primary producers, such as corals, *Halimeda spp*. And macroalgae were restricted to relatively shallow areas (<30 m) within the marine park and comprised a small portion of overall benthic habitats. Sparse to moderate density filter feeders, dominated by small sponges, were observed on areas of bare or sand covered pavement, with larger organisms observed on outcropping low-relief reef or rocks where the seabed slope changed around the edge of deeper channels. In general, epibenthic biota was sparse and initial observations suggest the dominant species present are consistent with what has been observed during other surveys of similarly turbid waters in the region, for example, Kelly & Prezlawski (2012).

Fish diversity within the Oceanic Shoals is relatively low compared to other locations sampled in the Timor Sea (Radford et al., 2019). This is likely to reflect the absence of complex or rugose benthic habitats, which have been shown to support higher species richness. Analysis of baited remove underwater video systems (BRUVS) recordings within the Oceanic Shoals Marine Park highlighted the strong linage between benthic habitats and fish assemblage characteristics. The unconsolidated sediments hosted pelagic or mobile demersal species that were not closely associated with benthic habitats, such as sharks and trevallies. While relatively uncommon, commercially important demersal fishes such as snappers (Lutjanidae) and cod (Serranidae) were observed in filter feeder benthic habitats (Radford et al., 2019).

12.1.1.2 Arafura Marine Park

The Arafura marine park covers 22,924 km^2 and is comprised of a Multiple Use Zone (IUCN Category VI, 12,422 km^2), Special Purpose Zone (IUCN Category VI, 42 km^2) and Special Purpose Zone (Trawl; IUCN Category VI, 10,461 km^2). Only a relatively small part (0.004%) of the northernmost and southern parts of this marine park falls within the EMBA and this is within the Multiple Use Zone (IUCN VI; Figure 10-1). It is located about 256 km from Darwin and extends to the outer edge of the EEZ with water depths ranging from 15 to 500 m (Director of National Parks, 2018).

The Arafura Marine Park has been deemed significant because ‘it contains habitats, species and ecological communities associated with the Northern Shelf Province and Timor Transition. It includes one key ecological feature: the tributary canyons of the Arafura Depression (valued as a unique seafloor feature with ecological properties of regional significance). It is near to important wetland systems including the Cobourg Peninsula Ramsar site and provides important foraging habitat for seabirds’ (Director of National Parks, 2018).

The Arafura Marine Park has both cultural and natural values. The natural values it protects include:

- ecosystems representative of the Northern Shelf Province
- ecosystems representative of the Timor Transition Province
- BIAs that include internesting and nesting habitat for marine turtles
- a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act

- Tributary canyons of the Arafura Depression KEF (Director of National Parks, 2018).

Sea country is valued for Indigenous cultural identity and Indigenous people have been sustainably using and managing their sea country, including that within the Arafura Marine Park, for tens of thousands of years (Director of National Parks, 2018b). North Marine Parks Network Management Plan 2018 states that the Croker Island clans have sea country interests in the Arafura Marine Park (Director of National Parks, 2018). Their sea country interests have been determined to exist in the area marked by their communally held Native Title that intersects the special purpose zone (IUCN VI) of the Arafura Marine Park, which does not extend into the EMBA.

No heritage listings apply to the marine park. Important socio-economic activities in the marine park include commercial fishing, tourism, and recreation, including recreational fishing (Director of National Parks, 2018).

12.2 State and Territory Marine Reserves

The EMBA does not overlap with any WA or NT marine reserves.

12.3 International Marine Parks

Both Indonesia and Timor-Leste have protected areas in the region of the EMBA. The waters and islands of these protected areas are frequented by tourists undertaking diving, snorkelling, sailing and other marine nature-based tourism with many attractions such as shipwrecks and whale sharks. Traditional fishing may also occur where permitted.

12.3.1 Savu Sea (Laut Sawu) Marine National Park (Taman Nasional Perairan Laut Sawu)

The EMBA overlaps the Laut Sawu Marine National Park, located within the Lesser Sunda Ecoregion in the Savu Sea. The park was established in 2009 with an IUCN Category II status and covers 35,211 km^2 (UNEP-WCMC, 2023). The marine park area is a known migration route for several cetacean species, including the blue whale and sperm whale, while other cetaceans including pygmy killer whales, melon-head whales, short-finned pilot whales, and numerous dolphin species including Risso's, Fraser's, common, bottlenose and spinner dolphins are known to use the marine park. Several species of sea turtle have also been recorded within the marine park. A core zone makes up 2.34% of the total area of the Savu Sea Marine National Park, with sub-cetacean zones making up 37.61% of the park (Perdanahardja & Lionata, 2017). The marine park area covers a range of habitats including:

- 532 corals species (including 11 endemic and sub endemic species)
- 350 reef fish species
- fifteen mangrove species representing nine mangrove families
- ten seagrass species
- deep-water seamounts, canyons and straits (migratory corridors) and large pelagic habitats
- migratory corridors and habitats for 14 whale species, seven dolphin's species, and dugong
- five sea turtle species (green, leatherback, olive ridley, loggerhead, and flatback)
- large marine fauna such as sharks, napoleon, parrotfish and groupers (Perdanahardja & Lionata, 2017).

12.3.2 Nino Konis Santana National Park

The Nino Konis Santana National Park, located at the eastern most point of Timor Island and including 58,600 ha of marine habitat (Da Silva, 2021; Pereira et al., 2013), it is intersected by the EMBA. As part of the Coral Triangle zone, an underwater area thought to contain the world's greatest diversity of coral and reef fish, studies have identified the area is home to at least 400 species of

coral and more than 500 fish species, with many more unidentified (dos Reis Martins, 2020; PEKA-UNESCO, 2014; Turak & DeVantier, 2012). Pelagic and demersal species including mackerel scads, snapper, white shrimp, and commercially important tuna species such as skipjack, yellowfin, bigeye, albacore, mackerel, bluefin, longtail and southern bluefin are also found in the area (dos Reis Martins, 2020; Pereira et al., 2013). There are six Marine Protected Areas and one dugong protection site within Timor-Leste's first national park.

13. Social, economic features

13.1 Energy Industry

A number of energy industry hold petroleum permits in and around the EMBA. The closest operational production facility and associated in-field subsea infrastructure to the OA is the Santos operated Bayu-Undan facility which lies within the EMBA. The associated subsea Bayu-Undan to Darwin gas pipeline also traverses the EMBA (Figure 13-1).

Petroleum retention leases and exploration permit leases within and near to the EMBA are currently held by various operators (and subsidiaries), including Bengal Energy Ltd, Carnarvon Energy Ltd, Woodside Energy Ltd, Shell Development (Australia) Pty Ltd, Eni Australia Limited, Inpex Icthys Pty Ltd, Finder No. 1 Pty Ltd, Jadestone Pty Ltd, Melbana Energy Pty Ltd, PTTEP Australia, Vulcan Exploration Pty Ltd and Timor Sea Oil & Gas Australia Pty Ltd.

13.2 Shipping

Commercial shipping traverses the EMBA with traffic generally concentrated along shipping channels associated with major State and Territory ports, or within transit routes used by supply vessels supporting offshore developments. The closest major commercial port to the EMBA is Darwin and the primary shipping channels within the EMBA are between Darwin and Southeast Asian ports. Darwin Port services both commercial and non-commercial vessels, including commercial ships carrying cargo and passengers, rig tenders, tankers and bulk-cargo vessels. In 2021–2022, there were 1,500 vessel calls to port.

While the Darwin Port remains the primary active port in the region, there is small-scale port activity to the south and east of the project area, at the Tiwi Islands. Port Melville is located on Melville Island and is situated on the Apsley Strait, immediately south of Barlow Point and the community of Pirlangimpi. Port Melville provides for the export of woodchips for Tiwi Plantations Corporation, and the shipment of equipment and supplied for other projects. The facility is capable of 24-hour operation, although most operations are undertaken during daylight hours. Most vessels enter and exit the Apsley Strait from its northern entrance. This is except for barges travelling between Darwin and Port Melville, which enter and exit the Apsley Strait from its southern entrance (Figure 13-2).

The Australian Maritime Safety Authority (AMSA) has established a network of shipping fairways off the north- west coast of Australia to manage traffic patterns. The Shipping Fairways are designed to keep shipping traffic away from offshore infrastructure and aim to reduce the risk of collision (AMSA, 2013).

Use of the fairways is strongly recommended but not mandatory. The International Regulations for Preventing Collisions at Sea 1972 apply to all vessels navigating within or outside the shipping fairways. The use of these fairways does not give vessels any special right of way (AMSA, 2012).

Under the Commonwealth Navigation Act 2012, certain vessels operating in Australian waters are required to report their location on a daily basis to the Rescue Coordination Centre (RCC) in Canberra. This Australian Ship Reporting System (AUSREP) is an integral part of the Australian Maritime Search and Rescue system and is operated by AMSA through the RCC.

13.3 Defence activities

The EMBA intersects parts of the North Australian Exercise Area (NAXA), a maritime military zone administered by the Department of Defence (Figure 13-3). The NAXA comprises practice and training areas and extends about 300 km offshore in two arcs east and west from Darwin into the Arafura Sea. The area is used for offshore naval exercise and onshore weapon-firing training.

The Australian Border Force also undertake civil and maritime surveillance (and enforcement) in Australian offshore maritime waters, which include the EEZ. During their surveillance, Australian Border Force vessels may transit the EMBA.

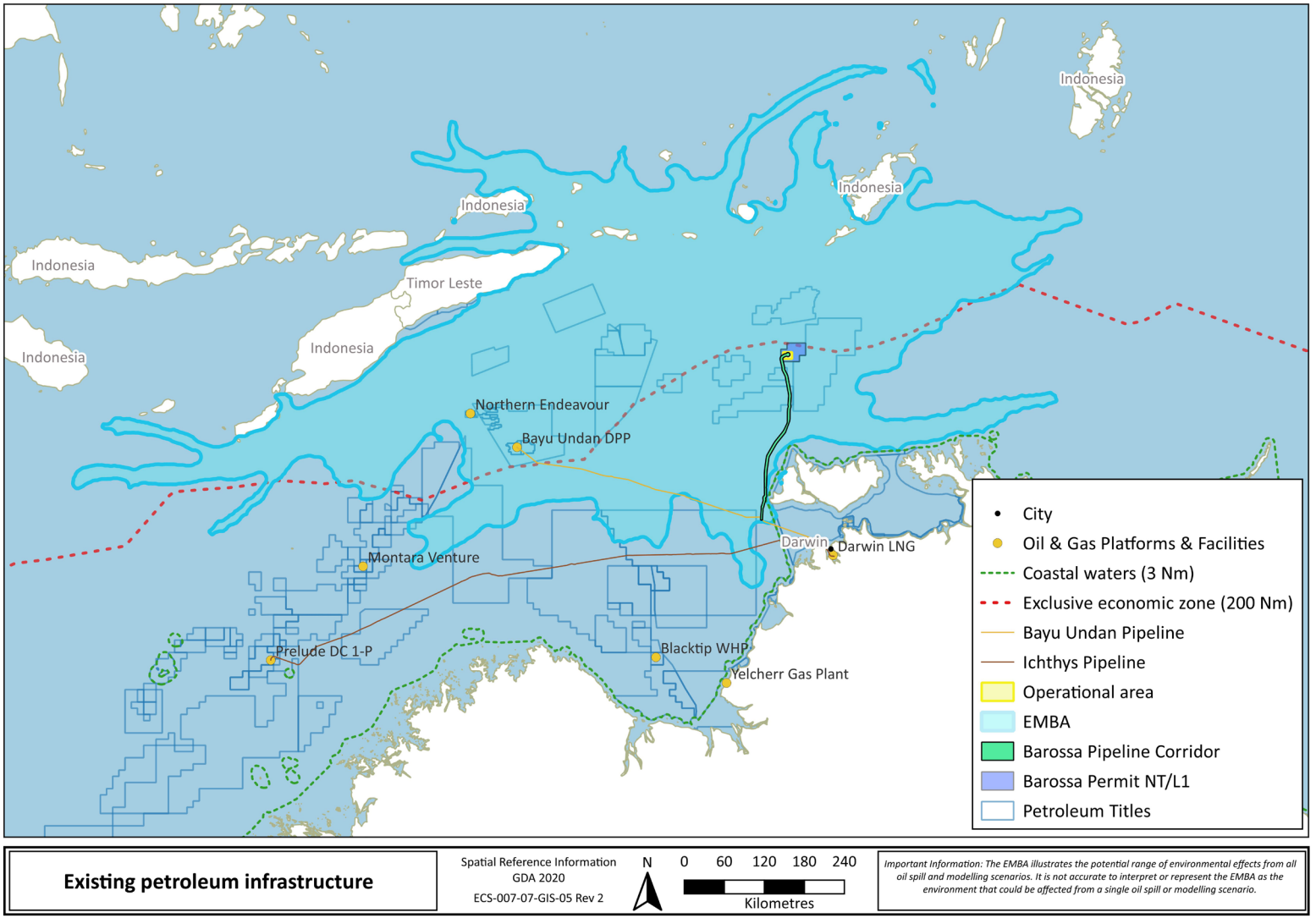


Figure 13-1: Existing Petroleum Infrastructure overlapping or proximal to the EMBA

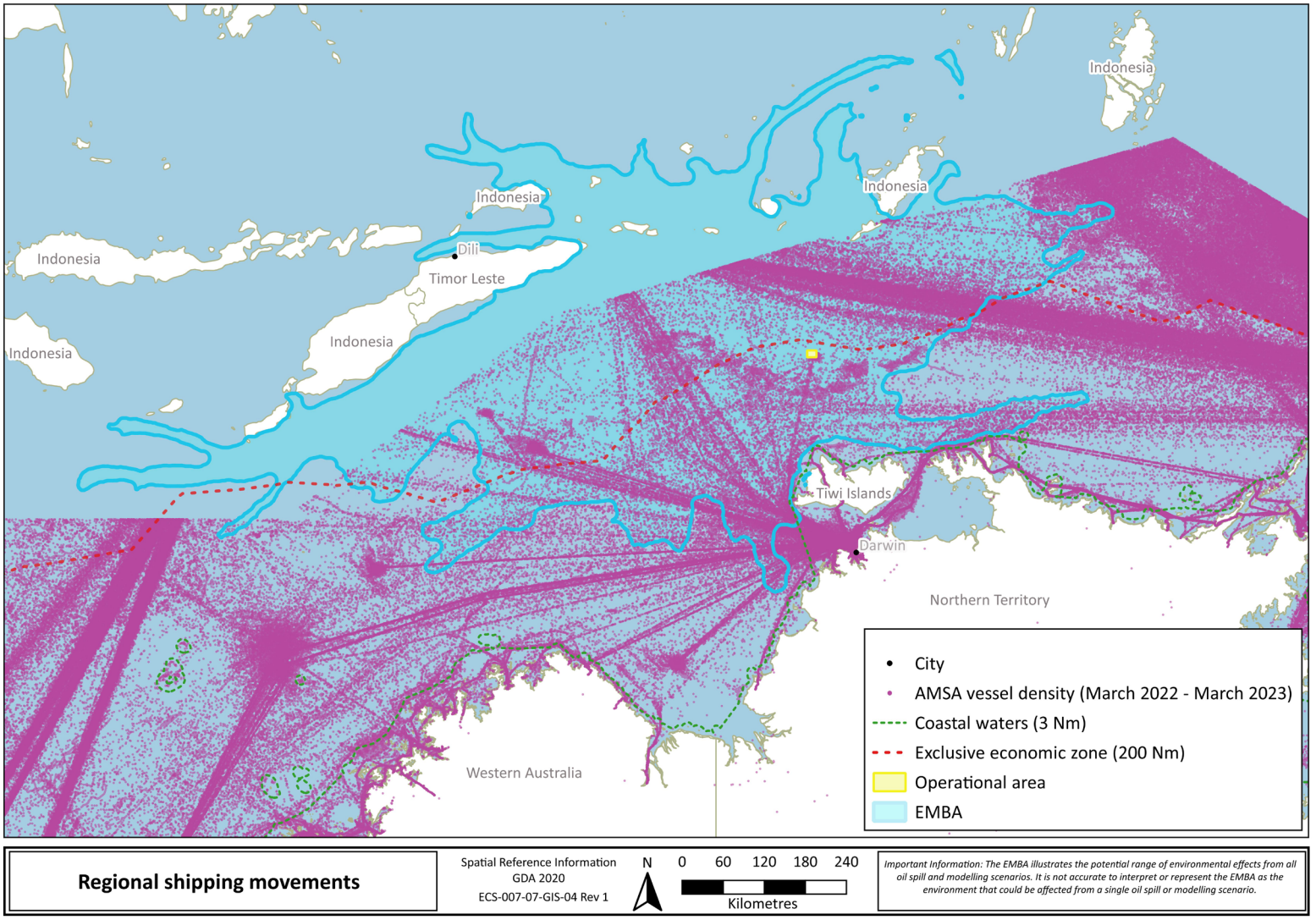


Figure 13-2: Regional Shipping overlapping of proximal to the EMBA

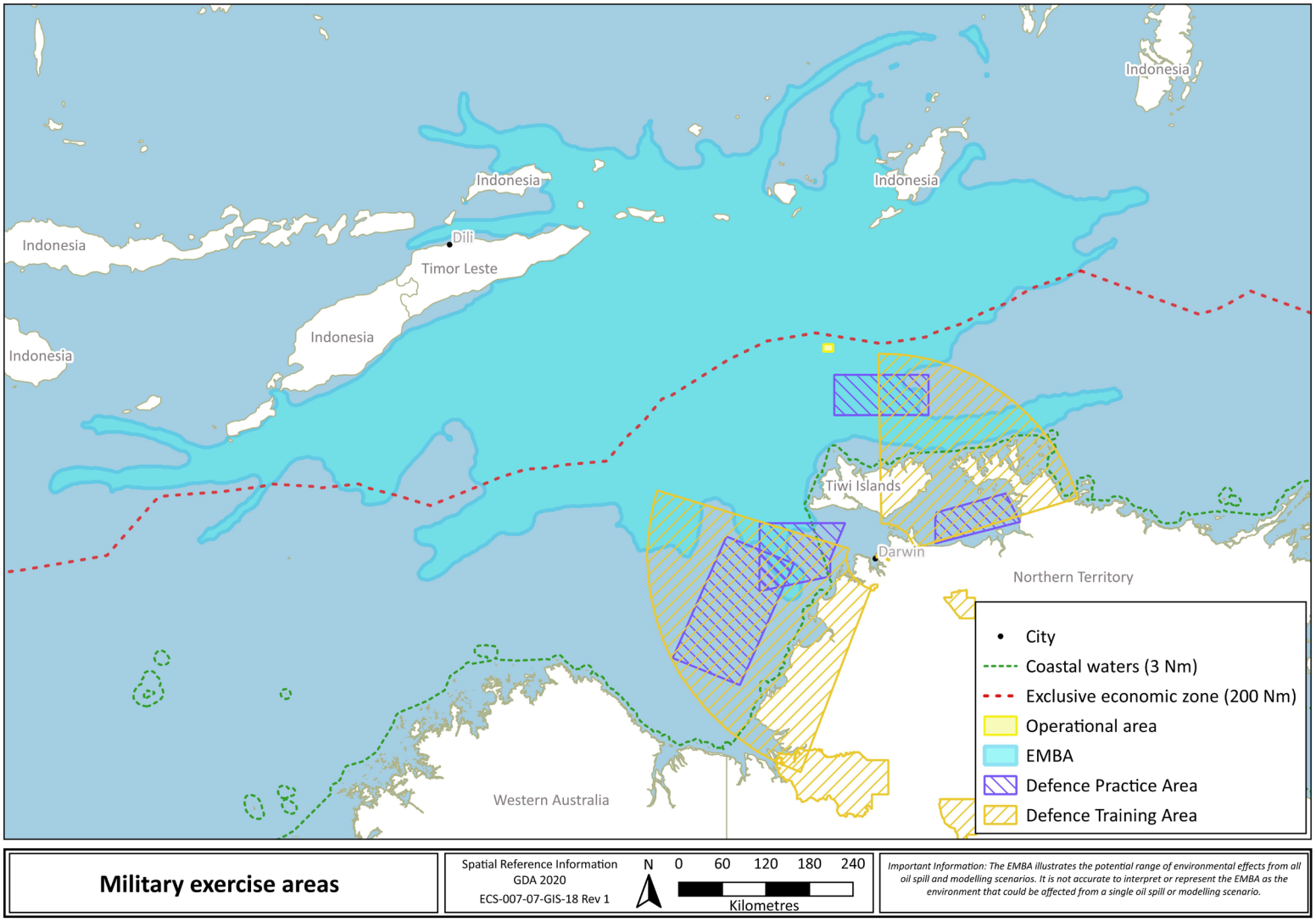


Figure 13-3: Defence training and exercise areas overlapping or proximal to the EMBA

13.4 Recreation and tourism

In NT there were 781,000 visitors for the purposes of tourism during the year ending September 2022 with a $1,332 million spend (NT Tourism, 2022).

In the NT, 95% of recreational fishing occurs in in areas <5 km from the coastline (outside of the EMBA), and offshore waters (may occur within the EMBA) (West et al., 2022). The peak fishing effort between October to December and April to June (West et al., 2022). Several shoals and banks in the EMBA may be visited by small numbers of recreational fishers/charter vessels targeting fish inhabiting these shallower offshore features.

Scuba diving, snorkelling, and charter vessels are also a tourist attraction, with operators visiting the numerous shipwrecks, coral reefs and artificial reefs and embarking on day or multiday trips out to offshore islands and shoals (such as Evans shoal ~67 km west of the OA) (INPEX Browse, 2010).

The Tiwi Islands are a popular tourist destination offering cruises, fishing, sailing and water tours among other cultural activities. Access and fishing are not permitted at the locations on the west coast of Bathurst Island that are intersected by the EMBA (Tiwi Land Council, 2023b). Tourism and recreational activities are likely to be more concentrated within coastal waters (outside of the EMBA), but activities such as deep-water fishing and diving around offshore shoals and reefs may potentially take place in the EMBA.

Indonesian and Timor-Leste-based marine tourism companies have advised that they also offer diving to areas predominantly close to shore. The majority occur off the northern coastlines, but some of these activities may occur in the EMBA..

13.5 Cultural heritage

13.5.1 Indigenous heritage

Indigenous Australians have a strong ongoing association with the coastal and marine environments and continue to rely on these areas and resources. The Tiwi Islands have a long history of occupancy by Aboriginal and Torres Strait Islander peoples and the marine areas, particularly in a southern portion of the Arafura Marine Park, there is an area identified (via Native Title determination) as sea country for Aboriginal and Torres Strait Islander peoples (outside of the EMBA) (DSEWPaC, 2012a; 2012b). Marine resource use such as fishing and hunting by Aboriginal and Torres Strait Islander peoples is generally restricted to coastal waters (outside of the EMBA). 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.

However, while direct use by Aboriginal and Torres Strait Islander peoples deeper offshore waters is limited, many groups continue to have a direct cultural interest in decisions affecting the management of these waters. The cultural connections Aboriginal and Torres Strait Islander peoples maintain with the sea may be affected, for example, by offshore fisheries and industries. In addition, some Indigenous people are involved in commercial activities such as fishing and marine tourism, so have an interest in how these industries are managed in offshore waters with respect to their cultural heritage and commercial interests (DEWHA, 2008c).

A mapping exercise was undertaken with the Tiwi Land Council to identify environmental and socioeconomic values along the Tiwi Islands coastline focused on the northern, western and southern coastlines of the Tiwi Islands and developed maps in consultation with the Tiwi People (ConocoPhillips, 2019). Through consultation, Santos identified the presence of one sacred site intersecting with the EMBA. All sacred sites in the NT are protected in accordance with the NTASS Act. There are no other recorded Aboriginal heritage sites under applicable Aboriginal heritage legislation within the EMBA. Under the Commonwealth *Underwater Cultural Heritage Act 2018* (UCH Act), if a First Nations underwater cultural heritage site is discovered in Commonwealth waters, it may be declared as protected under section 19 of the UCH Act (DCCEEW, 2023).

A detailed description of cultural features is provided in Section 3.2.5 of the SURF EP.

13.5.2 Non-Indigenous heritage

There are no known underwater cultural heritage sites within the OA. Multiple known shipwrecks, sunken aircraft, and historic (more than 75 years old) aircraft and shipwrecks and other sites occur within the EMBA (see Figure 13-4). Under the UCH Act, Australia's UCH (such as shipwrecks, sunken aircraft and other types) is automatically protected, whether or not their existence or location is known (DCCEEW, 2023).

In the Timor Sea there are 10 unlocated historic aircraft wrecks from the Second World War (associated with the Japanese and Australian air forces) and one unlocated modern Indonesian fishing vessel that sank in 1997 (Cosmos Archaeology, 2023). These historic aircraft wrecks are subject to automatic protection under the UCH Act and could fall within the boundaries of the EMBA.

A search of the Australian National Shipwrecks database (DCCEEW, 2023c) identified the following shipwrecks within or proximal to the EMBA:

- Florence D: a twin-screw steamer sunk in the Timor Sea in NT
- Drysdale: a sailing vessel sunk in the Admiralty Gulf Area in WA
- Julia: a sailing vessel sunk in the Admiralty Gulf Area in WA
- Marguerite: a sailing vessel sunk in the Admiralty Gulf Area in WA
- Paul Pry: a whale boat sunk in the Admiralty Gulf Area in WA
- Scalaria: an unknown type of vessel sunk in the Admiralty Gulf Area in WA
- Swan: a sailing vessel sunk in the Admiralty Gulf Area in WA
- Voladora: a sailing vessel sunk in the Admiralty Gulf Area in WA
- Wanderer II: a sailing vessel sunk in the Admiralty Gulf Area in WA
- Enchantress: a sailing vessel sunk in the Bonaparte Archipelago in WA
- John S. Lane: a sailing vessel sunk in the Cambridge Gulf Area in WA

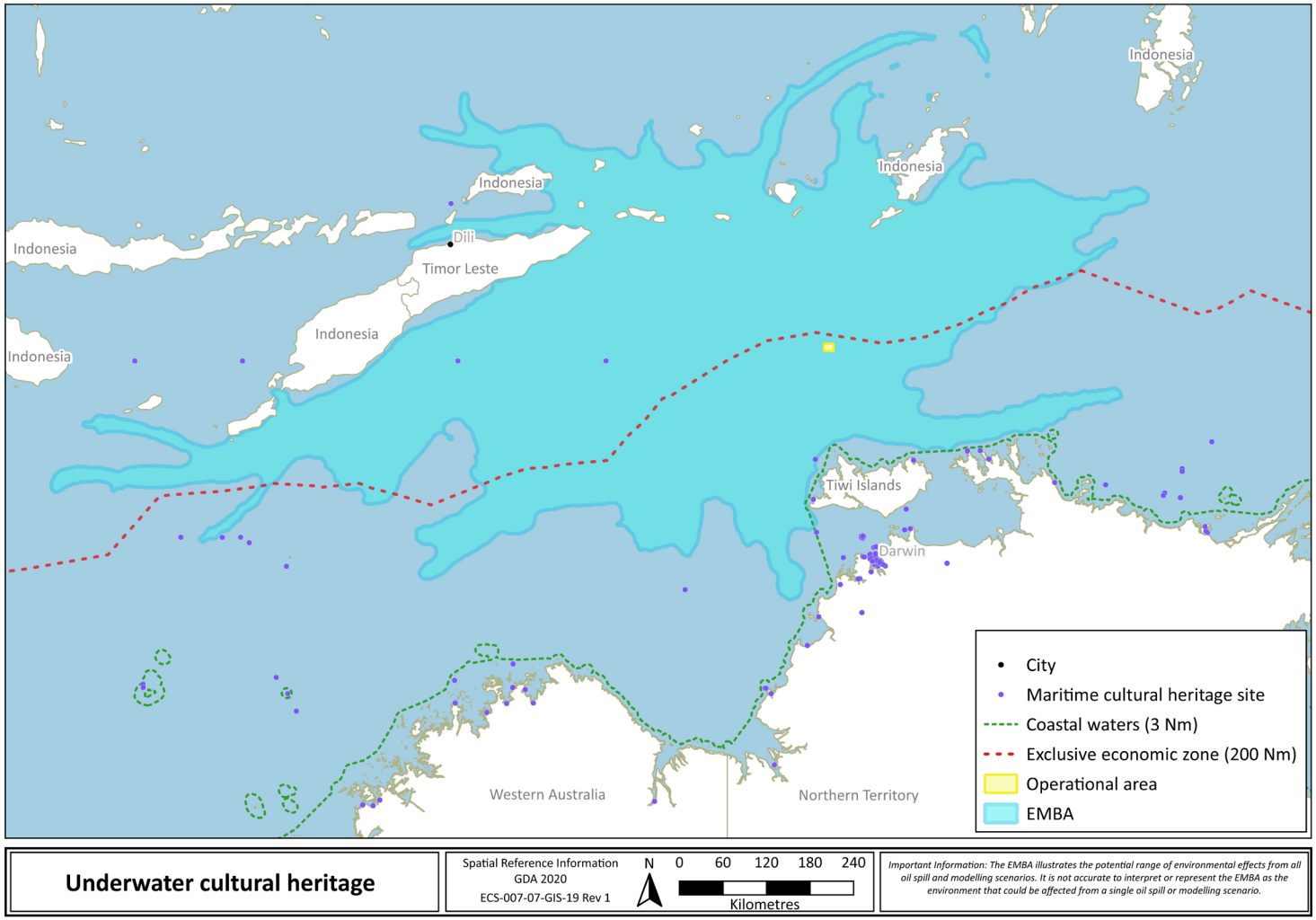


Figure 13-4: Underwater cultural heritage overlapping or proximal to the EMBA[1]

[1] One or multiple sites may occur at each identified maritime cultural heritage site location.

13.6 Commercial fisheries

The NWMR and NMR support Commonwealth and state (NT and WA) managed commercial fisheries. The Timor and Arafura seas support various shark, demersal and pelagic finfish and crustacean species of commercial importance.

The fisheries overlapping the EMBA are shown in Figure 13-5, Figure 13-6 and Figure 13-7, and Table 13-1 summarises Santos' understanding of commercial fishers and fishing effort.

Table 13-1: Commonwealth and state fisheries that overlap the OA and/or EMBA

Commercial fishery	Description
Commonwealth-managed	
Northern Prawn Fishery	**Area**: extends from Joseph Bonaparte Gulf across the top end to the Gulf of Carpentaria. Most of the Northern Prawn Fishery effort lies in the Gulf of Carpentaria, Joseph Bonaparte Gulf and along the Arnhem Land coast (DoA, 2014). **Gear**: trawl. **Key target species**: The key target species are banana prawns, tiger prawns and endeavour prawns. There are 2 fishing seasons—the season end date depends on catch rates: Season 1 (mainly banana prawns caught): 1 April to 15 June. Season 2 (mainly tiger prawns caught): 1 August to 30 November. Fishing for scampi also occurs in deeper waters, with fishing effort spread across 2–3 months of the year (December to February). **Effort** (2020): 52 active vessels; around 4,767 t (Patterson et. Al., 2021).
North-West Slope Trawl Fishery	**Area**: Operates off north-western Australia from 114°E to 125°E, roughly between the 200 m isobath and the outer boundary of the Australian Fishing Zone. A large area of the Australia–Indonesia MoU Box falls within the Northwest Shelf throughflow. **Gear**: demersal trawl. **Key target species**: scampi. **Effort** (2020): Six active vessels; around 111.5 t (Patterson et. Al., 2021).
Southern Bluefin Tuna Fishery	**Area**: The Southern Bluefin Tuna Fishery spans the Australian Fishing Zone. However, it is only active in waters off south and south-eastern Australia. **Gear**: purse seine and pelagic long line. **Key target species**: southern bluefin tuna. **Effort** (2020): 30 active vessels; around 5,429 t (Patterson et. Al., 2021).
Western Skipjack Tuna Fishery	**Area**: The Western Skipjack Tuna Fishery spans the Australian EEZ and adjacent high seas, from Cape York to the Victoria–South Australia border, including waters around Tasmania and the high seas of the Pacific Ocean. **Gear**: purse seine **Key target species**: skipjack tuna **Effort** (2020): None. There has been no fishing effort since the 2008–2009 season, and in that season, activity was concentrated off South Australia (Patterson et. Al., 2021).
Western Tuna and Billfish Fishery	**Area**: Operates in Australia's EEZ and high seas of the Indian Ocean. In recent years, fishing effort has concentrated off south-west WA, with occasional activity off South Australia. **Gear**: pelagic longline. **Key target species**: bigeye tuna, yellowfin tuna, striped marlin, swordfish. **Effort** (2020): 3 active vessels; around 161 t (Patterson et. Al., 2021).
NT-managed	
Aquarium Fishery	**Area**: Includes freshwater, estuarine and marine habitats to the outer boundary of the Australian Fishing Zone. Most marine species are collected within 100 km of Nhulunbuy and Darwin. A specimen shell collection

Commercial fishery	Description
	enterprise occurs around Ashmore Reef and Cartier Island (outside the EMBA). **Gear**: handheld, nets and pots (dive-based). **Key target species**: fish, invertebrates and plants for aquariums. **Effort**: unknown – no restriction on number of licences (NT Government, 2023).
Spanish Mackerel Fishery	**Area**: Commercial fishing for Spanish mackerel is allowed from the high-water mark to the outer boundary of the Australian Fishing Zone, which is 200 Nm offshore. Most fishing effort occurs near reefs, headlands and shoals and includes waters near Bathurst Island, New Year Island, northern and western Groote Eylandt, the Gove Peninsula, the Wessel Islands, the Sir Edward Pellew Group and suitable fishing grounds on the western and eastern mainland coasts. Fishing generally takes place around reefs, headlands and shoals. **Gear**: trolling, handline. **Key target species**: Spanish mackerel. **Effort**: 15 licences allowed (NT Government, 2023).
Timor Reef Fishery	**Area**: The Timor Box extends north-west of Darwin to the WA/NT border and to the outer boundary of the Australian Fishing Zone. The fishery has an area of approximately 15,000 km^2 (NT Government, 2022). Fishing occurs primarily in waters 100–200 m deep (OA water depths are 227–269 m). Previous consultation indicates that the main target species is goldband snapper, with other tropical snappers (e.g., crimson and saddletail snapper) also making up part of the catch; main fishing method is trap fishing; fishery is most productive between October and May, with less activity during the dry season months of June–August due to strong northerly winds. Due to the water depth and based on a review of available historical catch data, fishing activity has been reported within the OA. **Gear**: line and trap. **Key target species**: snapper, red emperor, seabream and cods. **Effort**: 15 licences allowed; 2 active licences (NT Government, 2023).
Offshore Net and Line Fishery	**Area**: Operates in NT waters from the low water mark to the boundary of the Australian Fishing Zone. Most fishing is done in the coastal zone within 12 Nm of the coast, and immediately offshore in the Gulf of Carpentaria. The fishery has an area of approximately 522,000 km^2. **Gear**: longlines or pelagic nets (there are restrictions on where certain gear can be used). **Key target species**: blacktip sharks, grey mackerel. **Effort**: Unknown – no restriction on number of licences (NT Government, 2023).
Pearl Oyster Fishery	**Area**: The fishery extends from the high-water mark in NT waters to the outer boundary of the Australian Fishing Zone, 200 nautical miles offshore in Commonwealth waters. All current activity occurs in NT waters within 12 nautical miles of the mainland. There are five active fishing licence holders currently operating in the fishery which can be active throughout the year. **Gear:** farming by hand only.

Commercial fishery	Description
	Effort: 5 licences allowed.
Demersal Fishery	**Area**: Demersal fishing is allowed from 15 nautical miles to the outer boundary of the Australian Fishing Zone, excluding the area of the Timor Reef Fishery. **Gear**: lines, fish traps and semi-demersal trawl nets. **Key target species**: snapper (various species). **Effort**: Unknown – 18 licences currently issued (NT Government, 2023).
Coastal Line Fishery	**Area**: Fishery is allowed from the high-water mark to 15 nautical miles seaward of the coast. **Gear**: lines, hooks, cast nets, scoop nets or gaffs. **Key target species**: black jewfish and golden snapper **Effort**: 52 licences currently issued. (NT Government, 2023).
WA-managed	
Mackerel Managed Fishery	**Area**: Commercially fished between Geraldton and the WA/NT border. **Gear**: trolling. **Key target species**: Spanish mackerel. **Effort** (2021): 16 active vessels; total catch: 238 t (Newman et al., 2023).
Northern Demersal Scalefish Managed Fishery	**Area**: Operates off WA's coast in waters east of 120°E longitude. **Gear**: handline, dropline and fish traps, although the fishery has essentially operated as a trap-based fishery since 2002. **Key target species**: goldband snapper and red emperor. **Effort (2021):** active vessels: (unknown); total catch: 1,544 t (Newman et al., 2023).
Southwest Coast Salmon Fishery	**Area**: Perth metropolitan area extending to Cape Beaufort (WA/NT border). No fishing takes place north of the Perth metropolitan area. **Gear**: beach seine nets. **Key target species**: Western Australian salmon. **Effort**: 6 licences (DPIF, 2019); No catch data was provided for the 2021 to 2022 reporting period (Newman et al., 2023).
Abalone Fishery	**Area**: Operates in all WA waters (between the NT and SA borders). **Gear**: unknown. **Key target species**: abalone. **Effort** (2020): 0 diver days; total catch 0 t. Closed since 2012 due to environmentally induced mortality (Newman et al., 2021).
Kimberley Crab Fishery	**Area**: Operates off the north-west coast of WA in WA waters. Fishing effort is concentrated in nearshore waters. **Gear**: crab traps. **Key target species**: green and brown mud crab. **Effort** (2021): effort occurring between April and September with a catch of 0.8 t (Newman et al., 2023).
Kimberley Prawn Fishery	**Area**: Operates off the north-west coast of WA in WA waters east of 123°45'E longitude and west of 126°58'E longitude. **Gear**: unknown. **Key target species**: prawn.

Commercial fishery	Description
	Effort (2021): 203.9 t (Newman et al., 2023)
Marine Aquarium Fishery	**Area**: Operates in all WA waters (between the NT and SA borders). Typically more active in waters south of Broome with higher levels of effort around the Capes region of south-west WA, Perth, Geraldton, Exmouth, Dampier and Broome. **Gear**: unknown. **Key target species**: coral, live rock, algae, seagrass and invertebrates. **Effort** (2021): 12 licences; total catch: 92,227 fishes, 27.97 t of coral, live rock & living sand and 42 L of plants and live feed. (Newman et al., 2023).
Specimen Shell Fishery	**Area**: Operates in all WA waters (between the NT and South Australian borders) **Gear**: unknown. **Key target species**: cowries, cones, murexes and volutes. **Effort** (2021): 30 licences; total catch: 5,443 shells (Newman et al., 2023).
West Coast Deep Sea Crustacean Fishery	**Area**: Operates primarily in the Gascoyne bioregion in WA. **Gear**: unknown. **Key target species**: champagne, giant and crystal crab. **Effort** (2021): 155.5 t (Newman et al., 2023).

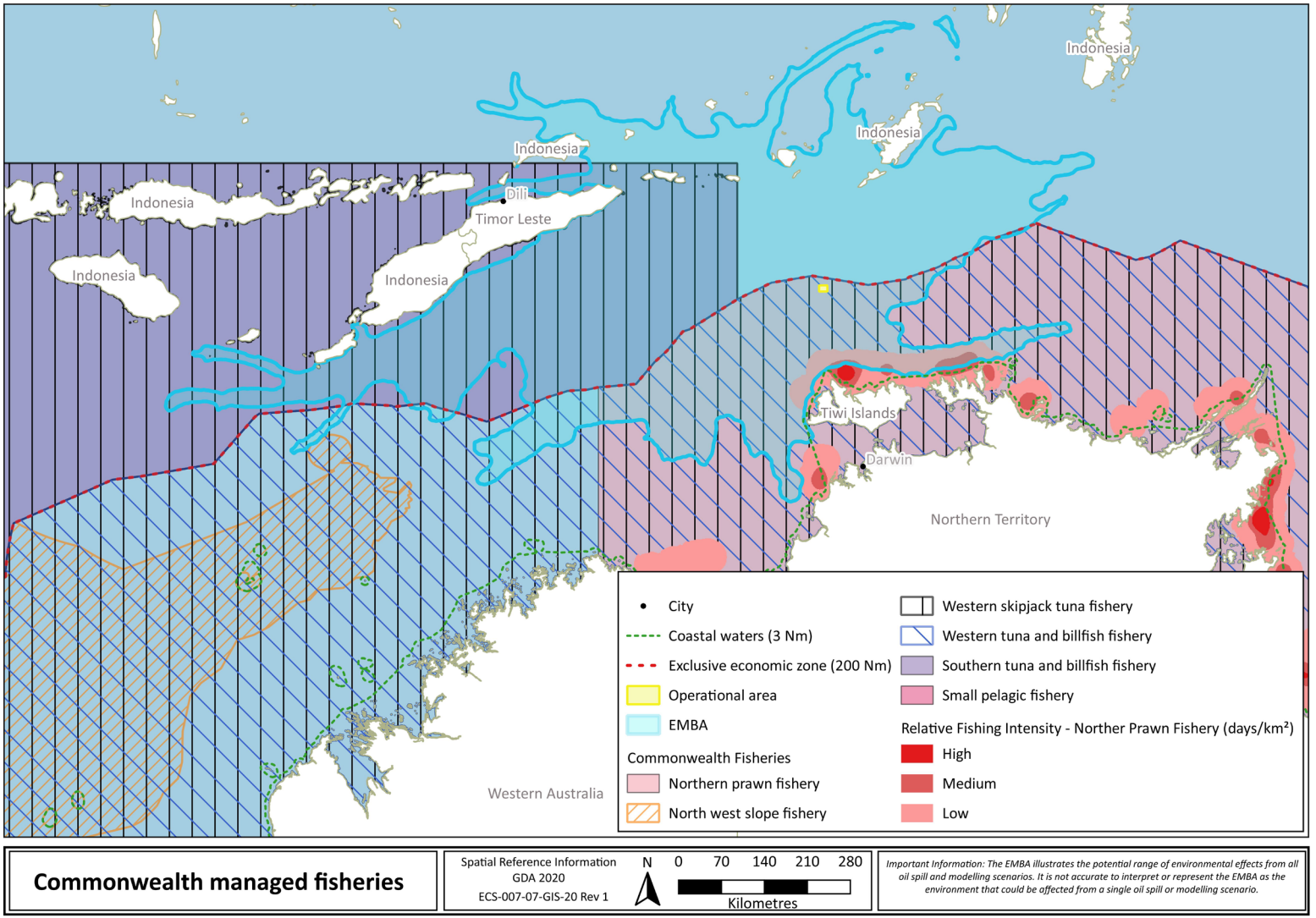


Figure 13-5: Commonwealth-managed fisheries overlapping or proximal to the EMBA

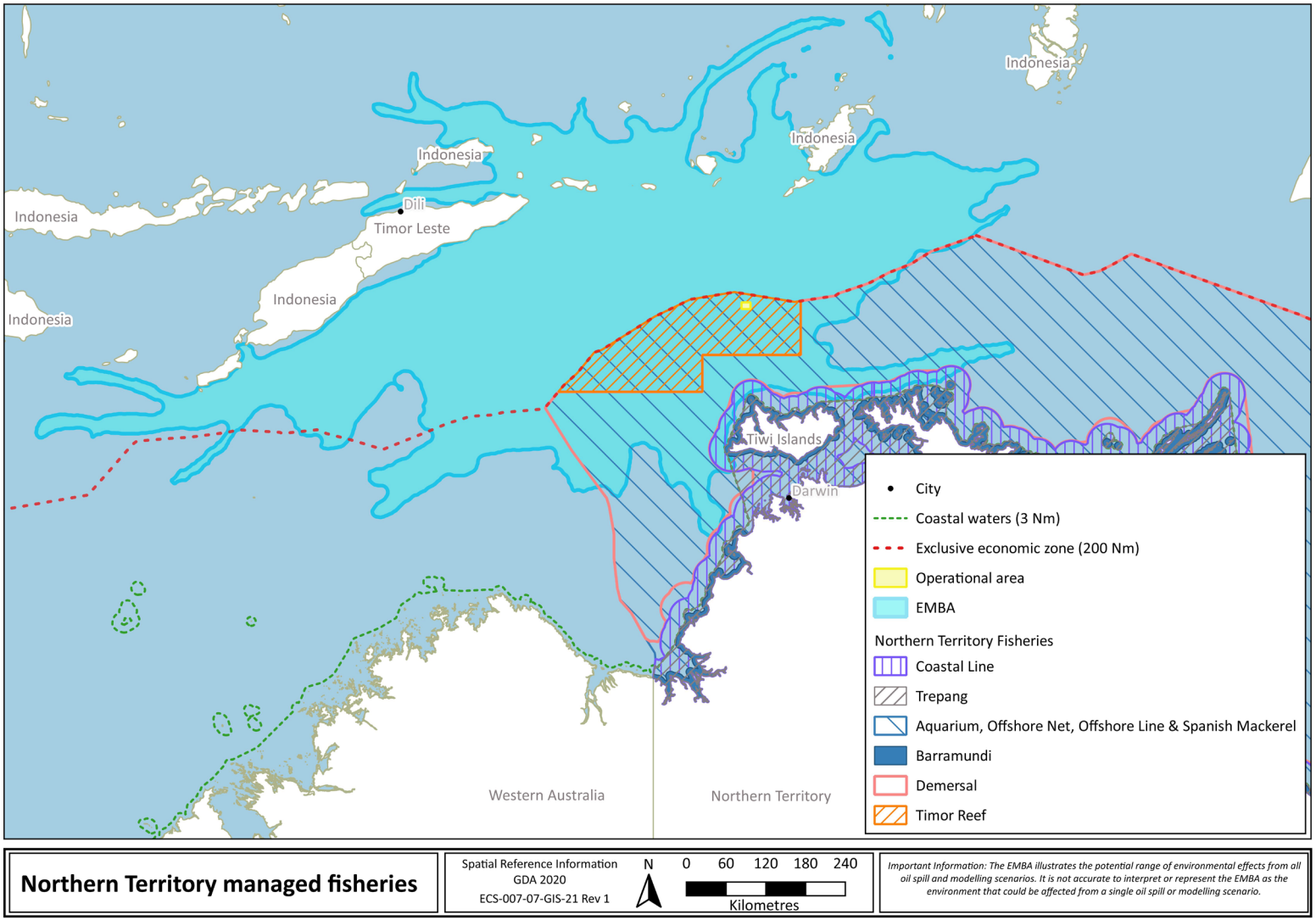


Figure 13-6: Northern Territory managed fisheries overlapping or proximal to the EMBA

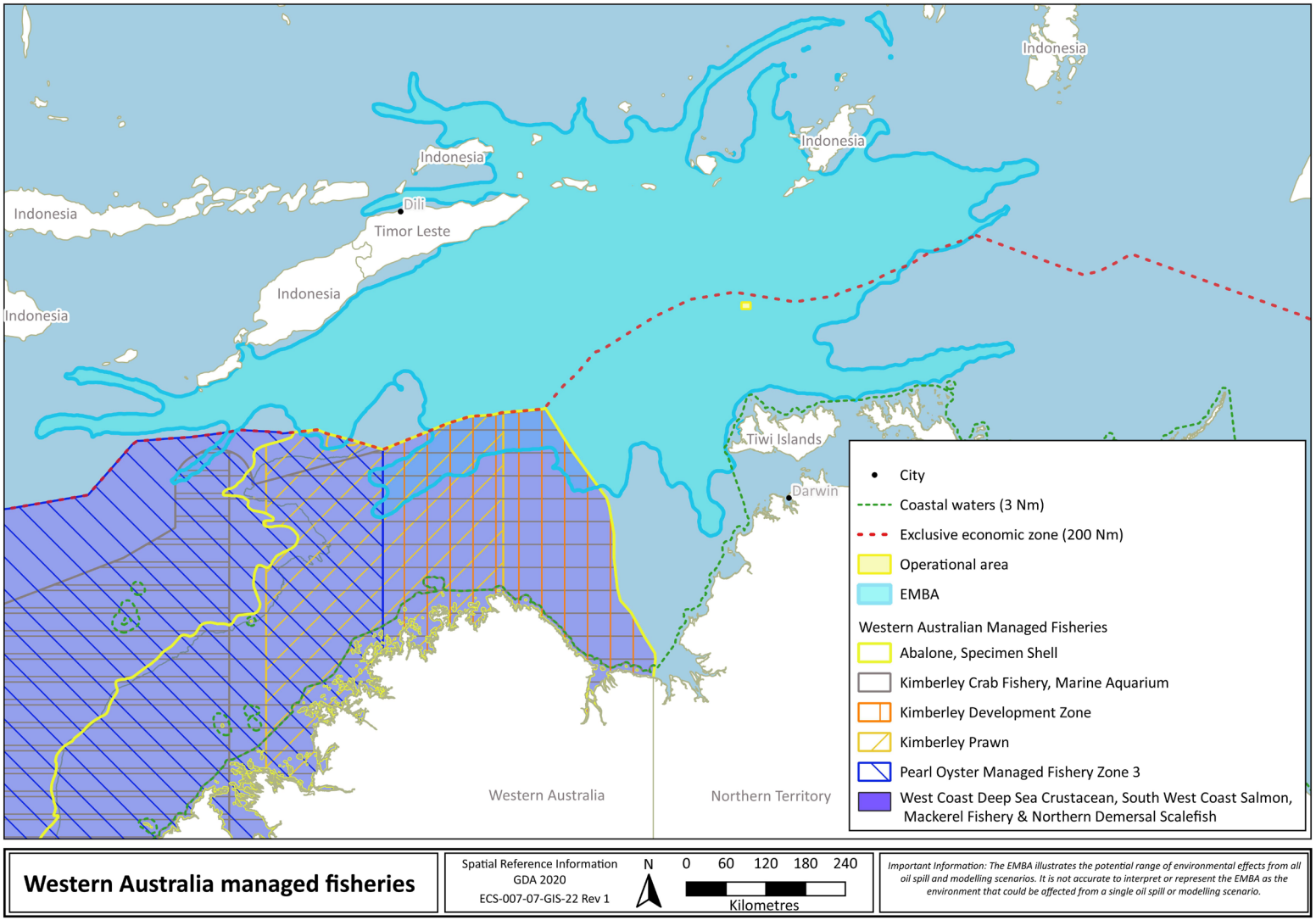


Figure 13-7: Western Australian managed fisheries overlapping or proximal to the EMBA

13.7 Indonesian and Timorese commercial and subsistence fishing

Within Commonwealth waters, there are shoals within the EMBA, so these subsistence fishers may fish in the EMBA or transit the EMBA to reach a fishing location outside of the EMBA such as Ashmore Reef, approximately 800 km south-west of the OA. Fishing occurs from April to December, with most activity occurring in September and October. The Big Bank Shoals are in the Indonesian EEZ, and Indonesian commercial vessels may fish in and around these shoals (Heyward et al., 1997).

An MoU between the Australian and Indonesian governments, officially known as the Australia–Indonesia Memorandum of Understanding on the Operations of Indonesian Traditional Fishermen in Areas of the Australian Fishing Zone and Continental Shelf – 1974, exists to:

'provide the framework for fisheries and marine cooperation between Australia and Indonesia, and facilitates information exchange on research, management and technological developments, complementary management of shared stocks, training and technical exchanges, aquaculture development, trade promotion and cooperation to deter illegal fishing.' (Department of Agriculture, Water and the Environment [DAWE], 2020b)

The MoU enables subsistence fishing to occur within sections of the Australian EEZ (outside of the EMBA).

The EMBA intersects the jurisdiction established in an Agreement between the Government of the Commonwealth of Australia and the Government of the Republic of Indonesia establishing Certain Seabed Boundaries (1971) and the Seabed Boundaries Agreement between the Commonwealth of Australia and the Republic of Indonesia on Seabed Boundaries in the Area of the Timor and Arafura Seas (1972). Each of these Agreements, together with the MOU, was affirmed by the Treaty between the Government of Australia and the Government of the Republic of Indonesia establishing an Exclusive Economic Zone Boundary and Certain Seabed Boundaries (Perth, 14 March 1997) (Perth Treaty). This area is commonly referred to as the Perth Treaty Area. When this treaty is ratified, Australia will have jurisdiction over the seabed and Indonesia will have jurisdiction over the water column within the Perth Treaty Area. The treaty permits Indonesian fishing by both traditional and modern vessels. Although not yet ratified, Santos understands that the Perth Treaty is generally observed. Traditional owner fishing, hunting and gathering

Almost all traditional fishing effort (93%) in NT waters is concentrated within coastal waters (up to 3 Nm) of the NT coastline and Tiwi Islands (outside of the EMBA) (NT Government, 2017). Tiwi People continue to undertake the customary harvesting of sea turtles and dugongs. Green turtles are the main species harvested in the water, while eggs of all turtle species are taken periodically. Dugongs are also taken occasionally (Tiwi Land Council, 2022).

Sensitivity mapping carried out with the Tiwi (ConocoPhillips, 2019) indicated that traditional fishing and other sustenance activities occur within the coastal waters of the Tiwi Islands includes fishing, hunting (turtles and dugongs) and gathering (turtle eggs). In terms of fishing tour operators, the key target species in the vicinity of the Tiwi Islands has traditionally been barramundi (DPIF, 2014).

13.8 Aquaculture

A range of aquacultural production systems are used Seaweed farming occurs off the Indonesian and Timor-Leste coastlines to produce a range of species including seaweed, fish and shrimp.

14. Document review

In the event that a revision to the accepted SURF EP is required, this document will be reviewed. The review and revision will consider any changes to the values and sensitivities associated with the Barossa development as well as any changes to EPBC Act Matters of National Environmental Significance (MNES). A review of changes to MNES shall consider any changes to the EPBC Act species lists, species management/recovery plans and MNES spatial layers.

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Appendix A Protected Matters Search Tool

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. Please see the caveat for interpretation of information provided here.

Report created: 26-Jun-2023

Summary

Matters of National Environment 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 (Ramsar	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	5
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	47
Listed Migratory Species:	56

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 https://www.dcceew.gov.au/parks-heritage/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 Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	98
Whales and Other Cetaceans:	27
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	7
Habitat Critical to the Survival of Marine Turtles:	5

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	1
Regional Forest Agreements:	None
Nationally Important Wetlands:	1
EPBC Act Referrals:	71
Key Ecological Features (Marine):	7
Biologically Important Areas:	26
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar Wetlands)	[Resource Information]
Ramsar Site Name	Proximity
Ashmore reef national nature reserve	Within 10km of 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 a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name
EEZ and Territorial Sea
Extended Continental Shelf
Extended Continental Shelf
Extended Continental Shelf
Extended Continental Shelf

Listed Threatened Species	[Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text
BIRD		
Anous tenuirostris melanops		
Australian Lesser Noddy [26000]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat likely to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Endangered	Species or species habitat likely to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area
Geophaps smithii smithii Partridge Pigeon (eastern) [64441]	Vulnerable	Species or species habitat likely to occur within area
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat may occur within area
Melanodryas cucullata melvillensis Tiwi Islands Hooded Robin, Hooded Robin (Tiwi Islands) [67092]	Critically Endangered	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely 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
Tyto novaehollandiae melvillensis Tiwi Masked Owl, Tiwi Islands Masked Owl [26049]	Endangered	Species or species habitat known to occur within area
FISH		
Thunnus maccoyii Southern Bluefin Tuna [69402]	Conservation Dependent	Breeding known to occur within area
MAMMAL		

Scientific Name	Threatened Category	Presence Text
Antechinus bellus Fawn Antechinus [344]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Conilurus penicillatus Brush-tailed Rabbit-rat, Brush-tailed Tree-rat, Pakooma [132]	Vulnerable	Species or species habitat known to occur within area
Phascogale pirata Northern Brush-tailed Phascogale [82954]	Vulnerable	Species or species habitat likely to occur within area
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheath-tailed Bat, Bare-rumped Sheathtail Bat [66889]	Vulnerable	Species or species habitat may occur within area
Sminthopsis butleri Butler's Dunnart [302]	Vulnerable	Species or species habitat known to occur within area
Trichosurus vulpecula arnhemensis Northern Brushtail Possum [83091]	Vulnerable	Species or species habitat known to occur within area
Xeromys myoides Water Mouse, False Water Rat, Yirrkoo [66]	Vulnerable	Species or species habitat likely to occur within area
PLANT		
Burmannia sp. Bathurst Island (R.Fensham 1021) [82017]	Endangered	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Elaeocarpus miegei [65147]	Endangered	Species or species habitat may occur within area
Tarennoidea wallichii [65173]	Endangered	Species or species habitat likely to occur within area
Typhonium jonesii a herb [62412]	Endangered	Species or species habitat likely to occur within area
Typhonium mirabile a herb [79227]	Endangered	Species or species habitat likely to occur within area
Xylopia monosperma a shrub [82030]	Endangered	Species or species habitat likely to occur within area
REPTILE		
Acanthophis hawkei Plains Death Adder [83821]	Vulnerable	Species or species habitat may occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Congregation or aggregation known to occur within area

Scientific Name	Threatened Category	Presence Text
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	Breeding known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
SHARK		
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
Glyphis glyphis Speartooth Shark [82453]	Critically 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 likely 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
Sphyrna lewini Scalloped Hammerhead [85267]	Conservation Dependent	Species or species habitat known to occur within area

Listed Migratory Species [Resource Information]

Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Foraging, feeding or related behaviour known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat likely to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Species or species habitat likely to occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Sternula albifrons Little Tern [82849]		Congregation or aggregation known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
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 area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Congregation or aggregation known to occur within area
Dugong dugon Dugong [28]		Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
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	Breeding known to occur within area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area
Mobula alfredi as Manta alfredi Reef Manta Ray, Coastal Manta Ray [90033]		Species or species habitat likely to occur within area
Mobula birostris as Manta birostris Giant Manta Ray [90034]		Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Orcaella heinsohni Australian Snubfin Dolphin [81322]		Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
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 likely to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sousa sahulensis as Sousa chinensis Australian Humpback Dolphin [87942]		Species or species habitat known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to 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 may occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Acrocephalus orientalis Oriental Reed-Warbler [59570]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to 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 likely to 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
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
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 likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Thalasseus bergii		
Greater Crested Tern [83000]		Breeding likely to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Bird		
Acrocephalus orientalis		
Oriental Reed-Warbler [59570]		Species or species habitat may occur within area overfly marine area
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus		
Common Noddy [825]		Foraging, feeding or related behaviour known to occur within area
Anous tenuirostris melanops		
Australian Lesser Noddy [26000]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area
Bubulcus ibis as Ardea ibis		
Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
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 likely to occur within area overfly marine area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Cecropis daurica as Hirundo daurica Red-rumped Swallow [80610]		Species or species habitat may occur within area overfly marine area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area overfly marine 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 likely to occur within area

Scientific Name	Threatened Category	Presence Text
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area overfly marine area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area overfly marine area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Species or species habitat likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Rostratula australis as Rostratula benghalensis (sensu lato)		
Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area overfly marine area
Sterna dougallii		
Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Sternula albifrons as Sterna albifrons		
Little Tern [82849]		Congregation or aggregation 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
Thalasseus bengalensis as Sterna bengalensis		
Lesser Crested Tern [66546]		Breeding known to occur within area
Thalasseus bergii as Sterna bergii		
Greater Crested Tern [83000]		Breeding likely to occur within area
Fish		
Bhanotia fasciolata		
Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Campichthys tricarinatus		
Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma		
Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys suillus		
Pig-snouted Pipefish [66198]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
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 haematopterus Reef-top Pipefish [66201]		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
Festucalex cinctus Girdled Pipefish [66214]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
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 cyanospilos Blue-speckled Pipefish, Blue-spotted Pipefish [66228]		Species or species habitat may occur within area
Hippichthys parvicarinatus Short-keel Pipefish, Short-keeled Pipefish [66230]		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

Scientific Name	Threatened Category	Presence Text
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
Mammal		
Dugong dugon Dugong [28]		Species or species habitat known to occur within area
Reptile		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
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 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	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Chitulia inornata as Hydrophis inornatus Plain Seasnake [87379]		Species or species habitat may occur within area
Chitulia ornata as Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [87377]		Species or species habitat may 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	Congregation or aggregation known to occur within area

Scientific Name	Threatened Category	Presence Text
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 elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis macdowelli as Hydrophis mcdowelli Small-headed Seasnake [75601]		Species or species habitat may occur within area
Lapemis curtus as Lapemis hardwickii Spine-bellied Seasnake [83554]		Species or species habitat may occur within area
Leioselasma coggeri as Hydrophis coggeri Black-headed Sea Snake, Slender-necked Seasnake [87373]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Leioselasma czeblukovi as Hydrophis czeblukovi		
Fine-spined Seasnake, Geometrical Seasnake [87374]		Species or species habitat may occur within area
Leioselasma pacifica as Hydrophis pacificus		
Large-headed Seasnake, Pacific Seasnake [87378]		Species or species habitat may occur within area
Lepidochelys olivacea		
Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Parahydrophis mertoni		
Northern Mangrove Seasnake [1090]		Species or species habitat may occur within area
Pelamis platurus		
Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and Other Cetaceans		[Resource Information]
Current Scientific Name	Status	Type of Presence
Mammal		
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

Current Scientific Name	Status	Type of Presence
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 sima Dwarf Sperm Whale [85043]		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]		Species or species habitat likely to occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Orcaella heinsohni Australian Snubfin Dolphin [81322]		Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area

Current Scientific Name	Status	Type of Presence
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Sousa sahulensis Australian Humpback Dolphin [87942]		Species or species habitat known 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 known to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Australian Marine Parks	[Resource Information]
Park Name	Zone & IUCN Categories
Oceanic Shoals	Habitat Protection Zone (IUCN IV)
Arafura	Multiple Use Zone (IUCN VI)
Oceanic Shoals	Multiple Use Zone (IUCN VI)
Oceanic Shoals	Multiple Use Zone (IUCN VI)
Oceanic Shoals	National Park Zone (IUCN II)
Arafura	Special Purpose Zone (Trawl) (IUCN VI)
Oceanic Shoals	Special Purpose Zone (Trawl) (IUCN VI)

Habitat Critical to the Survival of Marine Turtles		
Scientific Name	Behaviour	Presence
Aug - Sep		
Natator depressus		
Flatback Turtle [59257]	Nesting	Known to occur
Dec - Jan		
Chelonia mydas		
Green Turtle [1765]	Nesting	Known to occur
Dermochelys coriacea		
Leatherback Turtle [1768]	Nesting	Known to occur
May - Jul		
Lepidochelys olivacea		
Olive Ridley Turtle [1767]	Nesting	Known to occur
Nov - May		
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Nesting	Known to occur

Extra Information

State and Territory Reserves		[Resource Information]
Protected Area Name	Reserve Type	State
Garig Gunak Barlu	Marine Park	NT

Nationally Important Wetlands	[Resource Information]
Wetland Name	State
Cobourg Peninsula System	NT

EPBC Act Referrals			[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status
Darwin Pipeline Duplication (DPD) Project	2022/09372		Assessment
Northern Endeavour Phase 1 Decommissioning	2022/09327		Approval
Controlled action			
Audacious Oil Field Standalone Development	2001/407	Controlled Action	Completed
Decommissioning of Buffalo Oil Field	2003/984	Controlled Action	Post-Approval
Floating Liquefied Natural Gas facility	2001/533	Controlled Action	Completed
Hardwood Plantation	2001/229	Controlled Action	Post-Approval
Ichthys Gas Field, Offshore and onshore processing facilities and subsea pipeline	2008/4208	Controlled Action	Post-Approval
PTTEP AA Floating LNG Facility	2011/6025	Controlled Action	Completed
Tassie Shoal Gas Reforming and Methanol Production Plants - NT/P48	2000/108	Controlled Action	Post-Approval
Tassie Shoal LNG Project	2003/1067	Controlled Action	Post-Approval
Not controlled action			
Audacious-3 oil drilling well	2003/1042	Not Controlled Action	Completed
Backpacker-1 Offshore Hydrocarbon Exploration Well	2001/300	Not Controlled Action	Completed
Barossa-1 (NT/P69), Caldita-2 (NT/P61) exploration wells	2006/2793	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Buffalo In-Fill Production Wells	2001/475	Not Controlled Action	Completed
Caldita-1 Hydrocarbon Exploration Well, NT/P61	2004/1854	Not Controlled Action	Completed
Construction and operation of Radar Infrastructure	2004/1406	Not Controlled Action	Completed
Controlled Source Electromagnetic 2D Survey	2009/4980	Not Controlled Action	Completed
Controlled Source Electromagnetic Survey	2010/5434	Not Controlled Action	Completed
Drilling of exploration well Audacious-1 in AC/P17	2000/5	Not Controlled Action	Completed
Exploration Drilling in AC/P17, AC/P18 and AC/P24	2001/359	Not Controlled Action	Completed
Geo-scientific survey	2005/2004	Not Controlled Action	Completed
Marine Survey for the Australia-ASEAN Power Link AAPL	2020/8714	Not Controlled Action	Completed
NT/P68 2007 Two Well Drilling Program	2007/3569	Not Controlled Action	Completed
Woodside Geotechnical Investigation Sunrise Bank	2000/13	Not Controlled Action	Completed
Not controlled action (particular manner)			
2D and 3D Seismic Survey	2011/6197	Not Controlled Action (Particular Manner)	Post-Approval
2D and 3D Seismic Survey WA-405-P	2008/4133	Not Controlled Action (Particular Manner)	Post-Approval
2D and 3D Seismic Survey WA-405-P	2009/5104	Not Controlled Action (Particular Manner)	Post-Approval
2D Marine Seismic Survey	2009/4728	Not Controlled Action (Particular Manner)	Post-Approval
2D marine seismic survey of Braveheart,Kurrajong,Sunshine and Crocodile	2006/2917	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
2D or 3D Marine Seismic Survey in Petroleum Permit Area AC/P35	2009/4864	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic survey	2009/5076	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic Survey - Petroleum Exploration Area NT/P68, Eastern Bonaparte Basin	2006/2922	Not Controlled Action (Particular Manner)	Post-Approval
3D Seismic Survey	2006/2729	Not Controlled Action (Particular Manner)	Post-Approval
3D Seismic Survey, petroleum exploration permit AC/P33	2006/2918	Not Controlled Action (Particular Manner)	Post-Approval
3D Seismic Survey (NT/P68)	2008/4121	Not Controlled Action (Particular Manner)	Post-Approval
3D Seismic Survey (NT/P68)	2006/2980	Not Controlled Action (Particular Manner)	Post-Approval
3D seismic survey of AC/P4, AC/P17 and AC/P24	2006/2857	Not Controlled Action (Particular Manner)	Post-Approval
3D Seismic Survey WA-406-P Bonaparte Basin	2007/3904	Not Controlled Action (Particular Manner)	Post-Approval
Auralandia 3D marine seismic survey	2011/5961	Not Controlled Action (Particular Manner)	Post-Approval
Bonaparte 2D & 3D marine seismic survey	2011/5962	Not Controlled Action (Particular Manner)	Post-Approval
Bonaparte 3D & 2D Seismic Survey, in NT/P82, Timor Sea	2012/6398	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
Bonaparte Basin Barossa Appraisal Drilling Campaign, NT	2012/6481	Not Controlled Action (Particular Manner)	Post-Approval
Bonaparte Basin Seabed Mapping Survey	2009/4951	Not Controlled Action (Particular Manner)	Post-Approval
Bonaparte Seismic and Bathymetric Survey	2012/6295	Not Controlled Action (Particular Manner)	Post-Approval
Caldita 3D Marine Seismic Survey - NT/P61, NT/P69, and acreage release area NT06-5	2006/3142	Not Controlled Action (Particular Manner)	Post-Approval
Cartier East and Cartier West 3D Marine Seismic Surveys	2009/5230	Not Controlled Action (Particular Manner)	Post-Approval
Dillon South-1 Exploration Well Drilling - AC/P4, Territory of Ashmore/Cartier	2013/6849	Not Controlled Action (Particular Manner)	Post-Approval
Drilling of Audacious-5 appraisal well	2008/4327	Not Controlled Action (Particular Manner)	Post-Approval
Drilling of two appraisal wells	2011/5840	Not Controlled Action (Particular Manner)	Post-Approval
Eni Bathurst 3D Seismic Survey	2011/6118	Not Controlled Action (Particular Manner)	Post-Approval
Exploration Drilling in Permit Areas WA-402-P & WA-403-P	2010/5297	Not Controlled Action (Particular Manner)	Post-Approval
Joseph Bonaparte Gulf Seabed mapping survey	2010/5517	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
Kingtree & Ironstone-1 Exploration Wells	2011/5935	Not Controlled Action (Particular Manner)	Post-Approval
Malita West 3D Seismic Survey WA-402-P and WA-403-P	2007/3936	Not Controlled Action (Particular Manner)	Post-Approval
Marine Environmental Survey 2012	2012/6310	Not Controlled Action (Particular Manner)	Post-Approval
NT/P77 3D Marine Seismic Survey	2009/4683	Not Controlled Action (Particular Manner)	Post-Approval
NT/P80 2010 2D Marine Seismic Survey	2010/5487	Not Controlled Action (Particular Manner)	Post-Approval
Offshore Fibre Optic Cable Network Construction & Operation, Port Hedland WA to Darwin NT	2014/7223	Not Controlled Action (Particular Manner)	Post-Approval
Panda NT/P76 3D Seismic Acquisition Survey Program	2009/4992	Not Controlled Action (Particular Manner)	Post-Approval
Removal of Potential Unexploded Ordnance within NAXA	2012/6503	Not Controlled Action (Particular Manner)	Post-Approval
Sandalford 3D Seismic Survey	2012/6261	Not Controlled Action (Particular Manner)	Post-Approval
Sonar and Acoustic Trials	2001/345	Not Controlled Action (Particular Manner)	Post-Approval
Songa Venus Drilling and Testing Operations	2009/5122	Not Controlled Action (Particular Manner)	Post-Approval
Songa Venus Drilling Programme, Bonaparte Basin	2009/4990	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
Sunshine Infill 2D and Mimosa 2D Marine Seismic Surveys	2009/4699	Not Controlled Action (Particular Manner)	Post-Approval
Thoar 3D Marine Seismic Survey	2010/5668	Not Controlled Action (Particular Manner)	Post-Approval
Ursa 3D Marine Seismic Survey	2008/4634	Not Controlled Action (Particular Manner)	Post-Approval
Vampire 2D Non Exclusive Seismic Survey, WA	2010/5543	Not Controlled Action (Particular Manner)	Post-Approval
Westralia SPAN Marine Seismic Survey, WA & NT	2012/6463	Not Controlled Action (Particular Manner)	Post-Approval
Referral decision			
2D Marine Seismic Survey	2008/4623	Referral Decision	Completed
3D Seismic Survey (NT/P68)	2006/2949	Referral Decision	Completed

Key Ecological Features [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 Shelf	North-west
Carbonate bank and terrace system of the Van Diemen Rise	North
Continental Slope Demersal Fish Communities	North-west
Pinnacles of the Bonaparte Basin	North-west
Pinnacles of the Bonaparte Basin	North
Shelf break and slope of the Arafura Shelf	North

Name	Region
Tributary Canyons of the Arafura Depression	North

Biologically Important Areas

Scientific Name	Behaviour	Presence
Marine Turtles		
Caretta caretta Loggerhead Turtle [1763]	Foraging	Known to occur
Chelonia mydas Green Turtle [1765]	Foraging	Known to occur
Chelonia mydas Green Turtle [1765]	Internesting	Likely to occur
Chelonia mydas Green Turtle [1765]	Internesting buffer	Known to occur
Dermochelys coriacea Leatherback Turtle [1768]	Internesting	Likely to occur
Eretmochelys imbricata Hawksbill Turtle [1766]	Internesting	Likely to occur
Eretmochelys imbricata Hawksbill Turtle [1766]	Internesting buffer	Known to occur
Lepidochelys olivacea Olive Ridley Turtle [1767]	Foraging	Known to occur
Lepidochelys olivacea Olive Ridley Turtle [1767]	Internesting	Likely to occur
Natator depressus Flatback Turtle [59257]	Foraging	Known to occur
Natator depressus Flatback Turtle [59257]	Internesting	Likely to occur
Seabirds		
Ardenna pacifica Wedge-tailed Shearwater [84292]	Breeding	Known to occur
Fregata ariel Lesser Frigatebird [1012]	Breeding	Known to occur

Scientific Name	Behaviour	Presence
Fregata minor Greater Frigatebird [1013]	Breeding	Known to occur
Onychoprion anaethetus Bridled Tern [82845]	Breeding	Known to occur
Phaethon lepturus White-tailed Tropicbird [1014]	Breeding	Known to occur
Sterna dougallii Roseate Tern [817]	Breeding	Known to occur
Sternula albifrons sinensis Little Tern [82850]	Resting	Known to occur
Sula leucogaster Brown Booby [1022]	Breeding	Known to occur
Sula sula Red-footed Booby [1023]	Breeding	Known to occur
Thalasseus bengalensis Lesser Crested Tern [66546]	Breeding	Known to occur
Thalasseus bergii Crested Tern [83000]	Breeding	Known to occur
Thalasseus bergii Crested Tern [83000]	Breeding (high numbers)	Known to occur
Sharks		
Rhincodon typus Whale Shark [66680]	Foraging	Known to occur
Whales		
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Distribution	Known to occur
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Migration	Known to occur

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and 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

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a 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 detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

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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Appendix D EPBC Act protected matters reports

Appendix D1 – OA EPBC Act Protected Matters Report

Appendix D2 – EMBA EPBC Act Protected Matters Report

Appendix D3 – MEVA EPBC Act Protected Matters Report

Appendix D4 – OA with 20km Assessment Boundary EPBC Act Protected Matters Report

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 29-Apr-2022

Summary

Matters of National Environment 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 (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
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

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 Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	59
Whales and Other Cetaceans:	22
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	None
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	8
Key Ecological Features (Marine):	1
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	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 a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name	Buffer Status
EEZ and Territorial Sea	In feature area
Extended Continental Shelf	In feature area

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
MAMMAL			
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area	In feature area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
REPTILE			
[Caretta caretta](#) Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area	In feature area
[Chelonia mydas](#) Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area	In feature area
[Dermochelys coriacea](#) Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area	In feature area
[Eretmochelys imbricata](#) Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area	In feature area
[Lepidochelys olivacea](#) Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Species or species habitat likely to occur within area	In feature area
[Natator depressus](#) Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area	In feature area
SHARK			
[Carcharodon carcharias](#) White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area	In feature area
[Glyphis garricki](#) Northern River Shark, New Guinea River Shark [82454]	Endangered	Species or species habitat may occur within area	In feature area
[Glyphis glyphis](#) Speartooth Shark [82453]	Critically Endangered	Species or species habitat may occur within area	In feature area
[Pristis pristis](#) Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat may occur within area	In feature area
[Pristis zijsron](#) Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area	In feature area
Sphyrna lewini Scalloped Hammerhead [85267]	Conservation Dependent	Species or species habitat may occur within area	In feature area

Listed Migratory Species [Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area	In feature area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area	In feature area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat may occur within area	In feature area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area	In feature area
Phaethon lepturus White-tailed Tropicbird [1014]		Species or species habitat may occur within area	In feature area
Migratory Marine Species			
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat may occur within area	In feature area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area	In feature area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat may occur within area	In feature area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area	In feature area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area	In feature area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area	In feature area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Species or species habitat likely to occur within area	In feature area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Mobula birostris as Manta birostris Giant Manta Ray [90034]		Species or species habitat may occur within area	In feature area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area	In feature area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area	In feature area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area	In feature area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat may occur within area	In feature area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area	In feature area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area	In feature area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area	In feature area
Migratory Wetlands Species			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area	In feature area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris ferruginea			
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Calidris melanotos			
Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area
Numenius madagascariensis			
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area

Other Matters Protected by the EPBC Act

Listed Marine Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos			
Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Anous stolidus			
Common Noddy [825]		Species or species habitat may occur within area	In feature area
Calidris acuminata			
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area	In feature area
Calidris canutus			
Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area overfly marine area	In feature area
Calidris ferruginea			
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area	In feature area
Calidris melanotos			
Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Calonectris leucomelas](#) Streaked Shearwater [1077]		Species or species habitat likely to occur within area	In feature area
[Fregata ariel](#) Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat may occur within area	In feature area
[Fregata minor](#) Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area	In feature area
[Numenius madagascariensis](#) Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
[Phaethon lepturus](#) White-tailed Tropicbird [1014]		Species or species habitat may occur within area	In feature area
Fish			
[Bhanotia fasciolata](#) Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area	In feature area
[Campichthys tricarinatus](#) Three-keel Pipefish [66192]		Species or species habitat may occur within area	In feature area
[Choeroichthys brachysoma](#) Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area	In feature area
[Choeroichthys suillus](#) Pig-snouted Pipefish [66198]		Species or species habitat may occur within area	In feature area
[Corythoichthys amplexus](#) Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area	In feature area
[Corythoichthys flavofasciatus](#) Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area	In feature area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area	In feature area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area	In feature area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area	In feature area
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area	In feature area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area	In feature area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area	In feature area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area	In feature area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish [66220]		Species or species habitat may occur within area	In feature area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area	In feature area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area	In feature area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area	In feature area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area	In feature area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area	In feature area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area	In feature area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area	In feature area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area	In feature area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area	In feature area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area	In feature area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area	In feature area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Trachyrhamphus bicoarctatus](#) Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area	In feature area
[Trachyrhamphus longirostris](#) Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area	In feature area
Reptile			
[Acalyptophis peronii](#) Horned Seasnake [1114]		Species or species habitat may occur within area	In feature area
[Aipysurus laevis](#) Olive Seasnake [1120]		Species or species habitat may occur within area	In feature area
[Astrotia stokesii](#) Stokes' Seasnake [1122]		Species or species habitat may occur within area	In feature area
[Caretta caretta](#) Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area	In feature area
[Chelonia mydas](#) Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area	In feature area
[Chitulia ornata as Hydrophis ornatus](#) Spotted Seasnake, Ornate Reef Seasnake [87377]		Species or species habitat may occur within area	In feature area
[Dermochelys coriacea](#) Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area	In feature area
[Disteira kingii](#) Spectacled Seasnake [1123]		Species or species habitat may occur within area	In feature area
[Disteira major](#) Olive-headed Seasnake [1124]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Enhydrina schistosa Beaked Seasnake [1126]		Species or species habitat may occur within area	In feature area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Hydrophis atriceps Black-headed Seasnake [1101]		Species or species habitat may occur within area	In feature area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area	In feature area
Lapemis curtus as Lapemis hardwickii Spine-bellied Seasnake [83554]		Species or species habitat may occur within area	In feature area
Leioselasma coggeri as Hydrophis coggeri Black-headed Sea Snake, Slender-necked Seasnake [87373]		Species or species habitat may occur within area	In feature area
Leioselasma pacifica as Hydrophis pacificus Large-headed Seasnake, Pacific Seasnake [87378]		Species or species habitat may occur within area	In feature area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Species or species habitat likely to occur within area	In feature area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area	In feature area

Whales and Other Cetaceans			[Resource Information]
Current Scientific Name	Status	Type of Presence	Buffer Status
Mammal			
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area	In feature area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area	In feature area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area	In feature area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area	In feature area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area	In feature area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area	In feature area
Kogia sima as Kogia simus Dwarf Sperm Whale [85043]		Species or species habitat may occur within area	In feature area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat may occur within area	In feature area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area	In feature area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area	In feature area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area	In feature area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area	In feature area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area	In feature area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area	In feature area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area	In feature area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area	In feature area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area	In feature area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area	In feature area

Extra Information

EPBC Act Referrals				[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
Barossa-1 (NT/P69), Caldita-2 (NT/P61) exploration wells	2006/2793	Not Controlled Action	Completed	In feature area
Not controlled action (particular manner)				
2D Marine Seismic Survey	2009/4728	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
2D Seismic survey	2009/5076	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Bonaparte Basin Barossa Appraisal Drilling Campaign, NT	2012/6481	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Caldita 3D Marine Seismic Survey - NT/P61, NT/P69, and acreage release area NT06-5	2006/3142	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Kingtree & Ironstone-1 Exploration Wells	2011/5935	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Westralia SPAN Marine Seismic Survey, WA & NT	2012/6463	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Referral decision				
2D Marine Seismic Survey	2008/4623	Referral Decision	Completed	In feature area

Key Ecological Features		[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	Buffer Status
Shelf break and slope of the Arafura Shelf	North	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and 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

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a 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 detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

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. Please see the caveat for interpretation of information provided here.

Report created: 13-Feb-2023

Summary

Matters of National Environment 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 (Ramsar	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	5
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	46
Listed Migratory Species:	56

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 https://www.dcceew.gov.au/parks-heritage/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 Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	98
Whales and Other Cetaceans:	27
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	7
Habitat Critical to the Survival of Marine Turtles:	5

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	1
Regional Forest Agreements:	None
Nationally Important Wetlands:	1
EPBC Act Referrals:	72
Key Ecological Features (Marine):	7
Biologically Important Areas:	26
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar Wetlands)	[Resource Information]
Ramsar Site Name	Proximity
Ashmore reef national nature reserve	Within 10km of 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 a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name
EEZ and Territorial Sea
Extended Continental Shelf
Extended Continental Shelf
Extended Continental Shelf
Extended Continental Shelf

Listed Threatened Species	[Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text
BIRD		
Anous tenuirostris melanops		
Australian Lesser Noddy [26000]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat likely to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area
Geophaps smithii smithii Partridge Pigeon (eastern) [64441]	Vulnerable	Species or species habitat likely to occur within area
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat may occur within area
Melanodryas cucullata melvillensis Tiwi Islands Hooded Robin, Hooded Robin (Tiwi Islands) [67092]	Critically Endangered	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Tyto novaehollandiae melvillensis Tiwi Masked Owl, Tiwi Islands Masked Owl [26049]	Endangered	Species or species habitat likely to occur within area
FISH		
Thunnus maccoyii Southern Bluefin Tuna [69402]	Conservation Dependent	Breeding known to occur within area
MAMMAL		

Scientific Name	Threatened Category	Presence Text
Antechinus bellus Fawn Antechinus [344]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Conilurus penicillatus Brush-tailed Rabbit-rat, Brush-tailed Tree-rat, Pakooma [132]	Vulnerable	Species or species habitat known to occur within area
Phascogale pirata Northern Brush-tailed Phascogale [82954]	Vulnerable	Species or species habitat likely to occur within area
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheath-tailed Bat, Bare-rumped Sheathtail Bat [66889]	Vulnerable	Species or species habitat may occur within area
Sminthopsis butleri Butler's Dunnart [302]	Vulnerable	Species or species habitat likely to occur within area
Trichosurus vulpecula arnhemensis Northern Brushtail Possum [83091]	Vulnerable	Species or species habitat known to occur within area
Xeromys myoides Water Mouse, False Water Rat, Yirrkoo [66]	Vulnerable	Species or species habitat likely to occur within area
PLANT		
Burmannia sp. Bathurst Island (R.Fensham 1021) [82017]	Endangered	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Tarennoidea wallichii [65173]	Endangered	Species or species habitat likely to occur within area
Typhonium jonesii a herb [62412]	Endangered	Species or species habitat likely to occur within area
Typhonium mirabile a herb [79227]	Endangered	Species or species habitat likely to occur within area
Xylopia monosperma a shrub [82030]	Endangered	Species or species habitat likely to occur within area
REPTILE		
Acanthophis hawkei Plains Death Adder [83821]	Vulnerable	Species or species habitat may occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Congregation or aggregation known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Scientific Name	Threatened Category	Presence Text
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
SHARK		
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
Glyphis glyphis Speartooth Shark [82453]	Critically 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 likely 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
Sphyrna lewini Scalloped Hammerhead [85267]	Conservation Dependent	Species or species habitat known to occur within area

Listed Migratory Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		

Scientific Name	Threatened Category	Presence Text
Anous stolidus Common Noddy [825]		Foraging, feeding or related behaviour known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat likely to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Species or species habitat likely to occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Sternula albifrons Little Tern [82849]		Congregation or aggregation known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
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 area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Congregation or aggregation known to occur within area
Dugong dugon Dugong [28]		Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
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	Breeding known to occur within area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area
Mobula alfredi as Manta alfredi Reef Manta Ray, Coastal Manta Ray [90033]		Species or species habitat likely to occur within area
Mobula birostris as Manta birostris Giant Manta Ray [90034]		Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Orcaella heinsohni Australian Snubfin Dolphin [81322]		Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
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 likely to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sousa sahulensis as Sousa chinensis Australian Humpback Dolphin [87942]		Species or species habitat known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to 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 may occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Acrocephalus orientalis Oriental Reed-Warbler [59570]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
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 likely to 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
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Limosa lapponica Bar-tailed Godwit [844]		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
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Thalasseus bergii		
Greater Crested Tern [83000]		Breeding likely to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Bird		
Acrocephalus orientalis		
Oriental Reed-Warbler [59570]		Species or species habitat may occur within area overfly marine area
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Anous stolidus		
Common Noddy [825]		Foraging, feeding or related behaviour known to occur within area
Anous tenuirostris melanops		
Australian Lesser Noddy [26000]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area
Bubulcus ibis as Ardea ibis		
Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
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 likely to occur within area overfly marine area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Cecropis daurica as Hirundo daurica Red-rumped Swallow [80610]		Species or species habitat may occur within area overfly marine area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area overfly marine 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 likely to occur within area

Scientific Name	Threatened Category	Presence Text
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area overfly marine area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area overfly marine area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Species or species habitat likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Rostratula australis as Rostratula benghalensis (sensu lato)		
Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area overfly marine area
Sterna dougallii		
Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Sternula albifrons as Sterna albifrons		
Little Tern [82849]		Congregation or aggregation 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
Thalasseus bengalensis as Sterna bengalensis		
Lesser Crested Tern [66546]		Breeding known to occur within area
Thalasseus bergii as Sterna bergii		
Greater Crested Tern [83000]		Breeding likely to occur within area
Fish		
Bhanotia fasciolata		
Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Campichthys tricarinatus		
Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma		
Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys suillus		
Pig-snouted Pipefish [66198]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
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 haematopterus Reef-top Pipefish [66201]		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
Festucalex cinctus Girdled Pipefish [66214]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
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 cyanospilos Blue-speckled Pipefish, Blue-spotted Pipefish [66228]		Species or species habitat may occur within area
Hippichthys parvicarinatus Short-keel Pipefish, Short-keeled Pipefish [66230]		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

Scientific Name	Threatened Category	Presence Text
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
Mammal		
Dugong dugon Dugong [28]		Species or species habitat known to occur within area
Reptile		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
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 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	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Chitulia inornata as Hydrophis inornatus Plain Seasnake [87379]		Species or species habitat may occur within area
Chitulia ornata as Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [87377]		Species or species habitat may 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	Congregation or aggregation known to occur within area

Scientific Name	Threatened Category	Presence Text
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 elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis macdowelli as Hydrophis mcdowelli Small-headed Seasnake [75601]		Species or species habitat may occur within area
Lapemis curtus as Lapemis hardwickii Spine-bellied Seasnake [83554]		Species or species habitat may occur within area
Leioselasma coggeri as Hydrophis coggeri Black-headed Sea Snake, Slender-necked Seasnake [87373]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Leioselasma czeblukovi as Hydrophis czeblukovi		
Fine-spined Seasnake, Geometrical Seasnake [87374]		Species or species habitat may occur within area
Leioselasma pacifica as Hydrophis pacificus		
Large-headed Seasnake, Pacific Seasnake [87378]		Species or species habitat may occur within area
Lepidochelys olivacea		
Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Parahydrophis mertoni		
Northern Mangrove Seasnake [1090]		Species or species habitat may occur within area
Pelamis platurus		
Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and Other Cetaceans		[Resource Information]
Current Scientific Name	Status	Type of Presence
Mammal		
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

Current Scientific Name	Status	Type of Presence
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 sima as Kogia simus Dwarf Sperm Whale [85043]		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]		Species or species habitat likely to occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Orcaella heinsohni as Orcaella brevirostris Australian Snubfin Dolphin [81322]		Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area

Current Scientific Name	Status	Type of Presence
[Physeter macrocephalus](#) Sperm Whale [59]		Species or species habitat may occur within area
[Pseudorca crassidens](#) False Killer Whale [48]		Species or species habitat likely to occur within area
[Sousa sahulensis as Sousa chinensis](#) Australian Humpback Dolphin [87942]		Species or species habitat known 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 known to occur within area
[Tursiops truncatus s. str.](#) Bottlenose Dolphin [68417]		Species or species habitat may occur within area
[Ziphius cavirostris](#) Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Australian Marine Parks	[Resource Information]
Park Name	Zone & IUCN Categories
Oceanic Shoals	Habitat Protection Zone (IUCN IV)
Arafura	Multiple Use Zone (IUCN VI)
Oceanic Shoals	Multiple Use Zone (IUCN VI)
Oceanic Shoals	Multiple Use Zone (IUCN VI)
Oceanic Shoals	National Park Zone (IUCN II)
Arafura	Special Purpose Zone (Trawl) (IUCN VI)
Oceanic Shoals	Special Purpose Zone (Trawl) (IUCN VI)

Habitat Critical to the Survival of Marine Turtles		
Scientific Name	Behaviour	Presence
Aug - Sep		
Natator depressus		
Flatback Turtle [59257]	Nesting	Known to occur
Dec - Jan		
Chelonia mydas		
Green Turtle [1765]	Nesting	Known to occur
Dermochelys coriacea		
Leatherback Turtle [1768]	Nesting	Known to occur
May - Jul		
Lepidochelys olivacea		
Olive Ridley Turtle [1767]	Nesting	Known to occur
Nov - May		
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Nesting	Known to occur

Extra Information

State and Territory Reserves [Resource Information]

Protected Area Name	Reserve Type	State
Garig Gunak Barlu	Marine Park	NT

Nationally Important Wetlands [Resource Information]

Wetland Name	State
Cobourg Peninsula System	NT

EPBC Act Referrals [Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status
Darwin Pipeline Duplication (DPD) Project	2022/09372		Assessment
Northern Endeavour Phase 1 Decommissioning	2022/09327		Assessment
Controlled action			
Audacious Oil Field Standalone Development	2001/407	Controlled Action	Completed
Australia-ASEAN Power Link	2020/8818	Controlled Action	Proposed Decision
Decommissioning of Buffalo Oil Field	2003/984	Controlled Action	Post-Approval
Floating Liquefied Natural Gas facility	2001/533	Controlled Action	Completed
Hardwood Plantation	2001/229	Controlled Action	Post-Approval
Ichthys Gas Field, Offshore and onshore processing facilities and subsea pipeline	2008/4208	Controlled Action	Post-Approval
PTTEP AA Floating LNG Facility	2011/6025	Controlled Action	Completed
Tassie Shoal Gas Reforming and Methanol Production Plants - NT/P48	2000/108	Controlled Action	Post-Approval
Tassie Shoal LNG Project	2003/1067	Controlled Action	Post-Approval
Not controlled action			
Audacious-3 oil drilling well	2003/1042	Not Controlled Action	Completed
Backpacker-1 Offshore Hydrocarbon Exploration Well	2001/300	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Barossa-1 (NT/P69), Caldita-2 (NT/P61) exploration wells	2006/2793	Not Controlled Action	Completed
Buffalo In-Fill Production Wells	2001/475	Not Controlled Action	Completed
Caldita-1 Hydrocarbon Exploration Well, NT/P61	2004/1854	Not Controlled Action	Completed
Construction and operation of Radar Infrastructure	2004/1406	Not Controlled Action	Completed
Controlled Source Electromagnetic 2D Survey	2009/4980	Not Controlled Action	Completed
Controlled Source Electromagnetic Survey	2010/5434	Not Controlled Action	Completed
Drilling of exploration well Audacious-1 in AC/P17	2000/5	Not Controlled Action	Completed
Exploration Drilling in AC/P17, AC/P18 and AC/P24	2001/359	Not Controlled Action	Completed
Geo-scientific survey	2005/2004	Not Controlled Action	Completed
Marine Survey for the Australia-ASEAN Power Link AAPL	2020/8714	Not Controlled Action	Completed
NT/P68 2007 Two Well Drilling Program	2007/3569	Not Controlled Action	Completed
Woodside Geotechnical Investigation Sunrise Bank	2000/13	Not Controlled Action	Completed
Not controlled action (particular manner)			
2D and 3D Seismic Survey	2011/6197	Not Controlled Action (Particular Manner)	Post-Approval
2D and 3D Seismic Survey WA-405-P	2008/4133	Not Controlled Action (Particular Manner)	Post-Approval
2D and 3D Seismic Survey WA-405-P	2009/5104	Not Controlled Action (Particular Manner)	Post-Approval
2D Marine Seismic Survey	2009/4728	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
2D marine seismic survey of Braveheart,Kurrajong,Sunshine and Crocodile	2006/2917	Not Controlled Action (Particular Manner)	Post-Approval
2D or 3D Marine Seismic Survey in Petroleum Permit Area AC/P35	2009/4864	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic survey	2009/5076	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic Survey - Petroleum Exploration Area NT/P68, Eastern Bonaparte Basin	2006/2922	Not Controlled Action (Particular Manner)	Post-Approval
3D Seismic Survey	2006/2729	Not Controlled Action (Particular Manner)	Post-Approval
3D Seismic Survey, petroleum exploration permit AC/P33	2006/2918	Not Controlled Action (Particular Manner)	Post-Approval
3D Seismic Survey (NT/P68)	2008/4121	Not Controlled Action (Particular Manner)	Post-Approval
3D Seismic Survey (NT/P68)	2006/2980	Not Controlled Action (Particular Manner)	Post-Approval
3D seismic survey of AC/P4, AC/P17 and AC/P24	2006/2857	Not Controlled Action (Particular Manner)	Post-Approval
3D Seismic Survey WA-406-P Bonaparte Basin	2007/3904	Not Controlled Action (Particular Manner)	Post-Approval
Auralandia 3D marine seismic survey	2011/5961	Not Controlled Action (Particular Manner)	Post-Approval
Bonaparte 2D & 3D marine seismic survey	2011/5962	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
Bonaparte 3D & 2D Seismic Survey, in NT/P82, Timor Sea	2012/6398	Not Controlled Action (Particular Manner)	Post-Approval
Bonaparte Basin Barossa Appraisal Drilling Campaign, NT	2012/6481	Not Controlled Action (Particular Manner)	Post-Approval
Bonaparte Basin Seabed Mapping Survey	2009/4951	Not Controlled Action (Particular Manner)	Post-Approval
Bonaparte Seismic and Bathymetric Survey	2012/6295	Not Controlled Action (Particular Manner)	Post-Approval
Caldita 3D Marine Seismic Survey - NT/P61, NT/P69, and acreage release area NT06-5	2006/3142	Not Controlled Action (Particular Manner)	Post-Approval
Cartier East and Cartier West 3D Marine Seismic Surveys	2009/5230	Not Controlled Action (Particular Manner)	Post-Approval
Dillon South-1 Exploration Well Drilling - AC/P4, Territory of Ashmore/Cartier	2013/6849	Not Controlled Action (Particular Manner)	Post-Approval
Drilling of Audacious-5 appraisal well	2008/4327	Not Controlled Action (Particular Manner)	Post-Approval
Drilling of two appraisal wells	2011/5840	Not Controlled Action (Particular Manner)	Post-Approval
Eni Bathurst 3D Seismic Survey	2011/6118	Not Controlled Action (Particular Manner)	Post-Approval
Exploration Drilling in Permit Areas WA-402-P & WA-403-P	2010/5297	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
Joseph Bonaparte Gulf Seabed mapping survey	2010/5517	Not Controlled Action (Particular Manner)	Post-Approval
Kingtree & Ironstone-1 Exploration Wells	2011/5935	Not Controlled Action (Particular Manner)	Post-Approval
Malita West 3D Seismic Survey WA-402-P and WA-403-P	2007/3936	Not Controlled Action (Particular Manner)	Post-Approval
Marine Environmental Survey 2012	2012/6310	Not Controlled Action (Particular Manner)	Post-Approval
NT/P77 3D Marine Seismic Survey	2009/4683	Not Controlled Action (Particular Manner)	Post-Approval
NT/P80 2010 2D Marine Seismic Survey	2010/5487	Not Controlled Action (Particular Manner)	Post-Approval
Offshore Fibre Optic Cable Network Construction & Operation, Port Hedland WA to Darwin NT	2014/7223	Not Controlled Action (Particular Manner)	Post-Approval
Panda NT/P76 3D Seismic Acquisition Survey Program	2009/4992	Not Controlled Action (Particular Manner)	Post-Approval
Removal of Potential Unexploded Ordnance within NAXA	2012/6503	Not Controlled Action (Particular Manner)	Post-Approval
Sandalford 3D Seismic Survey	2012/6261	Not Controlled Action (Particular Manner)	Post-Approval
Sonar and Acoustic Trials	2001/345	Not Controlled Action (Particular Manner)	Post-Approval
Songa Venus Drilling and Testing Operations	2009/5122	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
Songa Venus Drilling Programme, Bonaparte Basin	2009/4990	Not Controlled Action (Particular Manner)	Post-Approval
Sunshine Infill 2D and Mimosa 2D Marine Seismic Surveys	2009/4699	Not Controlled Action (Particular Manner)	Post-Approval
Thoar 3D Marine Seismic Survey	2010/5668	Not Controlled Action (Particular Manner)	Post-Approval
Ursa 3D Marine Seismic Survey	2008/4634	Not Controlled Action (Particular Manner)	Post-Approval
Vampire 2D Non Exclusive Seismic Survey, WA	2010/5543	Not Controlled Action (Particular Manner)	Post-Approval
Westralia SPAN Marine Seismic Survey, WA & NT	2012/6463	Not Controlled Action (Particular Manner)	Post-Approval
Referral decision			
2D Marine Seismic Survey	2008/4623	Referral Decision	Completed
3D Seismic Survey (NT/P68)	2006/2949	Referral Decision	Completed

Key Ecological Features [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 Shelf	North-west
Carbonate bank and terrace system of the Van Diemen Rise	North
Continental Slope Demersal Fish Communities	North-west
Pinnacles of the Bonaparte Basin	North-west

Name	Region
Pinnacles of the Bonaparte Basin	North
Shelf break and slope of the Arafura Shelf	North
Tributary Canyons of the Arafura Depression	North

Biologically Important Areas

Scientific Name	Behaviour	Presence
Marine Turtles		
Caretta caretta Loggerhead Turtle [1763]	Foraging	Known to occur
Chelonia mydas Green Turtle [1765]	Foraging	Known to occur
Chelonia mydas Green Turtle [1765]	Internesting	Likely to occur
Chelonia mydas Green Turtle [1765]	Internesting buffer	Known to occur
Dermochelys coriacea Leatherback Turtle [1768]	Internesting	Likely to occur
Eretmochelys imbricata Hawksbill Turtle [1766]	Internesting	Likely to occur
Eretmochelys imbricata Hawksbill Turtle [1766]	Internesting buffer	Known to occur
Lepidochelys olivacea Olive Ridley Turtle [1767]	Foraging	Known to occur
Lepidochelys olivacea Olive Ridley Turtle [1767]	Internesting	Likely to occur
Natator depressus Flatback Turtle [59257]	Foraging	Known to occur
Natator depressus Flatback Turtle [59257]	Internesting	Likely to occur
Seabirds		
Ardenna pacifica Wedge-tailed Shearwater [84292]	Breeding	Known to occur

Scientific Name	Behaviour	Presence
Fregata ariel Lesser Frigatebird [1012]	Breeding	Known to occur
Fregata minor Greater Frigatebird [1013]	Breeding	Known to occur
Onychoprion anaethetus Bridled Tern [82845]	Breeding	Known to occur
Phaethon lepturus White-tailed Tropicbird [1014]	Breeding	Known to occur
Sterna dougallii Roseate Tern [817]	Breeding	Known to occur
Sternula albifrons sinensis Little Tern [82850]	Resting	Known to occur
Sula leucogaster Brown Booby [1022]	Breeding	Known to occur
Sula sula Red-footed Booby [1023]	Breeding	Known to occur
Thalasseus bengalensis Lesser Crested Tern [66546]	Breeding	Known to occur
Thalasseus bergii Crested Tern [83000]	Breeding	Known to occur
Thalasseus bergii Crested Tern [83000]	Breeding (high numbers)	Known to occur
Sharks		
Rhincodon typus Whale Shark [66680]	Foraging	Known to occur
Whales		
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Distribution	Known to occur

Scientific Name	Behaviour	Presence
Balaenoptera musculus brevicauda		
Pygmy Blue Whale [81317]	Migration	Known to occur

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and 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

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a 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 detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

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. Please see the caveat for interpretation of information provided here.

Report created: 28-Mar-2023

Summary

Matters of National Environment 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 (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	4
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	22
Listed Migratory Species:	39

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 https://www.dcceew.gov.au/parks-heritage/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 Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	71
Whales and Other Cetaceans:	26
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	5
Habitat Critical to the Survival of Marine Turtles:	1

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	None
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	33
Key Ecological Features (Marine):	5
Biologically Important Areas:	4
Bioregional Assessments:	None
Geological and Bioregional Assessments:	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 a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name
EEZ and Territorial Sea
Extended Continental Shelf
Extended Continental Shelf
Extended Continental Shelf

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text
BIRD		
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
FISH		
Thunnus maccoyii		
Southern Bluefin Tuna [69402]	Conservation Dependent	Species or species habitat likely to occur within area
MAMMAL		

Scientific Name	Threatened Category	Presence Text
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to 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 likely to occur within area
REPTILE		
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat 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	Species or species habitat 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
SHARK		

Scientific Name	Threatened Category	Presence Text
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
Glyphis glyphis		
Speartooth Shark [82453]	Critically 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 may 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	Species or species habitat may occur within area
Sphyrna lewini		
Scalloped Hammerhead [85267]	Conservation Dependent	Species or species habitat likely to occur within area

Listed Migratory Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		
Anous stolidus		
Common Noddy [825]		Species or species habitat may occur within area
Calonectris leucomelas		
Streaked Shearwater [1077]		Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Species or species habitat likely 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 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 likely to occur within area
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
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
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat 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
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area
Mobula alfredi as Manta alfredi Reef Manta Ray, Coastal Manta Ray [90033]		Species or species habitat likely to occur within area
Mobula birostris as Manta birostris Giant Manta Ray [90034]		Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
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 may 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	Species or species habitat may occur within area
Sousa sahulensis as Sousa chinensis Australian Humpback Dolphin [87942]		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 known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
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]
Scientific Name	Threatened Category	Presence Text
Bird		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Species or species habitat likely to occur within area
Fish		
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
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 haematopterus Reef-top Pipefish [66201]		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
Festucalex cinctus Girdled Pipefish [66214]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
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 cyanospilos Blue-speckled Pipefish, Blue-spotted Pipefish [66228]		Species or species habitat may occur within area
Hippichthys parvicarinatus Short-keel Pipefish, Short-keeled Pipefish [66230]		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

Scientific Name	Threatened Category	Presence Text
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
Reptile		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Chitulia inornata as Hydrophis inornatus Plain Seasnake [87379]		Species or species habitat may occur within area
Chitulia ornata as Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [87377]		Species or species habitat may 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

Scientific Name	Threatened Category	Presence Text
Enhydrina schistosa Beaked Seasnake [1126]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Hydrophis atriceps Black-headed Seasnake [1101]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis macdowelli as Hydrophis mcdowelli Small-headed Seasnake [75601]		Species or species habitat may occur within area
Lapemis curtus as Lapemis hardwickii Spine-bellied Seasnake [83554]		Species or species habitat may occur within area
Leioselasma coggeri as Hydrophis coggeri Black-headed Sea Snake, Slender-necked Seasnake [87373]		Species or species habitat may occur within area
Leioselasma pacifica as Hydrophis pacificus Large-headed Seasnake, Pacific Seasnake [87378]		Species or species habitat may 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
Parahydrophis mertoni Northern Mangrove Seasnake [1090]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and Other Cetaceans [Resource Information]

Current Scientific Name	Status	Type of Presence
Mammal		
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 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 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

Current Scientific Name	Status	Type of Presence
Kogia sima as Kogia simus Dwarf Sperm Whale [85043]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Orcaella heinsohni as Orcaella brevirostris 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
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Sousa sahulensis as Sousa chinensis Australian Humpback Dolphin [87942]		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

Current Scientific Name	Status	Type of Presence
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat may occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Australian Marine Parks [Resource Information]

Park Name	Zone & IUCN Categories
Oceanic Shoals	Habitat Protection Zone (IUCN IV)
Oceanic Shoals	Multiple Use Zone (IUCN VI)
Oceanic Shoals	Multiple Use Zone (IUCN VI)
Oceanic Shoals	National Park Zone (IUCN II)
Oceanic Shoals	Special Purpose Zone (Trawl) (IUCN VI)

Habitat Critical to the Survival of Marine Turtles

Scientific Name	Behaviour	Presence
Aug - Sep		
Natator depressus Flatback Turtle [59257]	Nesting	Known to occur

Extra Information

EPBC Act Referrals			[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			
Floating Liquefied Natural Gas facility	2001/533	Controlled Action	Completed
Ichthys Gas Field, Offshore and onshore processing facilities and subsea pipeline	2008/4208	Controlled Action	Post-Approval
Tassie Shoal Gas Reforming and Methanol Production Plants - NT/P48	2000/108	Controlled Action	Post-Approval
Tassie Shoal LNG Project	2003/1067	Controlled Action	Post-Approval
Not controlled action			
Barossa-1 (NT/P69), Caldita-2 (NT/P61) exploration wells	2006/2793	Not Controlled Action	Completed
Caldita-1 Hydrocarbon Exploration Well, NT/P61	2004/1854	Not Controlled Action	Completed
Controlled Source Electromagnetic 2D Survey	2009/4980	Not Controlled Action	Completed
Controlled Source Electromagnetic Survey	2010/5434	Not Controlled Action	Completed
Marine Survey for the Australia-ASEAN Power Link AAPL	2020/8714	Not Controlled Action	Completed
NT/P68 2007 Two Well Drilling Program	2007/3569	Not Controlled Action	Completed
Woodside Geotechnical Investigation Sunrise Bank	2000/13	Not Controlled Action	Completed
Not controlled action (particular manner)			
2D Marine Seismic Survey	2009/4728	Not Controlled Action (Particular Manner)	Post-Approval
2D marine seismic survey of Braveheart,Kurrajong,Sunshine and Crocodile	2006/2917	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic survey	2009/5076	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
2D Seismic Survey - Petroleum Exploration Area NT/P68, Eastern Bonaparte Basin	2006/2922	Not Controlled Action (Particular Manner)	Post-Approval
3D Seismic Survey	2006/2729	Not Controlled Action (Particular Manner)	Post-Approval
3D Seismic Survey (NT/P68)	2008/4121	Not Controlled Action (Particular Manner)	Post-Approval
3D Seismic Survey (NT/P68)	2006/2980	Not Controlled Action (Particular Manner)	Post-Approval
Bonaparte 3D & 2D Seismic Survey, in NT/P82, Timor Sea	2012/6398	Not Controlled Action (Particular Manner)	Post-Approval
Bonaparte Basin Barossa Appraisal Drilling Campaign, NT	2012/6481	Not Controlled Action (Particular Manner)	Post-Approval
Bonaparte Basin Seabed Mapping Survey	2009/4951	Not Controlled Action (Particular Manner)	Post-Approval
Caldita 3D Marine Seismic Survey - NT/P61, NT/P69, and acreage release area NT06-5	2006/3142	Not Controlled Action (Particular Manner)	Post-Approval
Eni Bathurst 3D Seismic Survey	2011/6118	Not Controlled Action (Particular Manner)	Post-Approval
Exploration Drilling in Permit Areas WA-402-P & WA-403-P	2010/5297	Not Controlled Action (Particular Manner)	Post-Approval
Joseph Bonaparte Gulf Seabed mapping survey	2010/5517	Not Controlled Action (Particular Manner)	Post-Approval
Kingtree & Ironstone-1 Exploration Wells	2011/5935	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
Malita West 3D Seismic Survey WA-402-P and WA-403-P	2007/3936	Not Controlled Action (Particular Manner)	Post-Approval
Offshore Fibre Optic Cable Network Construction & Operation, Port Hedland WA to Darwin NT	2014/7223	Not Controlled Action (Particular Manner)	Post-Approval
Panda NT/P76 3D Seismic Acquisition Survey Program	2009/4992	Not Controlled Action (Particular Manner)	Post-Approval
Sunshine Infill 2D and Mimosa 2D Marine Seismic Surveys	2009/4699	Not Controlled Action (Particular Manner)	Post-Approval
Westralia SPAN Marine Seismic Survey, WA & NT	2012/6463	Not Controlled Action (Particular Manner)	Post-Approval
Referral decision			
2D Marine Seismic Survey	2008/4623	Referral Decision	Completed
3D Seismic Survey (NT/P68)	2006/2949	Referral Decision	Completed

Key Ecological Features [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 Shelf	North-west
Carbonate bank and terrace system of the Van Diemen Rise	North
Pinnacles of the Bonaparte Basin	North-west
Pinnacles of the Bonaparte Basin	North
Shelf break and slope of the Arafura Shelf	North

Biologically Important Areas

Scientific Name	Behaviour	Presence

Scientific Name	Behaviour	Presence
Marine Turtles		
Lepidochelys olivacea Olive Ridley Turtle [1767]	Foraging	Known to occur
Natator depressus Flatback Turtle [59257]	Internesting	Likely to occur
Whales		
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Distribution	Known to occur
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Migration	Known to occur

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and 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

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a 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 detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

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. Please see the caveat for interpretation of information provided here.

Report created: 07-Jun-2022

Summary

Matters of National Environment 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 (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	19
Listed Migratory Species:	34

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

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 Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	65
Whales and Other Cetaceans:	22
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	1
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	None
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	9
Key Ecological Features (Marine):	1
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	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 a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name
EEZ and Territorial Sea
Extended Continental Shelf

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text
BIRD		
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
MAMMAL		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to 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 likely to occur within area

Scientific Name	Threatened Category	Presence Text
REPTILE		
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
SHARK		
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
Glyphis glyphis Speartooth Shark [82453]	Critically 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 may occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Sphyrna lewini Scalloped Hammerhead [85267]	Conservation Dependent	Species or species habitat likely to occur within area

Listed Migratory Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat may occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		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
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 may occur within area

Scientific Name	Threatened Category	Presence Text
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 likely to occur within area
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Isurus 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
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Mobula alfredi as Manta alfredi Reef Manta Ray, Coastal Manta Ray [90033]		Species or species habitat may occur within area
Mobula birostris as Manta birostris Giant Manta Ray [90034]		Species or species habitat may 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
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat may 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	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
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

Scientific Name	Threatened Category	Presence Text
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]
Scientific Name	Threatened Category	Presence Text
Bird		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area overfly marine area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat may 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
Phaethon lepturus White-tailed Tropicbird [1014]		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

Scientific Name	Threatened Category	Presence Text
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

Scientific Name	Threatened Category	Presence Text
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

Scientific Name	Threatened Category	Presence Text
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
Reptile		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Chitulia inornata as Hydrophis inornatus Plain Seasnake [87379]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Chitulia ornata as Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [87377]		Species or species habitat may 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 atriceps Black-headed Seasnake [1101]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis macdowelli as Hydrophis mcdowelli Small-headed Seasnake [75601]		Species or species habitat may occur within area
Lapemis curtus as Lapemis hardwickii Spine-bellied Seasnake [83554]		Species or species habitat may occur within area
Leioselasma coggeri as Hydrophis coggeri Black-headed Sea Snake, Slender-necked Seasnake [87373]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Leioselasma pacifica as Hydrophis pacificus		
Large-headed Seasnake, Pacific Seasnake [87378]		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
Parahydrophis mertoni		
Northern Mangrove Seasnake [1090]		Species or species habitat may occur within area
Pelamis platurus		
Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and Other Cetaceans		[Resource Information]
Current Scientific Name	Status	Type of Presence
Mammal		
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 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 likely to occur within area
Delphinus delphis		
Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area

Current Scientific Name	Status	Type of Presence
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 sima as Kogia simus Dwarf Sperm Whale [85043]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area

Current Scientific Name	Status	Type of Presence
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 (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]
Park Name	Zone & IUCN Categories
Oceanic Shoals	Multiple Use Zone (IUCN VI)

Extra Information

EPBC Act Referrals			[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Barossa-1 (NT/P69), Caldita-2 (NT/P61) exploration wells	2006/2793	Not Controlled Action	Completed
Caldita-1 Hydrocarbon Exploration Well, NT/P61	2004/1854	Not Controlled Action	Completed
Not controlled action (particular manner)			
2D Marine Seismic Survey	2009/4728	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
2D Seismic survey	2009/5076	Not Controlled Action (Particular Manner)	Post-Approval
Bonaparte Basin Barossa Appraisal Drilling Campaign, NT	2012/6481	Not Controlled Action (Particular Manner)	Post-Approval
Caldita 3D Marine Seismic Survey - NT/P61, NT/P69, and acreage release area NT06-5	2006/3142	Not Controlled Action (Particular Manner)	Post-Approval
Kingtree & Ironstone-1 Exploration Wells	2011/5935	Not Controlled Action (Particular Manner)	Post-Approval
Westralia SPAN Marine Seismic Survey, WA & NT	2012/6463	Not Controlled Action (Particular Manner)	Post-Approval
Referral decision			
2D Marine Seismic Survey	2008/4623	Referral Decision	Completed

Key Ecological Features [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
Shelf break and slope of the Arafura Shelf	North

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and 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

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a 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 detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

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 E Relevant Persons consultation materials

Table 4.8 Advertising Phase 1 – Seeking Relevant Persons

Full page advertisement

- 1 x The Australian
- 3 x Northern Territory News
- 1 x Australian Financial Review
- 2 x The West Australian
- 1 x National Indigenous Times

We're Listening

Santos

BAROSSA GAS PROJECT

Seeking Relevant Persons

SUBSEA INFRASTRUCTURE INSTALLATION ENVIRONMENT PLAN (SURF EP)

Santos is seeking to identify and consult with relevant persons whose functions, interests or activities may be affected by activity proposed under a Barossa Gas Project environment plan. The environment plan relates to subsea infrastructure installation and pre-commissioning activity.

Barossa Gas Project

Santos proposes to undertake Subsea Infrastructure Installation activity for the Barossa Gas Project within Commonwealth waters approximately 300km north-northwest of Darwin, NT, within the boundaries of Commonwealth Petroleum Production Licence NT/L1. The Project will comprise a Floating Production Storage and Offloading (FPSO) vessel, a subsea production system, supporting in-field subsea infrastructure and a Gas Export Pipeline (GEP).

Once complete, natural gas will be transported from the offshore Barossa field to the existing Darwin liquefied natural gas (DLNG) plant at Wickham Point, south of Darwin city.

An Offshore Project Proposal for the Barossa Gas Project was accepted by Australia's offshore energy regulator, the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA), in March 2018.

Santos is currently preparing an environment plan (EP) in respect of a part of the Barossa Gas Project relating to the Subsea Umbilicals, Risers and Flowlines (SURF), manifolds and FPSO moorings installation (collectively referred to as the Subsea Infrastructure) and pre-commissioning activity. This is more simply referred to as the 'SURF activity'. Santos will submit the EP to NOPSEMA for assessment.

Santos is also currently consulting on its proposed Drilling and Completions activity and intends to submit further environment plans to NOPSEMA in relation to other aspects of the Barossa Gas Project during 2023. We will provide further information and advertise about this at a later date.

Proposed SURF Activity

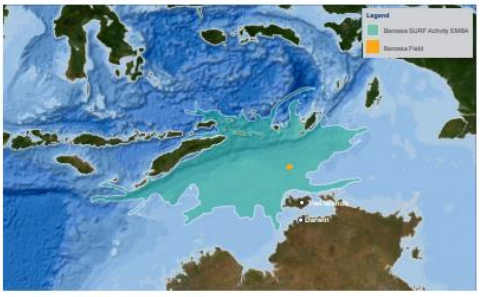
SURF is a term used to describe the subsea infrastructure required to gather gas and condensate from the production wells and deliver these products to the FPSO vessel for processing. Santos plans to install subsea infrastructure that is required to support the connection of six subsea production wells to the FPSO vessel. Santos also plans to complete pre-commissioning activities (a series of tests carried out to verify the integrity and capacity of the infrastructure and connections, as well as preserve installed equipment).

The environment that may be affected (EMBA) by the proposed activities

Santos is assessing the planned impacts and unplanned risks from our proposed activity on the environment, including on ecosystems (including people and communities), natural and physical resources, the qualities and characteristics of locations, places and areas and the heritage value of places. This will include assessment of the social, economic and cultural features of the environment. The map below depicts the Barossa field within which would be the operational area for the proposed activity. The map also shows the broader environment that may be affected by the proposed activity, referred to as the 'EMBA'. The 'EMBA' represents the greatest spatial extent that could be affected by the unplanned 'worst case' spill scenario (in this case a marine diesel release). Santos is proposing to implement measures to reduce the impacts and risks of the activity. It is a requirement under relevant environmental legislation that these impacts and risks are reduced to as low as reasonably practicable and to an acceptable level. This must be considered by NOPSEMA in determining whether to accept the environment plan.

Seeking Relevant Persons for Environment Plans

In preparing its environment plans, Santos must consult with relevant persons for each of its proposed activities for the Project. A relevant person includes a person or an organisation whose functions, interests or activities may be affected by an activity proposed to be carried out under an environment plan. Such functions, interests or activities may include those arising in relation to spiritual or cultural connections to land and sea country in accordance with Indigenous tradition; tourism; recreational and commercial fishing; other commercial or recreational activities and local communities that might be affected by our proposed activity (these are examples and not an exhaustive list). Santos is seeking to identify relevant persons for the purpose of preparing the SURF EP for the Barossa Gas Project. If you think your functions, interests or activities may be affected by the SURF activity, you may be a relevant person with whom Santos must consult.



Barossa Gas Project – SURF activity EMBA

We welcome your feedback

If you consider you may be a relevant person, please contact us by 22 May 2023 to allow Santos to initiate consultation with you in relation to the proposed SURF activity and so you can tell us how you would like to be consulted throughout this process. Santos is committed to undertaking genuine and meaningful consultation. We want to provide information for people to make informed assessments of the possible consequences of the proposed SURF activity on them. Your feedback and input is important to us and input will be considered in the development of our environment plan.

Visit **santos.com/barossa**, phone **1800 267 600**, email **offshore.consultation@santos.com** or use the QR code for more information, to self-identify as a relevant person or to provide feedback.

SCAN ME

Public notice

- 4 x Northern Territory News
- 4 x The Australian
- 4 x Australian Financial Review
- 3 x The West Australian

Barossa Gas Project

Santos

Seeking Relevant Persons

SUBSEA INFRASTRUCTURE INSTALLATION ENVIRONMENT PLAN

Santos is seeking to identify and consult with relevant persons whose functions, interests or activities may be affected by our proposed subsea infrastructure installation and pre-commissioning activity for the Barossa Gas Project.

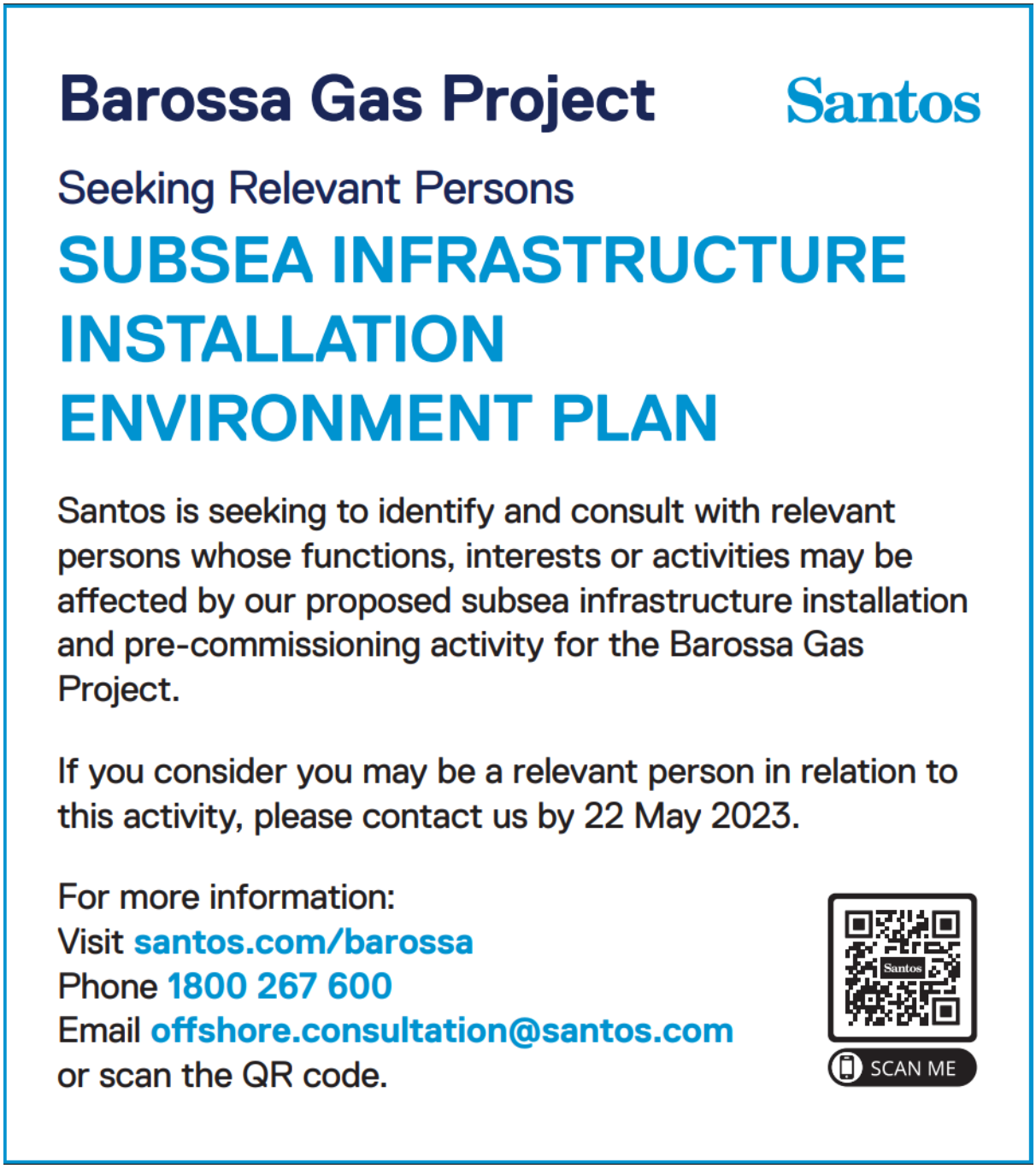
If you consider you may be a relevant person in relation to this activity, please contact us by 22 May 2023.

For more information:
Visit **santos.com/barossa**
Phone **1800 267 600**
Email **offshore.consultation@santos.com**
or scan the QR code.

SCAN ME

Social media

- 22 April – 22 May 2023 Geotargeted Australia (Facebook, Instagram, Messenger)
- 3 May 2023 – 22 May 2023 Geotargeted Australia, Indonesia, Timor-Leste (Facebook, Instagram, Messenger)



Radio

- 24 April 2023 – 21 May 2023 National radio advertising across metro stations in Sydney, Melbourne, Brisbane, Adelaide and Perth
- 24 April 2023 – 21 May 2023 Radio advertising across Darwin

Script:

Radio script:
Santos is seeking to identify and consult with relevant persons whose functions, interests or activities may be affected by our proposed subsea infrastructure installation and pre-commissioning activity for the Barossa Gas Project in Commonwealth waters north-northwest of Darwin, NT.
If you consider you may be a relevant person in relation to this activity, please contact us by 22 May 2023. For more information, visit ***santos.com/barossa****, phone* ***1800 267 600****, or email* ***offshore.consultation@santos.com****.*

Table 4.9 Phase 2 – Further advertising seeking Relevant Persons and seeking feedback (June – August 2023)

Half page advertisement

- 7 x Half page The Australian
- 7 x Half page NT News
- 8 x Half page AFR
- 7 x Half page The West Australian
- 1 x Half page NIT

Santos is now consulting with relevant persons for its Subsea Infrastructure Installation Environment Plan. The Plan proposes activity relating to the installation of subsea infrastructure to gather gas and condensate from the Barossa natural gas and condensate field, located in Commonwealth waters approximately 285 kilometres offshore north-north-west from Darwin.

More information is available at santos.com/barossa about who may be a relevant person for consultation, the proposed activity, the environment that may be affected by the proposed activity, potential environmental impacts and risks and proposed control measures to seek to reduce any impacts and risks to as low as reasonably practicable and an acceptable level.

We are asking relevant persons to provide feedback by 14 July 2023.
Please contact us via any of the below channels to discuss consultation or to provide feedback.

For more information:
Visit **santos.com/barossa**
Phone **1800 267 600**
Email **offshore.consultation@santos.com**
or scan the QR code

SCAN ME

Extension to 4 August close:

Santos is now consulting with relevant persons for its Subsea Infrastructure Installation Environment Plan. The Plan proposes activity relating to the installation of subsea infrastructure to gather gas and condensate from the Barossa natural gas and condensate field, located in Commonwealth waters approximately 285 kilometres offshore north-north-west from Darwin.

More information is available at santos.com/barossa about who may be a relevant person for consultation, the proposed activity, the environment that may be affected by the proposed activity, potential environmental impacts and risks and proposed control measures to seek to reduce any impacts and risks to as low as reasonably practicable and an acceptable level.

We have extended the period for consultation and are asking relevant persons to provide feedback by 4 August 2023. Please contact us via any of the below channels to discuss consultation or to provide feedback.

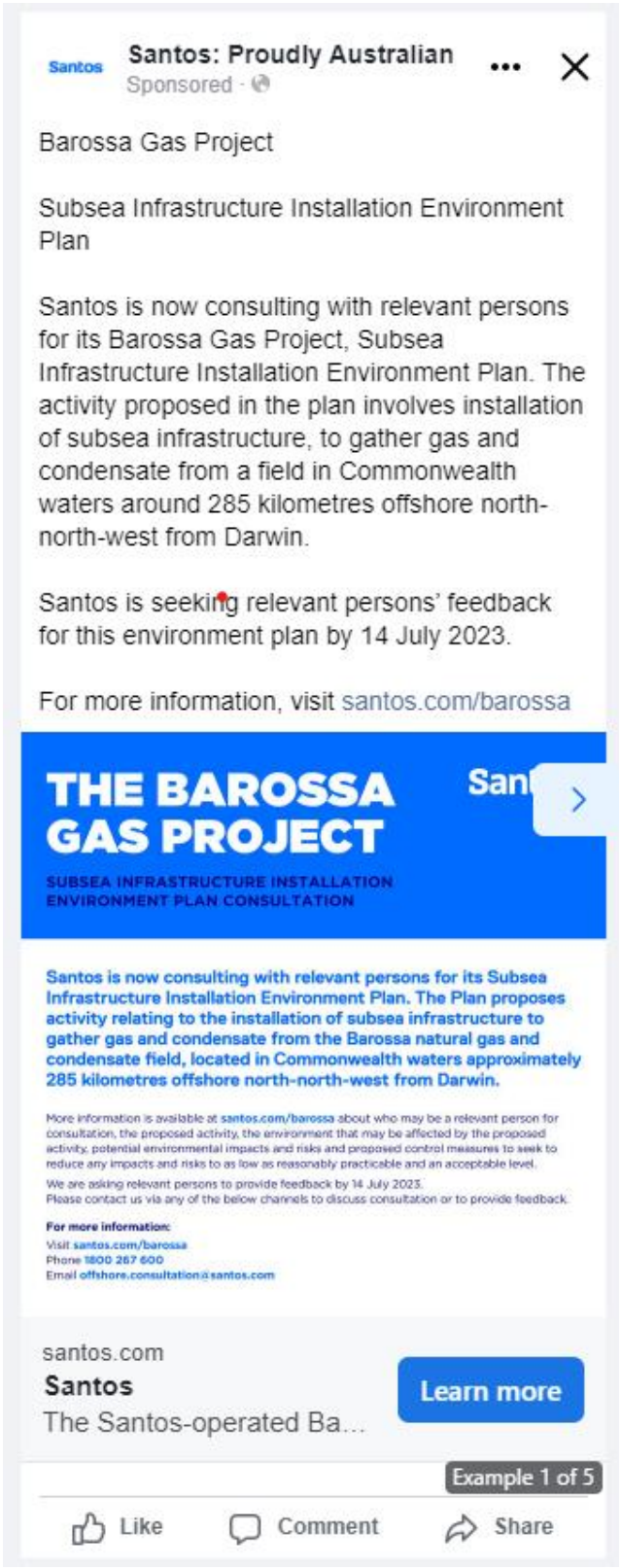
For more information:

Visit **santos.com/barossa**
Phone **1800 267 600**
Email **offshore.consultation@santos.com**
or scan the QR code

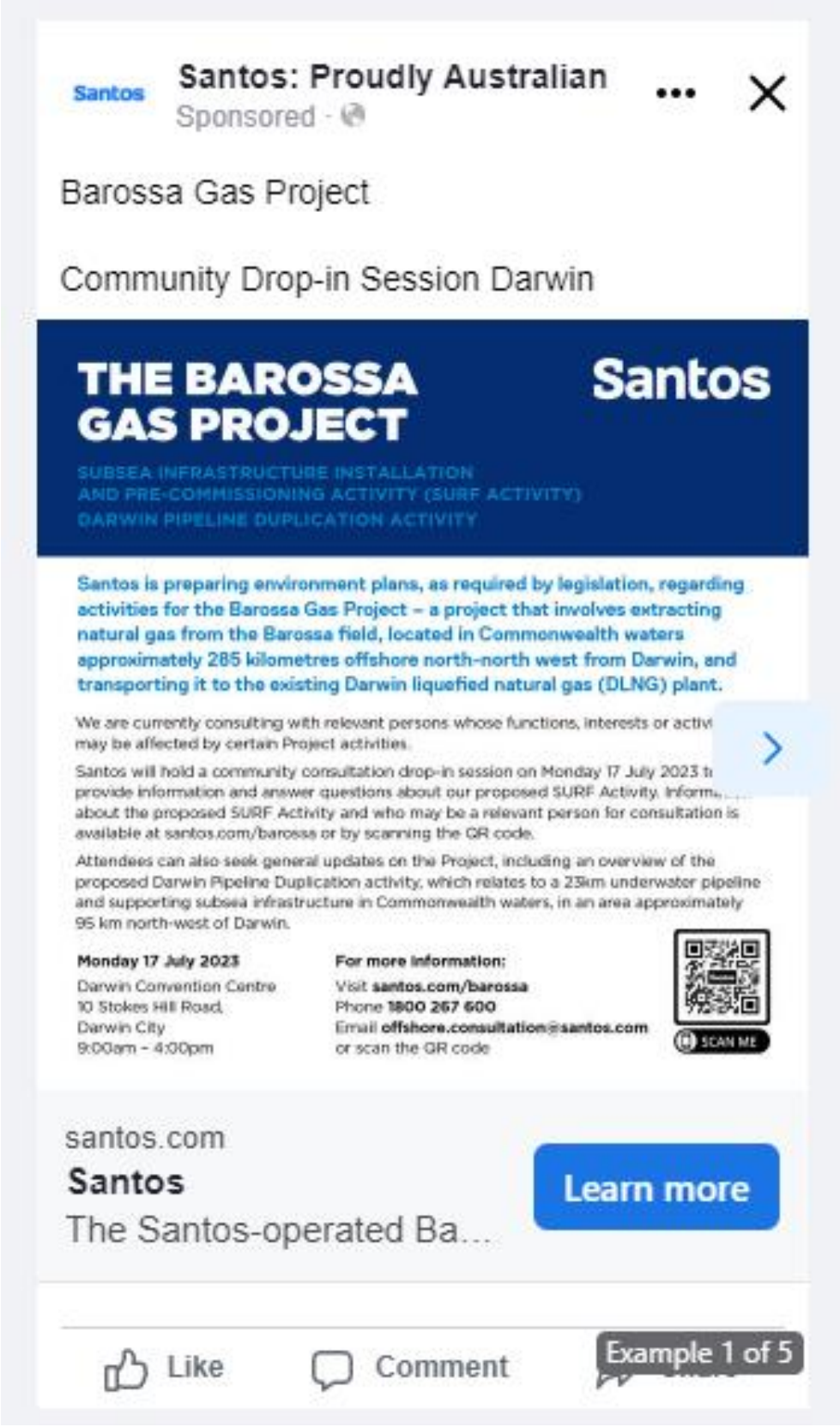
SCAN ME

Social media

- 20 June 2023 – 14 July 2023 Geotargeted NT & WA (Facebook, Instagram, Messenger)
- Tuesday 18 July 2023 – 4 August 2023 Geotargeted Australia Timor Leste and Indonesia



Social post extension to 4 August:



Radio

- 16 June 2023 – 14 July 2023 National metro stations Sydney, Melbourne, Brisbane, Adelaide and Perth
- 16 June 2023 – 14 July 2023 Darwin radio
- 16 June 2023 – 14 July 2023 Top End Aboriginal Bush Broadcasting Association (TEABBA) 29 remote communities across top end of Australia, including Tiwi Islands

Radio script:

Santos is now consulting with relevant persons for its Barossa Gas Project, Subsea Infrastructure Installation Environment Plan. The activity proposed in the plan involves installation of subsea infrastructure, to gather gas and condensate from a field in Commonwealth waters around 285 kilometres offshore north-north-west from Darwin.

Santos is seeking relevant persons' feedback for this environment plan by 14 July 2023.

For more information, visit santos.com/barossa, phone 1800 267 600, or email *offshore.consultation@santos.com*.

- 19 July 2023 – 4 August 2023 National metro stations Sydney, Melbourne, Brisbane, Adelaide and Perth
- 19 July 2023 – 4 August 2023 Darwin radio
- 19 July 2023 – 4 August 2023 Top End Aboriginal Bush Broadcasting Association (TEABBA) 29 remote communities across top end of Australia, including Tiwi Islands

Radio script extension to 4 August:

Santos is now consulting with relevant persons for its Barossa Gas Project, Subsea Infrastructure Installation Environment Plan. The activity proposed in the plan involves installation of subsea infrastructure, to gather gas and condensate from a field in Commonwealth waters around 285 kilometres offshore north-north-west from Darwin.
Santos has extended the period for consultation and is seeking relevant persons' feedback for this environment plan by 4 August 2023.
For more information, visit santos.com/barossa, phone 1800 267 600, or email offshore.consultation@santos.com.

Table 4.10 Phase 3 – Advertising and promoting Darwin drop in sessions (April - May 2023)

First round half page advertisement

- 4 x Northern Territory News

We're Listening

Santos

Community consultation drop-in session

BAROSSA GAS PROJECT

Santos is preparing environment plans, as required by legislation, regarding activities for the Barossa Gas Project – a project that involves extracting natural gas from the Barossa field, located in Commonwealth waters approximately 285 kilometres offshore north-north west from Darwin, and transporting it to the existing Darwin liquefied natural gas (DLNG) plant.

We are currently consulting with relevant persons whose functions, interests or activities may be affected by the following project activities:

- Drilling and completions activity
- Subsea infrastructure installation and pre-commissioning activity.

Detailed information about these proposed activities is available at santos.com/barossa or by scanning the QR code below.

Santos will hold community consultation drop-in sessions for relevant persons to obtain information about these proposed activities, provide feedback and ask any questions.

THURSDAY: 27 April 2023

Rooms 2 & 3
Darwin Convention Centre
10 Stokes Hill Rd,
Darwin City
9.00am – 5.00pm

WEDNESDAY: 3 May 2023

Rooms 2 & 3
Darwin Convention Centre
10 Stokes Hill Rd,
Darwin City
9.00am – 5.00pm

Further drop-in sessions in relation to Barossa Gas Project activities will be held in coming weeks.

For more information:
Visit santos.com/barossa
Phone 1800 267 600
Email offshore.consultation@santos.com
or scan the QR code.

SCAN ME

Social media

- 21 April 2023 – 3 May 2023 Geotargeted Darwin (Facebook, Instagram, Messenger)

Radio

- 27 April 2023 – 3 May 2023 Darwin radio

Script:

Santos is holding Barossa Gas Project consultation drop-in sessions on April 27 and May 3 at the Darwin Convention Centre about proposed activities for the project. Relevant persons can nominate for consultation, give feedback and ask questions.

For more information, including who is a relevant person and proposed project activities, visit santos.com slash barossa, phone 1800 267 600, or email offshore.consultation@santos.com

Second round half page advertisement

- 9 x Northern Territory News

We're Listening

Santos

Community consultation drop-in session

BAROSSA GAS PROJECT

Santos is preparing environment plans, as required by legislation, regarding activities for the Barossa Gas Project – a project that involves extracting natural gas from the Barossa field, located in Commonwealth waters approximately 285 kilometres offshore north-north west from Darwin, and transporting it to the existing Darwin liquefied natural gas (DLNG) plant.

We are currently consulting with relevant persons whose functions, interests or activities may be affected by the following project activities:

+ Drilling and completions activity
+ Subsea infrastructure installation and pre-commissioning activity.

Detailed information about these proposed activities is available at santos.com/barossa or by scanning the QR code below.

Santos will hold community consultation drop-in sessions for relevant persons to obtain information about these proposed activities, provide feedback and ask any questions.

MONDAY: 22 May 2023

Darwin Convention Centre,
10 Stokes Hill Rd,
Darwin City
9.00am – 5.00pm

THURSDAY: 8 June 2023

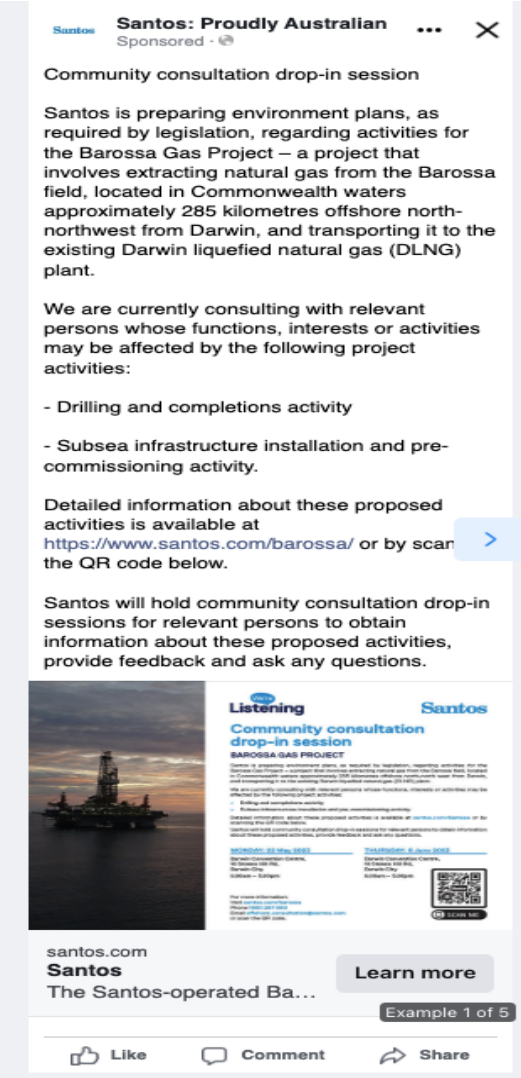
Darwin Convention Centre,
10 Stokes Hill Rd,
Darwin City
9.00am – 5.00pm

SCAN ME

For more information:
Visit santos.com/barossa
Phone 1800 267 600
Email offshore.consultation@santos.com
or scan the QR code.

Social media

- 17 May 2023 – 12 June 2023 Geotargeted Darwin (Facebook, Instagram, Messenger)



Radio

- 22 May 2023 – 7 June 2023 Darwin radio

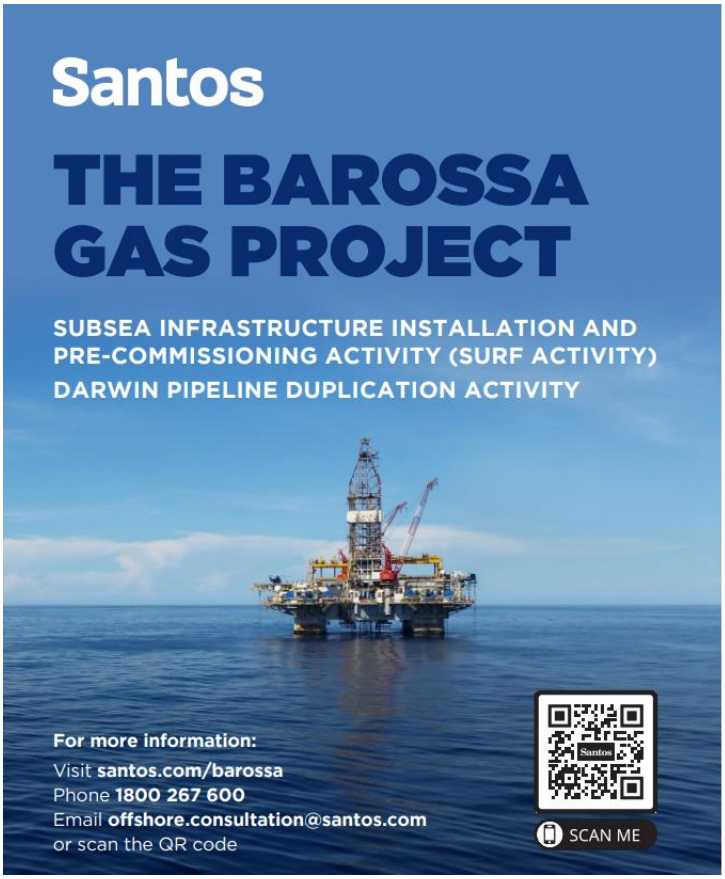
Script:

Santos is holding Barossa Gas Project consultation drop-in sessions on 22 May and 8 June in Darwin. Relevant persons can nominate for consultation, give feedback and ask questions.

For more information, including who is a relevant person and proposed project activities, visit santos.com/barossa, phone 1800 267 600, or email offshore.consultation@santos.com

Second round half page advertisement

- 4 x Northern Territory News



Santos is preparing environment plans, as required by legislation, regarding activities for the Barossa Gas Project – a project that involves extracting natural gas from the Barossa field, located in Commonwealth waters approximately 285 kilometres offshore north-north west from Darwin, and transporting it to the existing Darwin liquefied natural gas (DLNG) plant.

We are currently consulting with relevant persons whose functions, interests or activities may be affected by certain Project activities.

Santos will hold a community consultation drop-in session on Monday 17 July 2023 to provide information and answer questions about our proposed SURF Activity. Information about the proposed SURF Activity and who may be a relevant person for consultation is available at santos.com/barossa or by scanning the QR code.

Attendees can also seek general updates on the Project, including an overview of the proposed Darwin Pipeline Duplication activity, which relates to a 23km underwater pipeline and supporting subsea infrastructure in Commonwealth waters, in an area approximately 95 km north-west of Darwin.

Monday 17 July 2023

Darwin Convention Centre
10 Stokes Hill Road,
Darwin City
9:00am – 4:00pm

Social media

10 July – 17 July geotargeted NT

Radio

- 7 July 2023 – 17 July 2023 Darwin radio

Radio script:

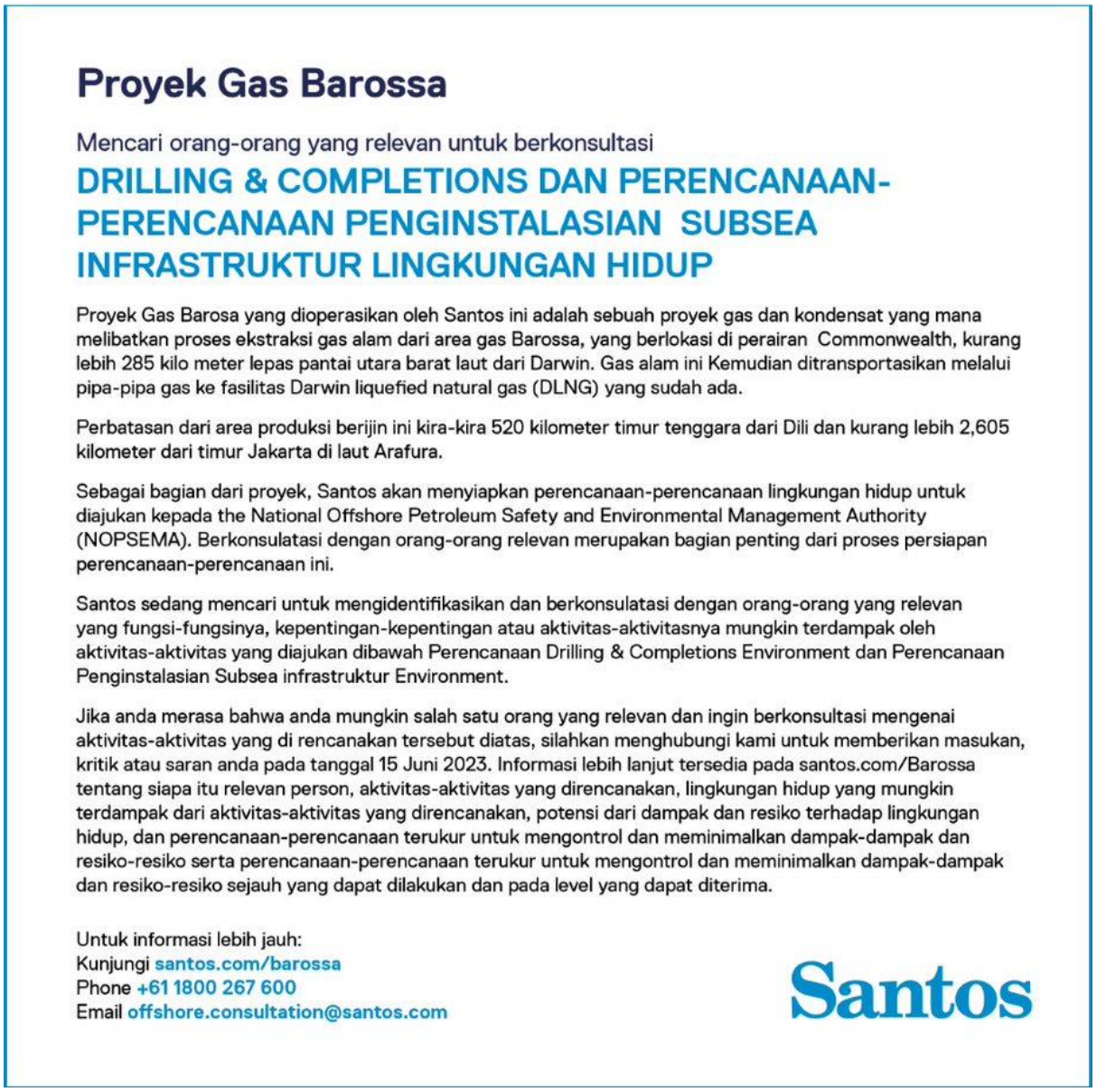
Santos is holding a Barossa Gas Project consultation drop-in session on Monday 17 July at the Darwin Convention Centre. Relevant persons can nominate for consultation, give feedback and ask questions.

For more information, including about the Project, who is a relevant person, and the project activities we are consulting on, visit santos.com/barossa, phone 1800 267 600, or email offshore.consultation@santos.com

Table 4.11 Targeted international phase

Social media

- 3 May 2023 – 22 May 2023 Geotargeted Indonesia and Timor-Leste (Facebook, Instagram and Messenger)
- 22 May 2023 – 15 June 2023 Geotargeted Timor-Leste in Tetum (Facebook, Instagram and Messenger)
- 23 May 2023 – 15 June 2023 Geotargeted Indonesia in Bahasa (Facebook, Instagram and Messenger)
- 20 June 2023 – 14 July 2023 Geotargeted NT & WA, Indonesia and Timor-Leste (Facebook, Instagram and Messenger)
- 18 July 2023 – 4 August 2023 Geotargeted Australia, Indonesia and Timor-Leste (Facebook, Instagram and Messenger)



Proyek Gas Barossa

Mencari orang-orang yang relevan untuk berkonsultasi

DRILLING & COMPLETIONS DAN PERENCANAAN-PERENCANAAN PENGINSTALASIAN SUBSEA INFRASTRUKTUR LINGKUNGAN HIDUP

Proyek Gas Barosa yang dioperasikan oleh Santos ini adalah sebuah proyek gas dan kondensat yang mana melibatkan proses ekstraksi gas alam dari area gas Barossa, yang berlokasi di perairan Commonwealth, kurang lebih 285 kilo meter lepas pantai utara barat laut dari Darwin. Gas alam ini Kemudian ditransportasikan melalui pipa-pipa gas ke fasilitas Darwin liquefied natural gas (DLNG) yang sudah ada.

Perbatasan dari area produksi berijin ini kira-kira 520 kilometer timur tenggara dari Dili dan kurang lebih 2,605 kilometer dari timur Jakarta di laut Arafura.

Sebagai bagian dari proyek, Santos akan menyiapkan perencanaan-perencanaan lingkungan hidup untuk diajukan kepada the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA). Berkonsulatasi dengan orang-orang relevan merupakan bagian penting dari proses persiapan perencanaan-perencanaan ini.

Santos sedang mencari untuk mengidentifikasikan dan berkonsulatasi dengan orang-orang yang relevan yang fungsi-fungsinya, kepentingan-kepentingan atau aktivitas-aktivitasnya mungkin terdampak oleh aktivitas-aktivitas yang diajukan dibawah Perencanaan Drilling & Completions Environment dan Perencanaan Penginstalasian Subsea infrastruktur Environment.

Jika anda merasa bahwa anda mungkin salah satu orang yang relevan dan ingin berkonsultasi mengenai aktivitas-aktivitas yang di rencanakan tersebut diatas, silahkan menghubungi kami untuk memberikan masukan, kritik atau saran anda pada tanggal 15 Juni 2023. Informasi lebih lanjut tersedia pada santos.com/Barossa tentang siapa itu relevan person, aktivitas-aktivitas yang direncanakan, lingkungan hidup yang mungkin terdampak dari aktivitas-aktivitas yang direncanakan, potensi dari dampak dan resiko terhadap lingkungan hidup, dan perencanaan-perencanaan terukur untuk mengontrol dan meminimalkan dampak-dampak dan resiko-resiko serta perencanaan-perencanaan terukur untuk mengontrol dan meminimalkan dampak-dampak dan resiko-resiko sejauh yang dapat dilakukan dan pada level yang dapat diterima.

Untuk informasi lebih jauh:
Kunjungi santos.com/barossa
Phone +61 1800 267 600
Email offshore.consultation@santos.com

Santos

Projetu Gas Barossa

Buka hela ema apropriadu sira hodi halo konsultasaun

PERFURASAUN & KONKLUZAUN NO PLANU AMBIENTAL BA INSTALASAUN INFRASTUTURA SUBMARINUP

Projetu Gas Barossa, operadu husi kompanhia Santos sai hanesan projetu ida ba gas no kondensadu ne'ebe sei involve dada sai gas natural husi kampo gas Barossa, lokalizadu iha area tasi Commonwealth, aproximadamente kilometru 285 husi kosta norte noroeste husi Darwin. Depois sei halo transportasaun ba gas natural liu husi kadoras gas ninian ba iha fasilidade Darwin liquified natural gas (DLNG) ne'ebe existe hela.

Baliza husi area lisensa ba produsaun maka aproximadamente kilometru 520 leste sudeste husi Dili no aproximadamente kilometru 2,605 leste husi Jakarta, iha tasi Arafura.

Hanesan parte husi projetu, kompanhia Santos sei prepara planu ambiental hodi hatama ba National Offshore Petroleum Safety and Environmental Management Authority (NOSPEMA).

Konsultasaun ho ema relevante sira sai hanesan parte importante ida hodi prepara plano sira ne.

Santos buka hela atu identifika no konsulta ho ema relevante sira ne'ebe maka ninia kna'ar, interese ou aktividade sira bele hetan afetadu husi proposta ba aktividades sira husi ami nia proposta ba Planu Ambiental ba Perfurasaun no Konkluzaun nomos Planu Ambiental ba Instalasaun Infrastutura Submarinu.

Karik ita bo'ot konsidera ita nia aan nudar ema ne'ebe relevante no hakarak simu konsultasaun relasiona ho atividade proposta mensiona iha leten, halo favor kontaktu mai ami hodi fornese ita bo'ot nia feedback ou hanoin tarde liu iha data 15 Junho 2023.

Informasaun klean liu tan konaba se mak sai hanesan ema apropriadu, proposta ba aktividades sira, ambiente ne'ebe bele sai afeitadu husi proposta ba aktividades sira, potensia sira ba impaktu no risku ambiental, nomos proposta ba sasukat kontrolu sira hodi reduz impaktu no risku sira to'o nivel ida razoavelmente praktikavel no aseitavel kiik liu, bele hetan iha santos.com/barossa.

Ba informasaun klean liu tan:
Visita santos.com/barossa
Telefone +61 1800 267 600
Email offshore.consultation@santos.com

Santos

Table 4-13 Notification and Advertising of Consultation Sessions

Tiwi community engagement sessions February 2023

Full page advertisement

- 3 x Northern Territory News

We're Listening

Santos

Santos Consultation Meeting

BAROSSA GAS DEVELOPMENT PROJECT

Santos is a global low-cost producer of oil and gas committed to ever-cleaner energy and fuels production with operations across Australia, Papua New Guinea, Timor-Leste and North America. Our Barossa Gas Development project, located approximately 300 kilometres offshore from Darwin, will transport natural gas to the existing Darwin liquefied natural gas (DLNG) plant. It has the potential to create and sustain hundreds of jobs in the Northern Territory (NT) and inject significant money into the NT economy through the purchase of local goods and services during both construction and operations.

We believe in developing strong, mutually beneficial relationships with communities where we operate, and your feedback is important to us achieving this. We want a productive working relationship with the Tiwi people and to hear from you what is important to your country and community. To achieve this, Santos will hold regular community consultation sessions. Our next session will be held with the below communities on the Tiwi Islands:

MONDAY, 6 February, 10.30am	TUESDAY, 7 February, 10.30am	WEDNESDAY, 8 February, 10.30am
Milikapiti Sport & Recreation Centre	**Pirlangimpi Club**	**Mantiyupwi Motel Meeting Room**

At this session we will provide you with an opportunity to:

- hear about the project including the pipelaying and drilling programs and plans
- tell us how you want us to consult with you and your community on this important project
- have your questions answered.

There will be regular consultation and engagement sessions where you and your community can learn more about the project and we can listen to your feedback and input. This will help us to understand your concerns and issues and to hear from you on how you want us to consult. We will carefully assess all your feedback and consider this in the way we consult with you on our upcoming plans and when developing the content of these plans. Further information – including fact sheets, maps and reports – will be provided at the consultation session.

If you require further information or would like to speak to us, please do not hesitate to contact us on 1800 267 600 or via email at Offshore.Consultation@santos.com

Social Media

Saturday 7 January – 4 February 2023 – Geotargeted Tiwi Islands

We're Listening

Santos

Santos Consultation Meeting

BAROSSA GAS DEVELOPMENT PROJECT

Santos is a global low-cost producer of oil and gas committed to ever-cleaner energy and fuels production with operations across Australia, Papua New Guinea, Timor-Leste and North America. Our Barossa Gas Development project, located approximately 300 kilometres offshore from Darwin, will transport natural gas to the existing Darwin liquefied natural gas (DLNG) plant. It has the potential to create and sustain hundreds of jobs in the Northern Territory (NT) and inject significant money into the NT economy through the purchase of local goods and services during both construction and operations.

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MONDAY, 6 February, 10.30am	TUESDAY, 7 February, 10.30am	WEDNESDAY, 8 February, 10.30am
Milikapiti Sport & Recreation Centre	**Pirlangimpi Club**	**Mantiyupwi Motel Meeting Room**

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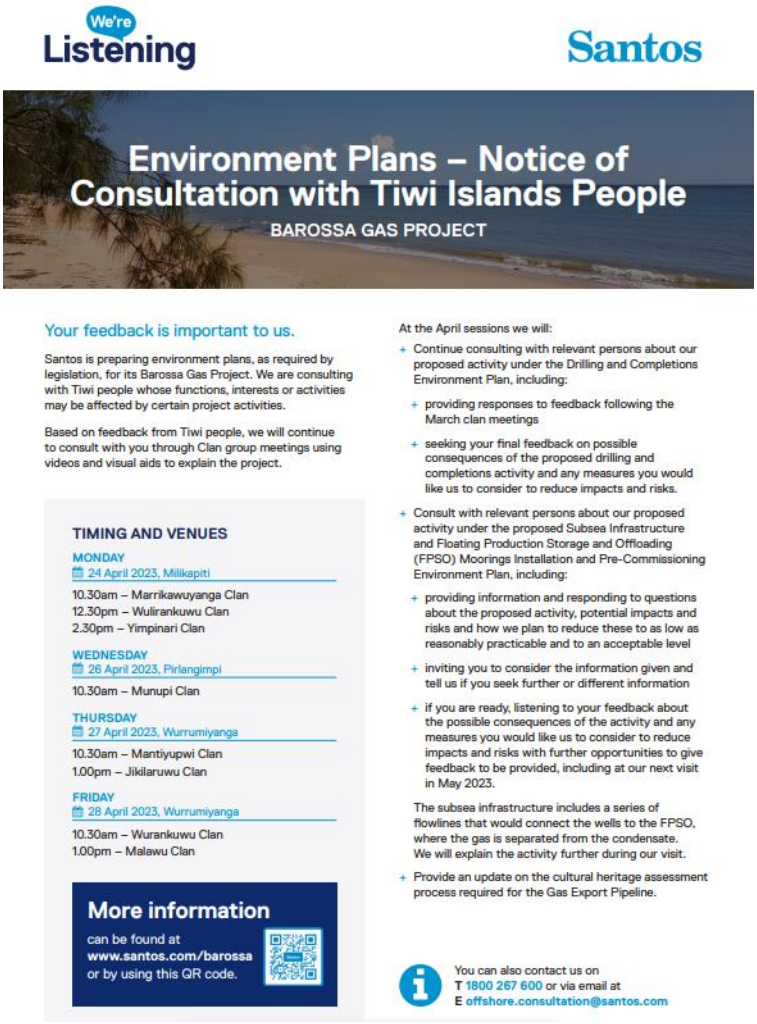
If you require further information or would like to speak to us, please do not hesitate to contact us on 1800 267 600 or via email at Offshore.Consultation@santos.com

Tiwi community engagement sessions April/May 2023 2023

Full page advertisement

- 5 x Northern Territory News



Advertisement updated 1

We're Listening

Santos

UPDATED

Environment Plans – Notice of Consultation with Tiwi Islands People

BAROSSA GAS PROJECT

Your feedback is important to us.

Santos is preparing environment plans, as required by legislation, for its Barossa Gas Project. We are consulting with Tiwi people whose functions, interests or activities may be affected by certain project activities.

Based on feedback from Tiwi people, we will continue to consult with you through Clan group meetings using videos and visual aids to explain the project.

TIMING AND VENUES

WEDNESDAY
26 April 2023, Pirlangimpi
10.30am – Munupi Clan

THURSDAY
27 April 2023, Wurrumiyanga
10.30am – Mantiyupwi Clan
1.00pm – Jikilaruwu Clan

FRIDAY
28 April 2023, Wurrumiyanga
10.30am – Wurankuwu Clan
1.00pm – Malawu Clan

THURSDAY
4 May 2023, Milikapiti
Please note new dates of meetings in Milikapiti
10.30am – Marrikawuyanga Clan
12.30pm – Wulirankuwu Clan
2.30pm – Yimpinari Clan

More information
can be found at
www.santos.com/barossa
or by using this QR code.

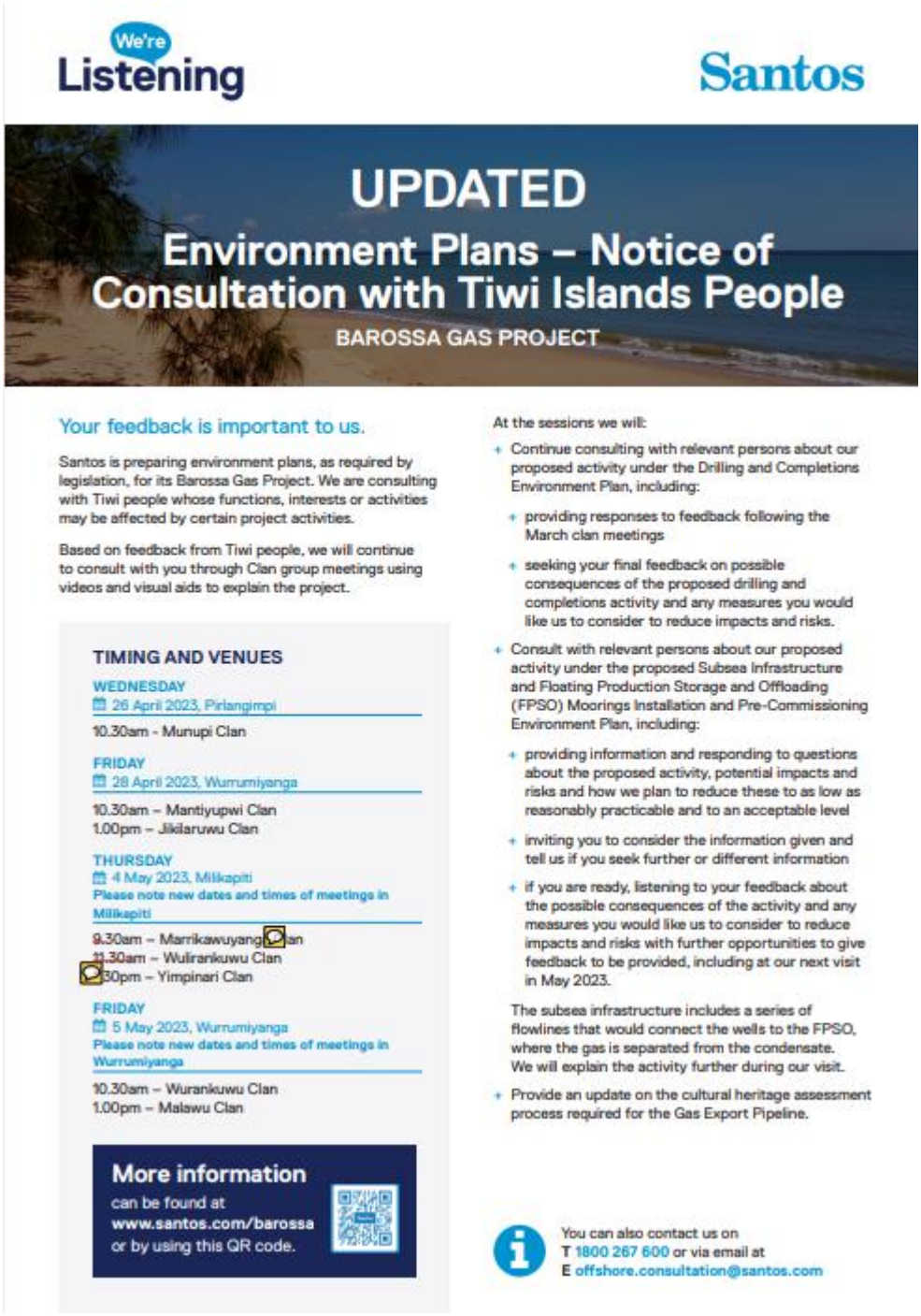
At the sessions we will:

- Continue consulting with relevant persons about our proposed activity under the Drilling and Completions Environment Plan, including:
  - providing responses to feedback following the March clan meetings
  - seeking your final feedback on possible consequences of the proposed drilling and completions activity and any measures you would like us to consider to reduce impacts and risks.
- Consult with relevant persons about our proposed activity under the proposed Subsea Infrastructure and Floating Production Storage and Offloading (FPSO) Moorings Installation and Pre-Commissioning Environment Plan, including:
  - providing information and responding to questions about the proposed activity, potential impacts and risks and how we plan to reduce these to as low as reasonably practicable and to an acceptable level
  - inviting you to consider the information given and tell us if you seek further or different information
  - if you are ready, listening to your feedback about the possible consequences of the activity and any measures you would like us to consider to reduce impacts and risks with further opportunities to give feedback to be provided, including at our next visit in May 2023.

  The subsea infrastructure includes a series of flowlines that would connect the wells to the FPSO, where the gas is separated from the condensate. We will explain the activity further during our visit.
- Provide an update on the cultural heritage assessment process required for the Gas Export Pipeline.

You can also contact us on
T 1800 267 600 or via email at
E offshore.consultation@santos.com

Advertisement updated 2



Social Media

- Saturday 28 March – 5 May 2023 – Geotargeted Tiwi Islands

(Same content as advertisements above)

Tiwi community engagement sessions June 2023

Full page advertisement

- 4 x Northern Territory News

Santos

Notice of Consultation with Tiwi Islands People

BAROSSA GAS PROJECT

Drilling and Completions Environment Plan
Subsea Infrastructure Installation Environment Plan

Your feedback is important to us.

Santos is preparing environment plans for its Barossa Gas Project, as required by legislation. We are consulting with Tiwi people whose functions, interests or activities may be affected by project activities proposed under the environment plans listed above. Based on feedback from Tiwi people, we will continue to consult with you through Clan group meetings using videos and visual aids to explain the project.

At the sessions we will:

- Continue consulting with relevant persons about our proposed activity under the **Drilling and Completions Environment Plan**, including:
  - providing responses to feedback following the April and May clan meetings
  - updating you about any measures we propose to adopt in our environment plan as a result of your feedback before it is submitted to the regulator for assessment
  - if any feedback is outstanding, seeking your final feedback on possible consequences of the proposed drilling and completions activity and any further measures you would like us to consider to reduce impacts and risks.
- Continue consulting with relevant persons about our proposed activity under the proposed **Subsea Infrastructure Installation Environment Plan**, including:
  - providing responses to feedback following the April and May clan meetings
  - seeking your final feedback on possible consequences of the subsea infrastructure installation and pre-commissioning activity and any measures you would like us to consider to reduce impacts and risks.

TIMING AND VENUES

TUESDAY
13 June 2023, Milikapiti
10.30am – Marrikawuyanga & Yimpinari Clans
1.00pm – Wulirankuwu

WEDNESDAY
14 June 2023, Wurrumiyanga
10.30am – Mantiyupwi Clan
1.00pm – Jikilaruwu Clan

THURSDAY
15 June 2023, Wurrumiyanga
10.30am – Wurankuwu Clan
1.00pm – Malawu Clan

FRIDAY
16 June 2023, Pirlangimpi
10.30am – Munupi Clan

You can also contact us on
T 1800 267 600 or via email at
E offshore.consultation@santos.com

More information
can be found at
www.santos.com/barossa
or by using this QR code.
SCAN ME

Social Media

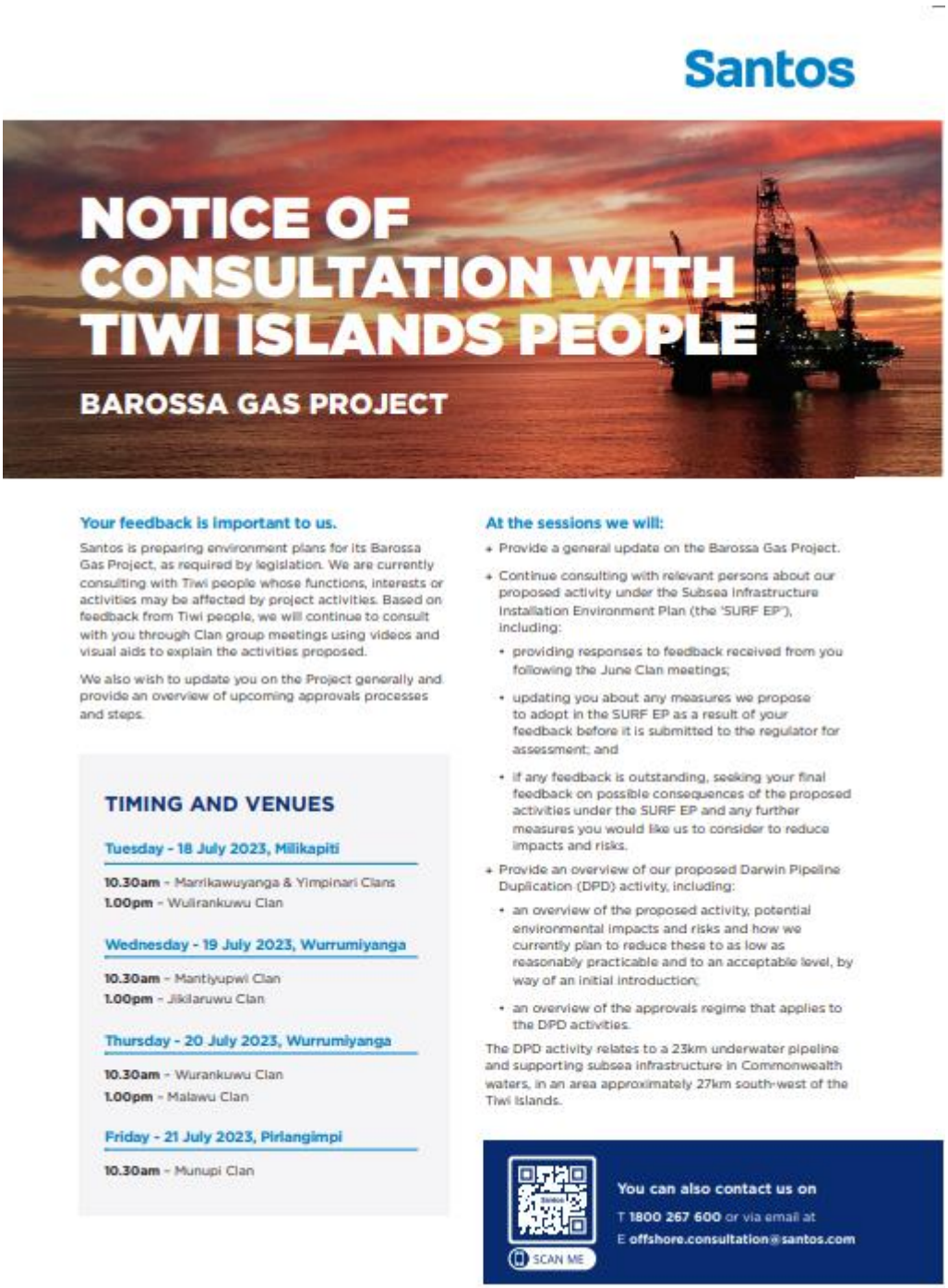
Saturday 12 May – 16 June 2023 – Geotargeted Tiwi Islands

(Same content as advertisement above)

Tiwi community engagement sessions August 2023

Full page advertisement

- 6 x Northern Territory News



Santos

NOTICE OF CONSULTATION WITH TIWI ISLANDS PEOPLE

BAROSSA GAS PROJECT

Your feedback is important to us.

Santos is preparing environment plans for its Barossa Gas Project, as required by legislation. We are currently consulting with Tiwi people whose functions, interests or activities may be affected by project activities. Based on feedback from Tiwi people, we will continue to consult with you through Clan group meetings using videos and visual aids to explain the activities proposed.

We also wish to update you on the Project generally and provide an overview of upcoming approvals processes and steps.

TIMING AND VENUES

Tuesday - 18 July 2023, Milikapiti

10.30am - Marrikawuyanga & Yimpinari Clans
1.00pm - Wulirankuwu Clan

Wednesday - 19 July 2023, Wurrumiyanga

10.30am - Mantiyupwi Clan
1.00pm - Jikilaruwu Clan

Thursday - 20 July 2023, Wurrumiyanga

10.30am - Wurankuwu Clan
1.00pm - Malawu Clan

Friday - 21 July 2023, Pirlangimpi

10.30am - Munupi Clan

At the sessions we will:

- Provide a general update on the Barossa Gas Project.
- Continue consulting with relevant persons about our proposed activity under the Subsea Infrastructure Installation Environment Plan (the 'SURF EP'), including:
  - providing responses to feedback received from you following the June Clan meetings;
  - updating you about any measures we propose to adopt in the SURF EP as a result of your feedback before it is submitted to the regulator for assessment; and
  - if any feedback is outstanding, seeking your final feedback on possible consequences of the proposed activities under the SURF EP and any further measures you would like us to consider to reduce impacts and risks.
- Provide an overview of our proposed Darwin Pipeline Duplication (DPD) activity, including:
  - an overview of the proposed activity, potential environmental impacts and risks and how we currently plan to reduce these to as low as reasonably practicable and to an acceptable level, by way of an initial introduction;
  - an overview of the approvals regime that applies to the DPD activities.

The DPD activity relates to a 23km underwater pipeline and supporting subsea infrastructure in Commonwealth waters, in an area approximately 27km south-west of the Tiwi Islands.

SCAN ME

You can also contact us on

T **1800 267 600** or via email at
E **offshore.consultation@santos.com**

Advertisement updated 1

UPDATED

Santos

NOTICE OF CONSULTATION WITH TIWI ISLANDS PEOPLE

BAROSSA GAS PROJECT

Your feedback is important to us.

Santos is preparing environment plans for its Barossa Gas Project, as required by legislation. We are currently consulting with Tiwi people whose functions, interests or activities may be affected by project activities. Based on feedback from Tiwi people, we will continue to consult with you through Clan group meetings using videos and visual aids to explain the activities proposed.

We also wish to update you on the Project generally and provide an overview of upcoming approvals processes and steps.

TIMING AND VENUES

Wednesday 26th July, Milikapiti
Milikapiti Sport & Recreation Centre

10.30am - Marrikawuyanga & Yimpinari Clans
1.00pm - Wullrankuwu Clan

Thursday 27th July, Pirlangimpi
Pirlangimpi Sports & Social Club

10.30am - Munupi Clan

Tuesday 1st August, Wurrumiyanga
Mantiyupwi Motel

10.30am - Mantiyupwi Clan
1.00pm - Jikilaruwu Clan

Wednesday 2nd August, Wurrumiyanga
Mantiyupwi Motel.

10.30am - Wurankuwu Clan
1.00pm - Malawu Clan

At the sessions we will:

+ Provide a general update on the Barossa Gas Project.
+ Continue consulting with relevant persons about our proposed activity under the Subsea Infrastructure Installation Environment Plan (the 'SURF EP'), including:
  - providing responses to feedback received from you following the June Clan meetings;
  - updating you about any measures we propose to adopt in the SURF EP as a result of your feedback before it is submitted to the regulator for assessment; and
  - if any feedback is outstanding, seeking your final feedback on possible consequences of the proposed activities under the SURF EP and any further measures you would like us to consider to reduce impacts and risks.
+ Provide an overview of our proposed Darwin Pipeline Duplication (DPD) activity, including:
  - an overview of the proposed activity, potential environmental impacts and risks and how we currently plan to reduce these to as low as reasonably practicable and to an acceptable level, by way of an initial introduction;
  - an overview of the approvals regime that applies to the DPD activities.

The DPD activity relates to a 23 kilometre underwater pipeline and supporting subsea infrastructure in Commonwealth waters, in an area approximately 27 kilometres south-west of the Tiwi Islands. It also relates to a further connected 100 kilometres of pipeline and supporting subsea infrastructure in Northern Territory (NT) waters, extending to the existing Darwin Liquified Natural Gas (DLNG) facility.

SCAN ME

You can also contact us on

T **1800 267 600** or via email at

E **offshore.consultation@santos.com**

Advertisement updated 2

Social Media

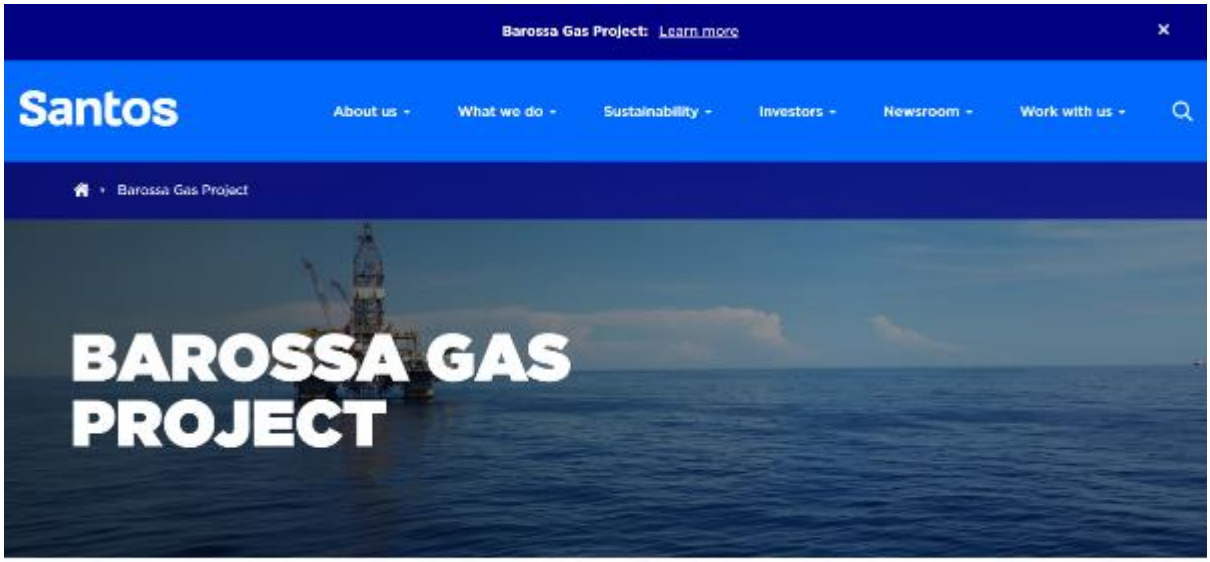
Saturday 17 July – 8 August 2023 – Geotargeted Tiwi Islands

(Same content as advertisements above)

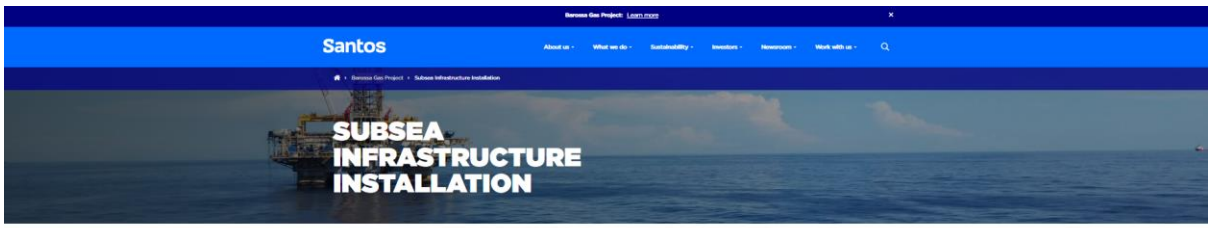
Appendix F Relevant Persons advertisements

1. Webpage

Barossa Project webpage



Subsea Infrastructure Installation webpage



Contents:

Santos's proposed Barossa Gas Project is an offshore gas and condensate project that proposes to provide a new source of gas to the existing Darwin liquified natural gas (DLNG) facility in the Northern Territory. Natural gas would be extracted from the offshore Barossa field, located in Commonwealth waters approximately 285 kilometres offshore north-north west from Darwin, in the Arafura Sea, and transported via gas pipeline (Gas Export Pipeline (GEP) and Darwin Pipeline Duplication (DPDD)) to the existing DLNG facility. The Barossa Gas Project will comprise a Floating Production Storage and Offloading facility (FPSO), a subsea production system, supporting in-field subsea infrastructure and a Gas Export Pipeline (GEP).

Santos is currently preparing an environment plan (the Subsea Infrastructure Installation Environment Plan, more simply referred to as the 'SURF EP') in respect of a part of the Barossa Gas Project. The SURF EP relates to the Subsea Umbilicals, Risers and Flowlines (SURF), manifolds and Floating Production Storage and Offloading (FPSO) moorings installation (collectively referred to as 'subsea infrastructure installation') and pre-commissioning activity. All of this is more simply referred to as the 'SURF activity'.

A glossary of terms used throughout this page can be found here.

2. Information booklets and factsheets

Subsea Infrastructure Installation and Pre-commissioning Activity Information Booklet

Santos

BAROSSA GAS PROJECT

Subsea Infrastructure Installation and Pre-commissioning Activity Information Booklet

Santos is continuing its Barossa Gas Project consultation efforts to further ascertain, understand and assess values and sensitivities of the environment that may be affected by our proposed activities, and potential environmental impacts and risks. There may be information Santos is not yet aware of but needs to properly understand to assess potential activity impacts and risks. Consultation may inform this. It may also inform what control measures are to be proposed to reduce environmental impacts and risks to as low as reasonably practicable and to an acceptable level.

This consultation material specifically relates to the Subsea Infrastructure Installation Environment Plan (SURF EP).

Overview

Santos is a global energy company committed to helping the world decarbonise to reach net-zero emissions through reliable and affordable energy. For more than 65 years, Santos has been working in partnership with local communities, providing local jobs and business opportunities, safely developing its natural gas resources, and powering industries and households.

The Santos-operated Barossa Gas Project is an offshore gas and condensate project that proposes to provide a new source of gas to the existing Darwin liquified natural gas (DLNG) facility in the Northern Territory. Natural gas would be extracted from the Barossa field, located in Commonwealth waters approximately 285 kilometres offshore north-north west from Darwin, and transported via a gas pipeline (Gas Export Pipeline (GEP) and Darwin Pipeline Duplication (DPD)) to the existing DLNG facility, with first gas targeted for 2025.

Project infrastructure would comprise a Floating Production Storage and Offloading (FPSO) facility, a subsea production system, supporting in-field subsea infrastructure, the GEP and the DPD.

Santos plans to drill six (6) subsea development wells at three (3) drill centres, with contingency plans for an additional two (2) wells. Gas and condensate would be gathered from the wells through the subsea production system and then brought to the FPSO facility via a network of subsea infrastructure.

Initial processing would occur at the FPSO facility, to separate the natural gas, water and condensate extracted from the Barossa field. The dry natural gas would be transported through the gas pipeline for onshore processing at the DLNG facility. Condensate would be transferred from the FPSO to specialised tankers for export.

Environmental approvals

The Commonwealth Government's independent expert regulator for offshore oil and gas development, the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA), accepted the Barossa Offshore Project Proposal (OPP) in March 2018.

Acceptance of the OPP is the government's project-level environmental approval for offshore projects, with construction and operations subject to further acceptance of activity-level environment plans (EPs).

To be accepted by NOPSEMA, an EP must meet the requirements set out in *the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (OPGGS Environment Regulations).

The OPGGS Environment Regulations set out that an EP must (among other things):

+ comprehensively describe the activity to be carried out under the EP
+ describe the environment that may be affected by the activity, including the values and sensitivities of that environment
+ detail and evaluate the environmental impacts and risks for the relevant activity
+ demonstrate that the impacts and risks of the activity will be reduced to as low as reasonably practicable and an acceptable level (and detail the control measures to be used to achieve this)
+ demonstrate that Santos has consulted, in accordance with regulatory requirements, with each relevant person, including those whose functions, interests or activities may be affected by the activities to be carried out under the EP
+ demonstrate that the measures (if any) that Santos has adopted, or proposes to adopt, because of the consultations are appropriate.

Santos is currently preparing an environment plan (the SURF EP) in respect of a part of the Barossa Gas Project relating to the Subsea Umbilicals, Risers and Flowlines (SURF), manifolds and FPSO moorings installation (collectively referred to as 'subsea infrastructure installation') and pre-commissioning activity. This is more simply referred to as the 'SURF activity'.

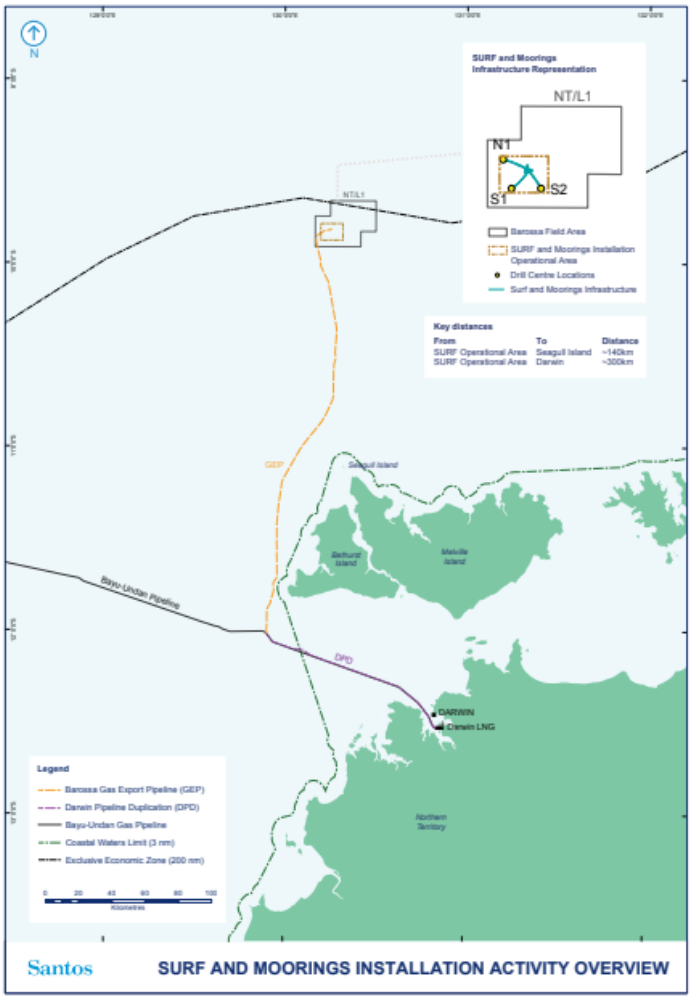


Figure 1 – Barossa overview and SURF environment plan operational area

Activity and location

The SURF EP provides for the Barossa SURF and moorings installation and pre-commissioning activities, which comprise the key infrastructure shown in Figure 2. The SURF and moorings infrastructure has been designed to support the connection of six (6) subsea production wells to the FPSO. Drilling of the wells, and use of the FPSO, are dealt with under separate EPs. The SURF and moorings installation and pre-commissioning campaign (SURF campaign) will be undertaken within Commonwealth waters within the boundaries of Commonwealth Petroleum Production Licence NT/L1, which is approximately 300 kilometres north-north west of Darwin, NT. The operational area is approximately 140 kilometres north of the Tiwi Islands, NT and approximately 44 kilometres north of the Oceanic Shoals Marine Park (Figure 1 and Figure 9).

The total duration of the SURF campaign is estimated to be approximately nine months, subject to factors including vessel availability, operational efficiencies and weather conditions. This campaign is currently planned to commence between Q1 2024 and Q4 2025, subject to obtaining regulatory approvals. The preservation phase commences on completion of installation of key infrastructure and pre-commissioning activities. The preservation phase is designed to maintain the integrity of the infrastructure. The preservation phase for the subsea infrastructure will last up until commissioning, i.e. upon the commencement of activities under the Barossa Production Operations Environment Plan.

The operational area covered under this EP is the area within which all planned activities will occur. The operational area is defined as approximately 10 kilometres by 13.5 kilometres. Figure 1 shows the proposed location and operational area of the SURF Activity.

Activity vessels and helicopters within the operational area are considered part of the activity under the SURF EP.

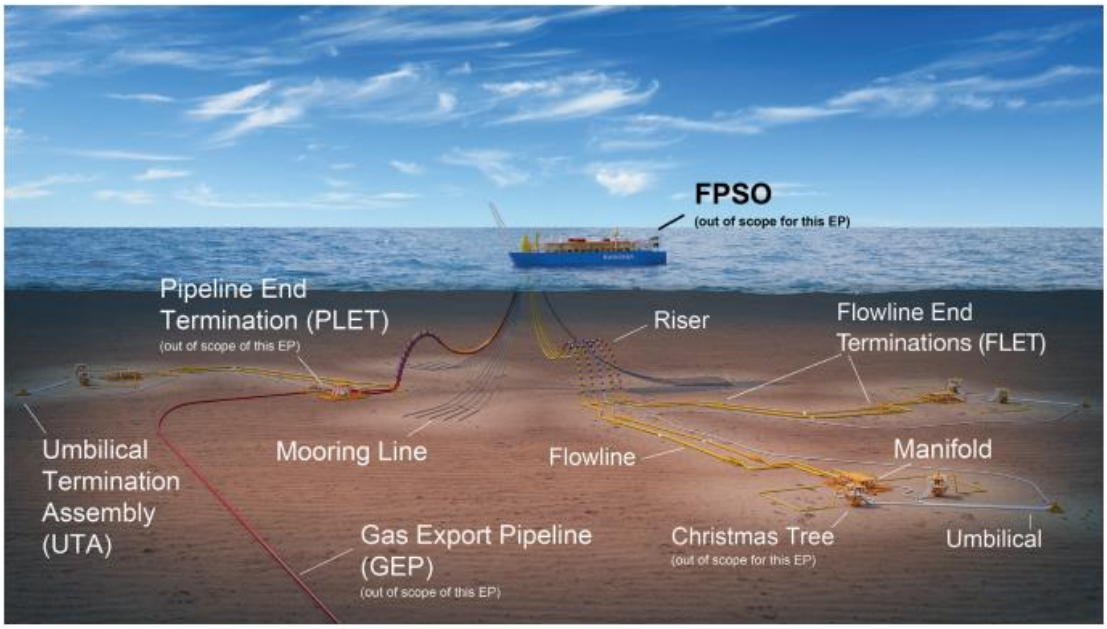


Figure 2 – Graphical representation of the Barossa field layout

Overview of proposed activities under SURF EP

The key installation activities proposed under the SURF EP include the following:

Underwater acoustic positioning

Installation of the subsea infrastructure requires accurate positioning on the seabed and therefore long baseline (LBL) and/or ultra short baseline (USBL) acoustic positioning may be required. These systems provide accuracy up to one metre. LBL and USBL systems work by emitting short pulses of medium to high-frequency sound. Transmissions are not continuous but comprise short 'chirps'. Typically, for USBL positioning, transponders are attached to subsea equipment and recovered once the equipment is correctly positioned on the seabed. For LBL, transponders are typically fixed to seabed frames, which are deployed and then fully recovered once the subsea equipment is correctly positioned.

Underwater surveys

An initial pre-lay survey is planned to be undertaken before flowline, umbilical and other infrastructure installation activities commence. An explanation of activities is provided below. These pre-lay surveys identify debris, seabed features or obstructions along the flowline and umbilical routes, or other areas where infrastructure is to be installed. It is not a full geophysical survey. The survey methods do not disturb the seabed but instead primarily include multibeam echo sounder (MBES), side-scan sonar (SSS) and magnetometer. An allowance of 50m on either side of the flowline and umbilical routes allows for localised rerouting if any significant obstructions or potential areas of spanning (where a gap may be present between the flowline or umbilical and the seabed) are identified during the pre-lay survey. Site surveys have already been undertaken for the flowline route and no debris was identified that would need to be removed before installation. However, if debris is identified during the pre-lay survey, the debris will be assessed using the Barossa Unexpected Finds Protocol to minimise potential impacts to any heritage and cultural objects and values.

As-laid, as-built and as-constructed surveys will also be progressively undertaken throughout the SURF campaign. The data from these surveys will be used to determine the final subsea infrastructure position.

Moorings installation

The floating production storage and offloading unit (FPSO), which is a vessel that will be used for the production, processing of hydrocarbons and the storage of gas (and which is not within the scope of the SURF EP), will be secured through a mooring system. The mooring system uses mooring lines, suction anchors and a Submerged Turret Production (STP) Buoy. Suction anchors are steel cylindrical structures that anchor mooring lines to the FPSO to keep it in position (Figure 3). The suction anchors have been designed to suit the local seabed's geotechnical properties. Fifteen suction anchors will be installed, one for each mooring line. The expected total footprint is less than 2 hectares. Suction anchors with short anchor chain segments pre-attached to each anchor's padeye (i.e. attachment point) will be installed using either the reel-lay or the construction vessel, which are explained below in the section on installation vessels. The vessel crane will lift the suction anchors from a barge deck to the seabed, then a Remotely Operated Vehicle (ROV) will help position and orientate the anchors. The suction anchor will penetrate the seabed under its own weight up to a self-penetration depth; further penetration to full depth will be achieved when the ROV docks onto the anchor top and pumps out the sea water within the suction anchor. Mooring lines will then be installed to attach the suction anchor to the STP Buoy (Figure 4), which secures the FPSO to the mooring system and will eventually be attached to the FPSO.

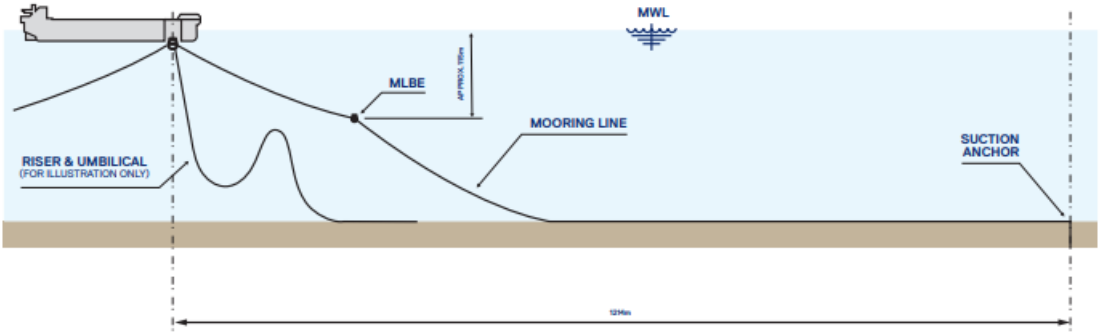


Figure 3 – Arrangement of suction anchors and mooring lines

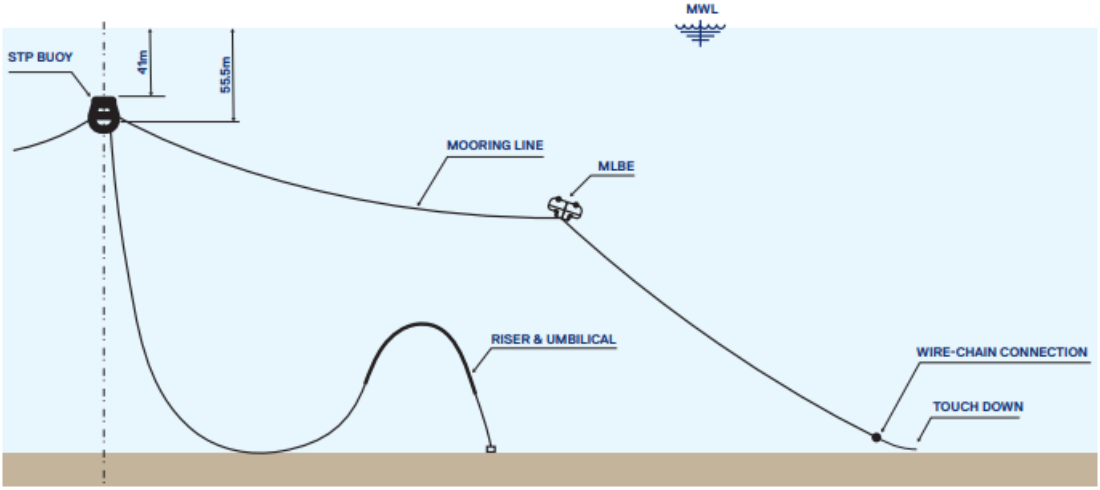


Figure 4 – Connection of the mooring line to the STP Buoy

Flowline lay

Flowlines are pipelines that will carry gas and condensate extracted from the wells to the FPSO. There will be three 14" production and three 6" service flowlines ranging from approximately 5,000– 7,000 metres long (nominally). Each flowline will have corrosion coating. The reel-lay vessel will install the flowlines using a reel-lay installation method (explained below). These flowlines will be prefabricated (welded) then reeled and stored on a large diameter reel on the vessel's deck. The vessel sails to the operational area and the flowlines are laid (or un-wound) off the reel and carefully positioned along their designed route on the seabed. Tie-in welds for Flow Line End Termination (FLET) connections will be welded on the vessel. The vessel may carry more than one flowline at a time.

The reel-lay vessel may be required to reload with flowlines during the campaign and this will likely take place outside the operational area. Lay direction may be from the FPSO location towards the drill centre or vice versa, depending on operational requirements. The production flowlines will be installed empty (air-filled), while the service flowlines will be installed pre-flooded.

The flowline goes through a straightening process and passes through the vessel's tensioners in a lay tower at the vessel's stern—the tower angle is adjusted for water depth and bottom pipe tension.

Tension is applied to the flowline by the reel-lay vessel's tensioners and forward Dynamic Positioning (DP) thrust to maintain the appropriate catenary (the shape the flowline takes when suspended from the reel-lay vessel to the seabed) and prevent the flowline from buckling as it is lowered to the seabed. The reel-lay vessel will proceed forwards at a pre-determined speed. Each flowline will be laid over the displacement initiators and touchdown mattresses and then scour protection will be installed as required.

Manifold installation

Manifolds are installed to assist with gathering and controlling the flow of gas and condensate safely between the wells and the FPSO. Production and riser base manifold foundations are steel structures that provide long-term support for manifolds and are designed to suit the local seabed's geotechnical properties. Four manifold foundations will be installed (one for each manifold). Production manifold foundations (with scour protection) are expected to have a footprint of approximately 500m2. The manifold foundations and manifolds will be installed by the construction vessel. The manifolds will arrive pre-flooded with monoethylene glycol (MEG). MEG is a widely used hydrate inhibitor in the oil and gas industry to reduce the risk of hydrate formation in infrastructure that could cause a blockage. The vessel crane will lift the manifold foundations and manifolds from the barge's deck to the seabed where an ROV may be used to position and orientate the structures. Once in place, the manifolds sit on the foundations and do not add to the seabed disturbance footprint. See Figure 5 for an image of a manifold.

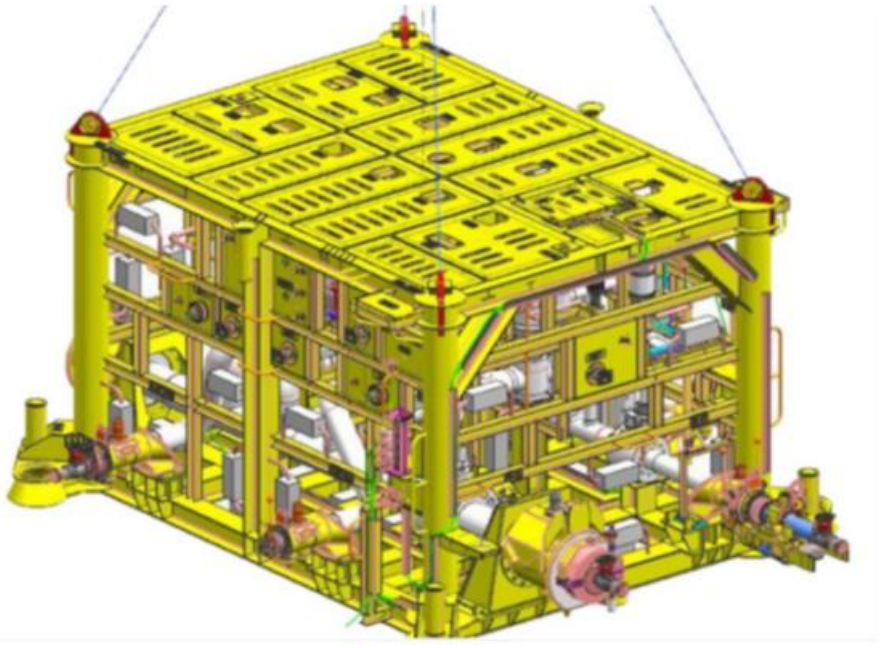


Figure 5 – Subsea manifold

Riser installation

Risers are flexible pipes that connect the flowlines to the FPSO. Risers are designed to allow for safe flexibility to cater for FPSO movement as it floats on the sea. Three 12" production, two 12" export and three 6" service risers of approximately 1 kilometre in length will be installed between the STP buoy and subsea infrastructure. The risers will arrive pre-flooded with MEG. The risers will be installed by deploying the first end topside termination and hanging it on the underside of the STP Buoy. The risers will then be progressively laid out as the construction vessel moves away from the STP Buoy and towards the pre-installed FLET/riser base manifold. During installation, ancillary equipment, including buoyancy modules and a tether clamp are attached to the riser. A temporary clump weight is attached to the riser to offset the buoyancy and enable the riser to be lowered near to the seabed. At this point, the tether is connected to the pre-installed riser tether base to allow the riser to be pulled into the riser base and connected.

Umbilical and flying lead installation

Umbilicals are cables and tubing that allow for communication and control of subsea infrastructure from the FPSO (e.g. valves). Three static umbilicals ranging from approximately 5,000–7,000 metres long with Umbilical Termination Assemblies (UTA) will be installed during the umbilical installation operations. The umbilicals are progressively lowered from the moving construction vessel to the seabed, until the UTA/umbilical assembly lands on the pre-installed UTA foundation. Once in place, the UTA structures sit on the UTA foundations and do not add to the seabed disturbance footprint. Two dynamic umbilicals (approximately 1 kilometre long) will be pulled in and hung off from the STP buoy. Each umbilical will be progressively lowered to the seabed as the construction vessel moves towards the pre-installed UTA foundation. Ancillary equipment including buoyancy modules, tether clamp and tether are attached during the lowering operation. A temporary clump weight is attached to assist the lowering operation and enable the tether to be attached to the pre-installed tether base. From the tether base to the UTA foundation the umbilical is laid on the seabed until the UTA/umbilical assembly lands on the pre-installed UTA foundation. Umbilicals and steel tube flying leads will be installed with the lines filled with either MEG or water-based hydraulic control fluid. Steel tube, optical and electrical flying leads will be installed to connect the UTAs to other subsea infrastructure. Some of the flying leads will be stabilised using sand or grout bags (approximately 20 kilograms) at various points along their length. Temporary clump weights or turning bollards may be used to help install the steel tube flying leads.

Installation vessels

Multiple vessel types will be required to complete the activities within the operational area to support the SURF campaign and interim preservation period. Vessels and the indicative activities they will undertake are as follows:

Reel-lay vessel

The Barossa flowlines and flowline end termination connections (FLETs) will be installed using a specialised reel-lay vessel, such as the Seven Oceans (Figure 6).

Indicative activities include:

+ install temporary initiation anchors
+ install the Barossa flowlines and FLETs
+ bunkering

Optional scope includes:

+ survey (pre-lay)
+ install riser tether bases
+ install displacement initiators
+ install suction anchors
+ install scour protection

Figure 6 – Reel-lay vessel

Figure 7 – Construction vessel

Construction vessels

The Barossa subsea infrastructure will be installed using specialised construction vessels, such as the Seven Oceanic (Figure 7).

Indicative activities include:

+ surveys (pre-lay, during and post-lay)
+ flowline span rectification work
+ install supporting structures (foundations, manifolds, suction anchors, buckle initiators)
+ flowline, riser and umbilical support activities (touchdown/ROV monitoring, subsea positioning)
+ mooring wire and Mooring (or mid) Line Buoyancy Element (MLBE) installation
+ STP buoy positioning and hook-up to mooring lines
+ riser, umbilical and flying lead installation
+ local stabilisation of flying leads (could include mattresses)
+ spool and well jumper installation and testing
+ install scour protection
+ pre-commissioning activities
+ STP Buoy deballasting
+ bunkering
+ MEG transfers

Other support vessels, ROVs and helicopters will also be used to complete support activities under the SURF EP.

Pre-commissioning activities

Once the key infrastructure is installed, pre-commissioning activities will be carried out to verify the integrity and connections of the infrastructure. These pre-commissioning activities include flood, clean, gauge and pressure testing (FCGT), dewatering, preconditioning, nitrogen packing, flushing and hydrostatic leak testing (leak testing). The pre-commissioning fluids that will be discharged to the sea include treated freshwater, treated sea water and MEG. Treated freshwater or treated sea water is freshwater or sea water conditioned with a hydrotest mixture comprising biocide, oxygen scavenger, corrosion inhibitor and leak detection dye. This is completed using products similar to Hydrosure or Roemex Hydro 4 and dosage rates will depend on the length of the preservation period. The hydrotest mixture is typically a mixture of biocides (to prevent biofouling on the internal surfaces), an oxygen scavenger and corrosion inhibitor (to control corrosion of the pipeline) and a dye (allows for leaks to be detected through visual inspections).

Unplanned and non-routine inspection, maintenance and repairs

The preservation period is the interim period from completing the pre-commissioning activities until the activities covered under the Barossa Production Operations EP commence. During the preservation period, no planned inspection, maintenance and repair (IMR) activities of the subsea infrastructure will occur. However, non-routine IMR activities of the subsea infrastructure may be required during the preservation period due to unplanned events (e.g. unstable seabed conditions, significant earthquake, cyclone events, anchor strike, dropped objects, and trawl gear interference) that could physically damage and affect the integrity of the Barossa subsea infrastructure, possibly triggering the requirement for an inspection. During the preservation period, these unplanned events are not expected to occur, however, non-routine IMR activities will be included in the SURF EP in the very unlikely event that they are required. Inspection activities that may occur on subsea infrastructure (e.g. cathodic protection surveys and general visual

inspections) are typically undertaken from an IMR vessel equipped with autonomos underwater vehicles (AUVs) and ROVs.

Typical maintenance and repairs undertaken include:

+ anode replacement
+ cathodic protection system maintenance
+ flowline, riser, umbilical, well jumper and spool repairs
+ restabilisation
+ subsea infrastructure servicing (including leak testing)
+ marine growth removal
+ fishing nets or other marine debris removal
+ recommissioning.

In the unlikely event of flowline failure, the flowline may need to be recovered and a new section of flowline installed in a similar manner to the initial installation.

More detail about the specific activities proposed to be carried out under the SURF EP can also be provided during consultation. If you have questions or would like further information about the detail of the activities listed above or what they involve, please ask us. Visit **santos.com/barossa**, phone **1800 267 600**, email **offshore.consultation@santos.com**

Regional existing environment summary

EMBA – environment that may be affected

In the preparation and assessment of EPs, each of the following is considered part of the 'environment' (under regulation 4 of the OPGGS Environment Regulations):

+ ecosystems and their constituent parts, including people and communities
+ natural and physical resources
+ the qualities and characteristics of locations, places and areas
+ the heritage value of places.

The 'Environment' includes the social, economic and cultural features of each of the above.

Santos recognises the region's various environmental values and sensitivities. In an EP, it is common to present a geographically defined area of the environment that may be affected (EMBA) by an offshore activity, primarily from the worst case hydrocarbon spill associated with the activity.

The EMBA was defined by overlaying hundreds of individual hypothetical spill model simulations into a single map using the low threshold exposure values (which can equate to approximately 1 millilitre of hydrocarbon per 1000 litres of sea water) to identify the full geographical extent of the environment that might be contacted by hydrocarbons. This also provides the basis for assessing the range of potential socio-economic risks and establishes a planning area for scientific monitoring.

The entirety of an EMBA is not considered to be representative of biological impact, but is used for identifying the full geographical extent of the environment that could potentially be affected (including where the effect may not constitute a significant impact).

As EMBA threshold values are very low, the Moderate Exposure Value (MEVA) thresholds (which equate to approximately 10 millilitres of hydrocarbon per 1000 litres of sea water) is used to inform environmental assessment, identify potential environmental consequences, and develop spill response plans. The EMBA and MEVA are illustrated in Figure 8 below.

It should be noted that an actual spill is more accurately represented by only one of the simulations from the modelling, meaning a much smaller geographical area would be affected in the event of an actual spill.

To learn more about spill modelling, exposure values and spill responses, see NOPSEMA Spill Modelling Video.

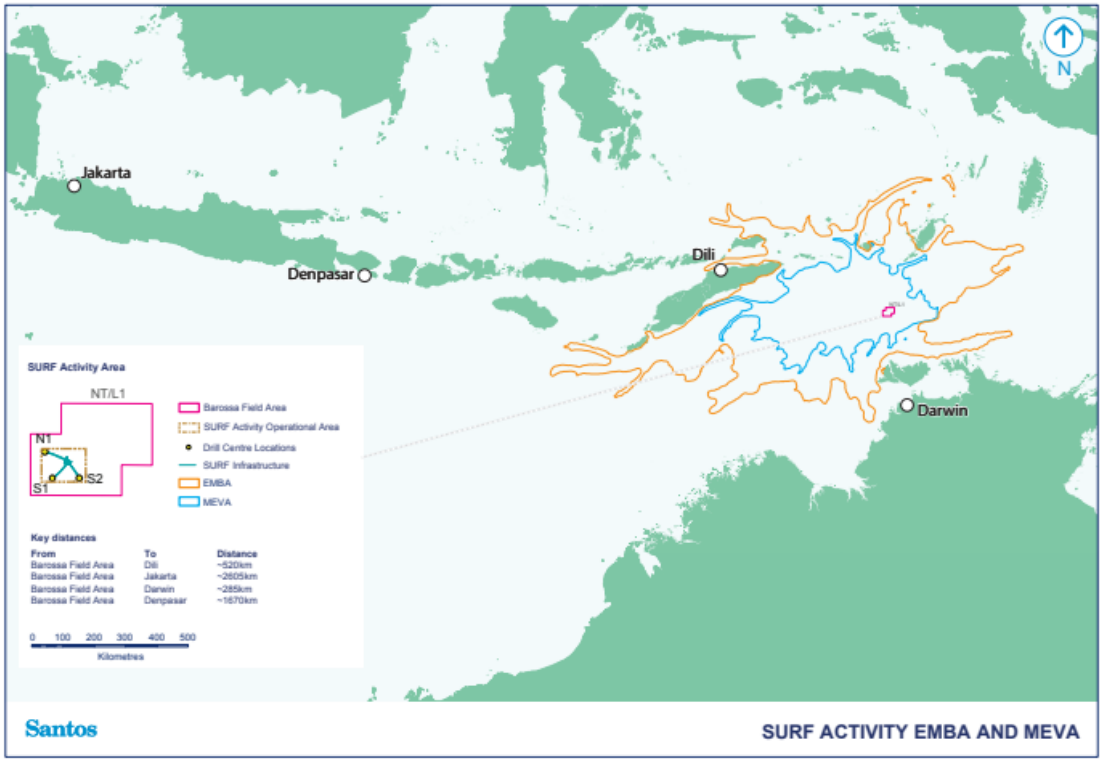


Figure 8 – The EMBA and MEVA

Regional protected and significant areas

Figures 9 and 10 illustrate the boundaries and zonings of regional marine parks and reserves, and key ecological features (KEFs) respectively.

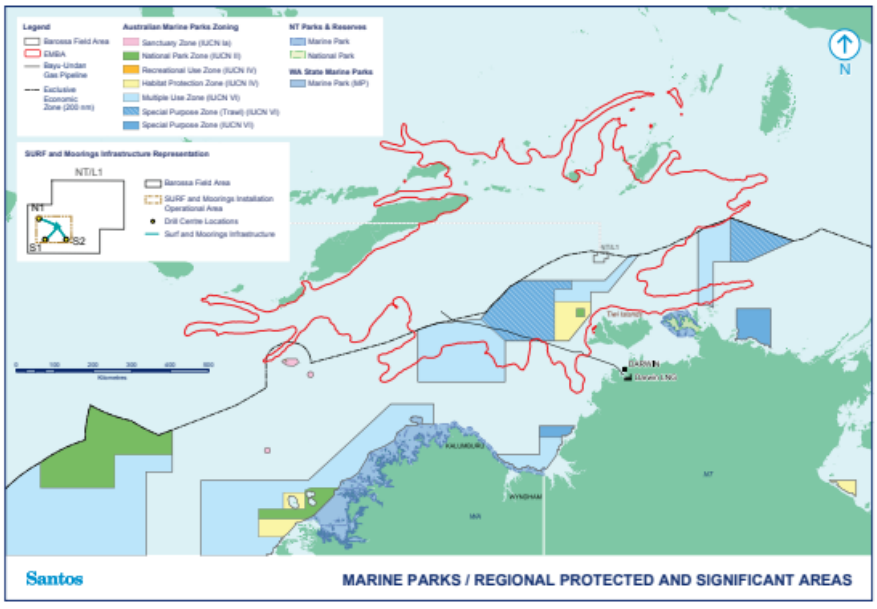


Figure 9 – Regional protected and significant areas

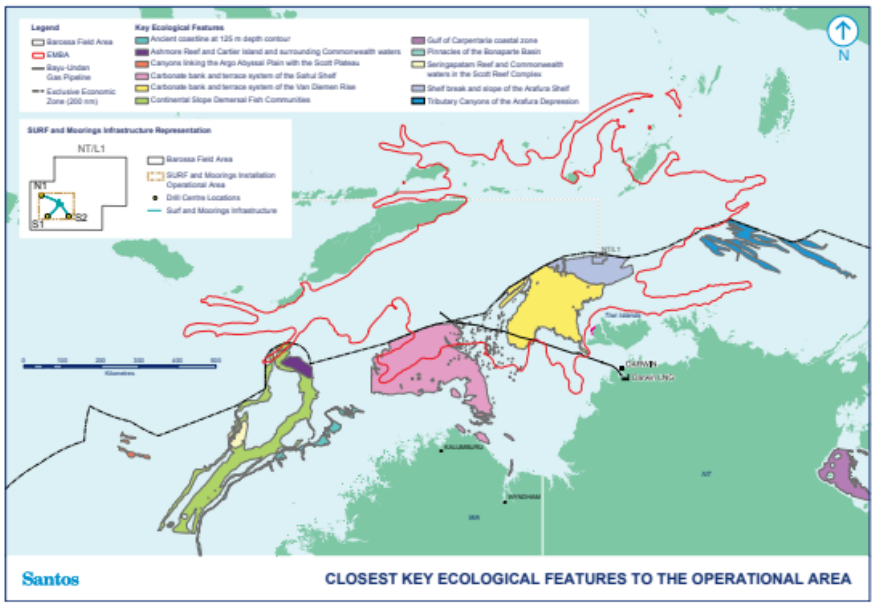


Figure 10 – Closest key ecological features to the operational area and EMBA

Table 1 contains a summary of known values and significant areas within the EMBA recognised under relevant environmental legislation.

Protected and significant areas	Summary of known values and significant areas	Operational area	EMBA	Distance to operational area (km)
Australian marine parks				
Oceanic Shoals Marine Park	The values within this Marine Park include: + ecosystems representative of the Northwest Shelf Transition + 4 KEFs: - carbonate bank and terrace systems of the Van Diemen Rise - carbonate bank and terrace systems of the Sahul Shelf - pinnacles of the Bonaparte Basin - shelf break and slope of the Arafura Shelf + a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act + BIAs that include foraging nesting and internesting habitat for marine turtles This area may also contain cultural and natural values, including sea country.	✗	✓	44
Arafura Marine Park	This area may contain cultural and natural values, including sea country. Ecosystems representative of the Northern Shelf Province, Timor Transition and Tributary canyons of the Arafura Depression key ecological feature. There are turtle and seabird biologically important areas within the marine park.	✗	✓	250

Protected and significant areas	Summary of known values and significant areas	Operational area	EMBA	Distance to operational area (km)
Key ecological features				
North Marine Region				
Carbonate bank and terrace system of the Van Diemen Rise	Unique seafloor features characterised by terrace, banks, channels and valleys. Supports rich sponge gardens, corals and diversity of fish life. Foraging areas for loggerhead, olive ridley and flatback turtles and provide habitat for humpback whales and sawfish. Regionally important due to enhancing productivity relative to their surrounds.	✗	✓	**55**
Pinnacles of the Bonaparte Basin	Unique seafloor features characterised by the largest concentration of pinnacles along the Australian margin. Recognised as a sponge biodiversity hotspot and regionally important due to biodiversity value.	✗	✓	**195**
Shelf break and slope of the Arafura Shelf	Unique seafloor features characterised by continental slope, patch reefs, hard substrate pinnacles. An important ecological feature that enhances biological productivity and attracts pelagic organisms.	Yes, however, surveys confirm that the values associated with the key ecological feature are not within or proximal to the operational area.	✓	**0**
Tributary canyons of the Arafura Depression	Tributary canyons are seabed features that are approximately 80-100m metres deep and 20km wide. Nationally and regionally important due to high productivity, high levels of biodiversity and endemism.	✗	✓	**264**
North-West Marine Region				
Carbonate bank and terrace system of the Sahul Shelf	Unique seafloor features characterised by terrace, banks, channels and valleys. Foraging areas for loggerhead, olive ridley and flatback turtles and provide habitat for humpback whales and green sawfish.	✗	✓	**326**
Continental slope demersal fish communities	High diversity of demersal fish assemblages. The EMBA covers about 50% of the total area of this key ecological feature.	✗	✓	**776**
Pinnacles of the Bonaparte Basin	Unique seafloor features characterised by the largest concentration of pinnacles along the Australian margin. Recognised as a sponge biodiversity hotspot and regionally important due to biodiversity value.	✗	✓	**195**

Table 1 Regional protected and significant areas

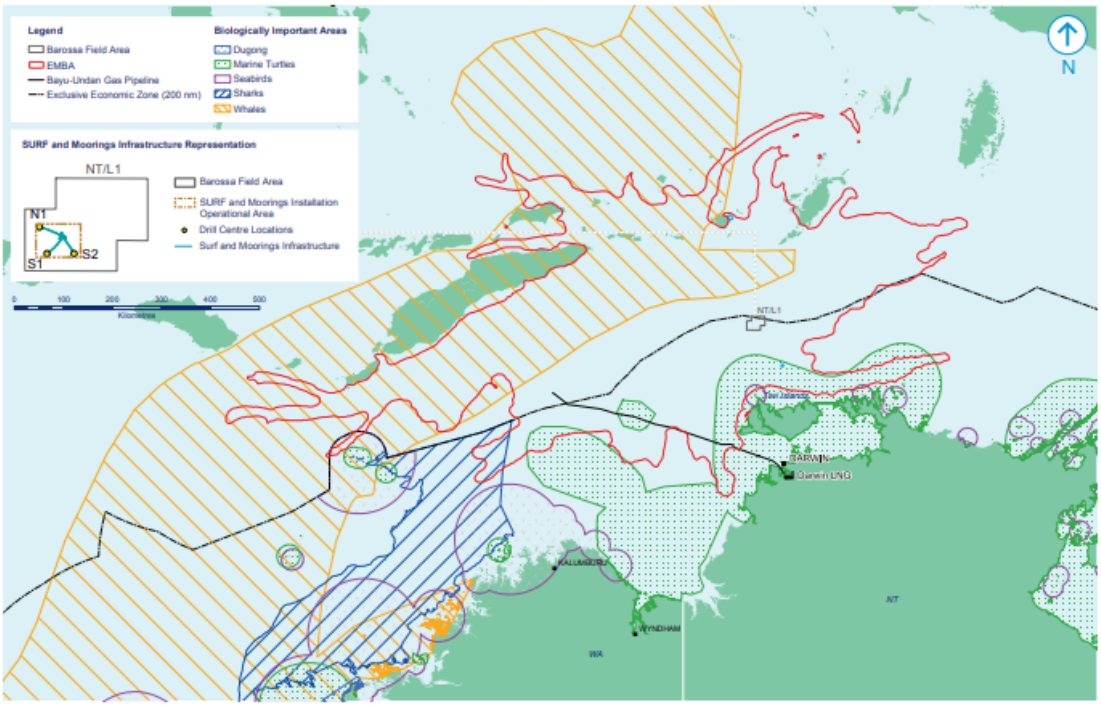


Figure 11 – Biologically Important Areas near the operational area and EMBA

Marine fauna and biologically important areas

The Australian Government has not defined any biologically important areas or habitat critical to the survival of any species under the *Environment Protection and Biodiversity Conservation Act 1999* within or close to the operational area. Within the EMBA there are biologically important areas for whale sharks, blue whales, dugongs, turtles and birds (Figure 11).

SURF and moorings installation activities will be conducted in water depths ranging from 230-280 metres where there is a variety of highly mobile marine fauna with a wide distribution that may transit the area in low numbers, such as:

+ blue, fin and sei whales
+ olive ridley, loggerhead, leatherback and flatback turtles
+ whale sharks
+ seasnakes
+ seabirds and migratory shorebirds
+ fish and sharks.

Santos has considered government guidance, including wildlife management plans, recovery plans, conservation advice and threat abatement plans in the development of the EP and to develop control measures to reduce impacts and risks to marine fauna and biologically important areas to as low as reasonably possible and to an acceptable level.

Regional socio-economic summary

Socio-economic activities that may occur within the operational area and the EMBA include commercial, recreational and traditional fishing, aquaculture, tourism, petroleum industry activities, defence, shipping and, to a lesser extent in the deeper offshore waters, recreational fishing and tourism. Maritime heritage and cultural values may also exist across the region. Due to the water depth and the remote offshore location of the operational area, the most likely marine users in the vicinity will be commercial fishing and shipping.

Nearest population centres

The operational area is located approximately 140 kilometres from Seagull Island which is part of the Tiwi Islands, Northern Territory (NT) with 2,348 residents reported during the 2021 Australian Bureau of Statistics census. Darwin, NT, is the closest city, located approximately 300 kilometres from the operational area, with a population of 148,801 residents. Darwin will be the logistics hub and supply base for the SURF activity, bringing employment and economic benefits to the local community.

Summary of other uses within the EMBA

Santos' understanding of the uses and values of the area and its strategies to reduce impacts or risks to these uses and values will be informed by consultation. Santos has set out in the list below a summary of the uses and values of the area of which it has knowledge based on existing information or previous consultation. Santos welcomes further information and encourages relevant persons to raise any further uses with Santos.

Commercial fishing

Santos recognises the presence and rights of commercial fishers within the operational area and EMBA. While the operational area is remote and water depths preclude most commercial fishing, the Timor Reef Fishery operates throughout the year. Low-level fishing effort for scampi also occurs in December and January each year in the north of the operational area. Other Commonwealth and NT managed fisheries provide rights to fish in the operational area but activity has not recently occurred within the operational area and is considered highly unlikely due to the water depth, remoteness, distribution of targeted species and concentration of effort near coastal areas. Santos has been consulting with the relevant fisheries representative associations, licence-holders and government over many years.

Tourism, recreational fishing and traditional fishing

The operational area is located in offshore waters that are not likely to be accessed for tourism activities (e.g. charter boat operations) or recreational fishing, as these tend to be centred around nearshore waters, islands and coastal areas. However, previous consultation has identified one fishing charter operator who may on occasions conduct tours near Evans Shoal, approximately 62km west of the operational area. There are several shoals and banks within the EMBA and some of these may be visited by small numbers of recreational fishers/charter vessels targeting fish that inhabit these shallower features. Indonesian and Timorese traditional fishers, as well as Australian recreational fishers, are expected to transit and fish in the EMBA. Some fishers may transit the operational area when travelling between sites. Santos continues to consult regarding recreational and traditional fishing and hunting within the EMBA.

Shipping

The Darwin Port is Australia's nearest port to Asia and the nation's 'northern gateway' for Australasian trade. It is the only port between Townsville (Queensland) and Fremantle (Western Australia) with full access to multi-modal transport services. The types of trading vessels include barges, rig tenders, LNG vessels, bunkers, livestock carriers, liquid bulk carriers and other types of vessels, with 1,510 trading vessel calls to port from 2021 to 2022. In addition to trading vessels, Darwin Port also services cruise ships and naval and fishing vessels.

There is also a port, Port Melville, located at Garden Point, Tiwi Islands, NT. Port Melville is a multi-user facility supporting the Northern Territory oil & gas industry, marine transport industry and local Tiwi community through the provision of a port facility and ancillary services (such as laydown areas and accommodation).

Defence Activities

No designated military/defence exercise areas are located within or near the operational area. However, the EMBA intersects a practice area of north Australian exercise area, a maritime military zone administered by the Department of Defence, which comprises practice and training areas used for offshore naval exercises and onshore weapons-firing training. The Australian Border Force also undertakes civil and maritime surveillance (and enforcement) in Australian offshore maritime waters, which includes the Australian EEZ. During their surveillance, Australian Border Force vessels may transit through the operational area and the EMBA.

Petroleum industry

The closest operational offshore production facility is the Santos-operated Bayu–Undan platform located approximately 410km southwest of the operational area. The Bayu–Undan field produces natural gas that is exported via pipeline to the DLNG facility. Petroleum retention lease area and exploration permit leases within the region are currently held by various oil and gas operators (and subsidiaries), including Carnarvon Petroleum Limited, Woodside Energy Ltd, Shell Development (Australia) Pty Ltd, Osaka Gas Australia Pty Ltd, Eni Australia Limited, Origin Energy, and Timor Sea Oil & Gas Australia Pty Ltd.

Heritage

There are no world heritage properties, national heritage places or Commonwealth heritage places within the operational area and the EMBA. There are no recorded Aboriginal heritage sites or Australian Marine Parks within the operational area. Under the Commonwealth Underwater Cultural Heritage Act 2018, Australia's underwater cultural heritage (such as shipwrecks, sunken aircraft and other types) is protected. Multiple known shipwrecks, sunken aircraft and historic (more than 75 years old) aircraft and shipwrecks and other sites occur within the EMBA. In the Timor Sea are 10 unlocated historic aircraft wrecks from the Second World War (associated with the Japanese and Australian air forces) and one unlocated modern Indonesian fishing vessel that sank in 1997. The historic aircraft wrecks are subject to automatic protection under the Commonwealth Underwater Cultural Heritage Act 2018. These unlocated wrecks could fall within the boundaries of the operational area or EMBA.

Santos contracted consultants to complete additional assessments and interpretation of historical and survey data to identify potential sites of maritime heritage significance within the operational area. No significant structures were identified within 500 metres of the proposed infrastructure location.

Cultural values

Santos has been alerted to Indigenous people's connections with Sea Country. Santos is seeking to identify cultural features and values within the EMBA, including through consultation with Indigenous people and their relevant representative bodies.

There are currently no native title claims or determinations within the EMBA.

Summary of environmental impacts and risks

Environmental impact and risk assessment is the process by which planned and unplanned events (that will or may occur during an activity) are assessed for their impacts (consequences) on the environment (physical, biological, and socio-economic). In addition, unplanned events are assessed based on their potential impact (consequence) and likelihood of occurrence, which informs the associated risk level.

An environmental assessment workshop was held in April 2022 to consider the potential environmental impacts of proposed activities under the SURF EP. The workshop involved participants from various Santos departments (health, safety and environment; SURF delivery team and operations) and specialist environmental consultants. Outcomes from the workshop are summarised below.

The identification of potential impacts and risks, and the controls proposed to reduce these impacts and risks, may be developed as a result of the consultation process. This includes consultation to inform Santos' understanding and assessment of potential impacts and risks in light of cultural values within the EMBA and any appropriate control measures if needed.

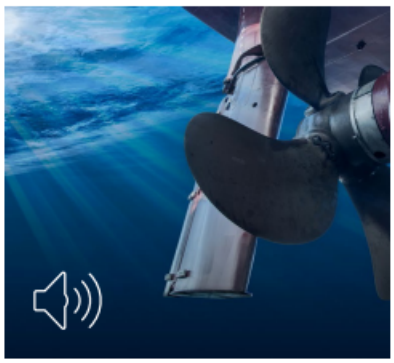
Planned activities

The Santos environmental assessment identified the following main potential impacts or risks associated with the planned activities:

- NOISE SOURCES
- INTERACTIONS WITH OTHER MARINE USERS
- LIGHT SOURCES
- AIR EMISSIONS
- SEABED DISTURBANCE
- DISCHARGES

Santos proposes to adopt a suite of Santos and contractor systems, procedures and standard control measures to reduce impacts and risks associated with these planned activities to a level that results in a minor or negligible environmental consequence. These consequence levels are considered by Santos to be acceptable and as low as reasonably practicable.

Santos continues to consult on the proposed activities under the SURF EP to inform its understanding of environmental and cultural values and sensitivities and the assessment of associated impacts, risks and control measures.



NOISE SOURCES

During the activity, noise will be generated by the vessels and helicopters, as well as ROVs and acoustic positioning systems. The vessels will generate noise from propellers in the water, use of thrusters and water flowing past the hull. The majority of the noise sources involved in the activity are lower pressure and not subject to sharp increases or decreases and will therefore be typical of other marine noise in the region (commercial, shipping, fishing etc). Noise from helicopters, acoustic positioning systems and ROVs is expected to be intermittent during the activity and underwater received levels will be comparable to or less than that of activity vessels.

What impacts are expected?

Santos engaged subject matter experts to conduct several underwater noise assessments.

Studies supporting the risk assessment indicated potential temporary impacts to marine fauna are expected to be confined to 12 kilometres from the noise sources, with no significant impacts at the species population level. Some noise from the thrusters may be audible above ambient noise levels up to 20 kilometres from the source. Santos uses this 20 kilometre range as the conservative distance for noise impact assessment.

There are no known significant feeding, breeding or aggregation areas for any fauna within the operational area or the 20 kilometre noise assessment boundary. The closest biologically important areas are for the pygmy blue whale and marine turtles, which are greater than 50 kilometres away. Although no biologically important area is within the 20 kilometre noise assessment boundary, or close to the operational area, individual noise-sensitive fauna (including whales and turtles) may transit the area.

The activities will be conducted over a limited timeframe in a remote offshore location where there is a relatively low probability of encountering significant numbers of noise-sensitive fauna. Transiting marine fauna are expected to demonstrate short-term avoidance behaviour within the operational area. Therefore, noise impacts are predicted to be minor, localised and temporary.

The marine fauna impacts are predicted to be limited due to the short-term nature of the activities under the SURF EP and the low sound levels generated by activity vessel noise. Noise levels from activity vessels that may cause behavioural responses in marine fauna are generally expected to be confined to the operational area and concentrated within a radius of ~12 kilometres to a few hundred metres of the noise source, depending upon the noise sources and operations. No BIAs occur within the operational area. Noise effects to fish of potential commercial value would be restricted to within hundreds of metres of the noise source. No effects to benthic invertebrates are expected, including those of commercial value (e.g., scampi which are targeted in waters deeper than 250 metres).

How will Santos manage impacts?

Vessels are required to comply with Santos's Protected Marine Fauna Interaction and Sighting Procedure which requires compliance with regulatory requirements for managing noise impacts to fauna. Compliance with vessel Marine Assurance Standards is to be required met and Planned Maintenance is to be completed in order to manage excessive noise from vessels.

LIGHT SOURCES

Artificial lighting is required for operational and navigational safety during the activity. Light sources include:

+ safety and navigational lighting on vessels (24 hours per day)
+ spot lighting when needed, such as when deploying or retrieving equipment
+ spot lighting when ROVs are working underwater.

What impacts are expected?

Light may impact threatened, migratory or local fauna (e.g. marine mammals, marine turtles, sharks, rays, other fish and seabirds) and socio-economic receptors (cultural features).

The vessels are expected to produce similar light levels to other marine vessels in the region. A 20 kilometre light assessment boundary has been used from the outer boundary of the operational area. The most significant risk posed to marine turtles from artificial lighting is the potential disorientation of hatchlings following their emergence from nests by light spill on beaches, although breeding adult turtles can also be disoriented. The nearest turtle nesting beaches are approximately 140 kilometres from the operational area. While seabird species such as wedge-tailed shearwaters may be present within the operational area, the nearest wedge-tailed shearwater BIA is located more than 700km from the operational area, and the nearest breeding colony further still. Lighting is, therefore, expected to have a negligible impact on breeding or hatchling turtles and seabirds.

Light modelling completed indicates that light from the reel-lay and construction vessels is predicted to reduce to below ambient levels at approximately 10.9 km and have the potential for behavioural impacts to turtles within 2.5 kilometres. However, no nesting habitat or BIAs occur within these vessels' distance. The closest turtle BIA (an internesting buffer for flatback turtles) is approximately 54 kilometres from the operational area.

Fish and seabirds may be attracted to artificial light leading to a short-term localised increase in fauna activity. The activity is assessed as unlikely to impact species abundance or distribution. Marine mammals are not known to be attracted to light sources at sea. Whales predominantly use acoustic senses rather than visual cues.

How will Santos manage impacts?

The vessels are expected to produce similar light levels to other marine vessels in the region. Lighting is to be limited to that required for safe operations and compliance with maritime regulations.

AIR EMISSIONS

Air emissions will occur from:

+ fuel combustion to operate vessels and helicopters
+ operation of vessel incinerators.

What impacts are expected?

The potential impacts of air emissions identified include:

+ deterioration of local air quality
+ contribution to national greenhouse gas (GHG) levels.

Air emissions may result in a temporary, localised reduction of air quality. In the offshore environment, air emissions rapidly dissipate into the surrounding atmosphere. Impacts are very localised and not significant. Seabirds and migratory shorebirds are unlikely to be impacted by the localised and temporary reduction in air quality.

Detectable environmental impacts are not predicted from GHG emissions during activities under the SURF EP.

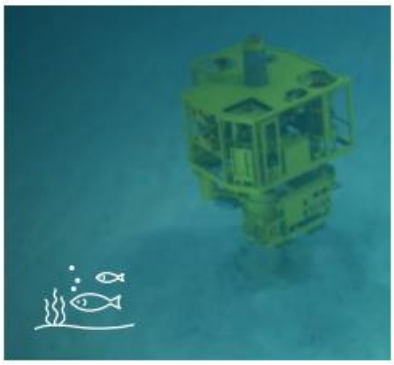
The estimated direct GHG emissions associated with the proposed activities under the SURF EP are 21,240 tonnes of CO_2-e, which is less than 0.0043% of the total 2022 annual Australian GHG emissions.

No indirect GHG emissions are associated with this proposed activity as there is no ability to extract, produce or transport the natural gas. The future Barossa Production Operations EP will assess indirect GHG emissions for the Barossa Gas Project associated with end use combustion of Barossa natural gas and condensate products.

How will Santos manage impacts?

Santos proposes to adopt numerous control measures to manage vessel emissions, including requiring contractor vessels' compliance with MARPOL requirements for low-sulphur fuel and air pollution prevention certifications. ('MARPOL' is a reference to the International Convention for the Prevention of Pollution from Ships). The control measures to be adopted are designed to be consistent with maritime regulations and petroleum industry standards.

Santos has a climate transition strategy and action plan to become a net-zero emissions energy and fuels business by 2040.



SEABED DISTURBANCE

Seabed disturbance will occur because of:

+ permanent placement of subsea infrastructure on the seabed (e.g. flowlines, manifolds, span rectification, mooring suction anchors)
+ temporary placement and set down of equipment on the seabed (e.g. clump weights, ROV)
+ temporary disturbance and sediment disturbance during installation.

Seabed disturbance may also cause a temporary increase in water turbidity.

The activity will involve equipment directly contacting the sea floor and will result in localised impact to benthic habitat (and associated fauna) in the operational area.

Table 2 below includes estimates of the seabed disturbance associated with the installation of the proposed SURF and moorings infrastructure.

Subsea infrastructure	Seabed footprint	Description
FPSO mooring system installation	1.93 ha	Includes suction anchors, mooring chains and a section of mooring wire that may contact the seabed, and temporary clump weights used during installation.
Flowline supporting structures installation	1.62 ha	Includes displacement initiators, FLET foundations, scour protection, support mattresses, flowline walking mitigation and LBL transponder frames.
Flowline installation	1.28 ha	Calculated based on the length of the flowlines multiplied by the diameter of the flowline (with corrosion coating included). It also includes the footprint for the temporary initiation anchors and wire.
Manifolds, spools and well jumpers installation	0.41 ha	Includes manifold foundations, spools, well jumpers, scour mitigation, support mattresses and installation aids.
Riser installation	0.22 ha	Includes footprint of the risers in contact with seabed, supporting riser tether base structures with scour protection and temporary clump weights used during installation.
Umbilical installation	0.39 ha	Includes static umbilicals and footprint of the dynamic umbilicals in contact with seabed, supporting riser tether base structures with scour protection, flying leads with stabilisation and temporary clump weights used during installation.
20% contingency	1.17 ha	To address potential footprint increase for structures and optimisation (subject to detailed design) as well as contingency span rectification / infrastructure repositioning (if required).
Estimated total seabed footprint 7.02 ha		

Table 2 Estimates of the seabed disturbance associated with the installation of the proposed SURF and moorings infrastructure

What impacts are expected?

The activity may cause a temporary increase in water turbidity and will involve equipment directly contacting the sea floor resulting in localised impact to benthic habitat (and associated fauna). Significant impacts to marine fauna as a result seabed disturbance are not expected. Total estimated seabed footprint is approximately seven (7) hectares, slightly larger than the area of a football field (the MCG playing surface is about four (4) hectares). This seabed disturbance represents a very small portion of the operational area.

Extensive marine studies have been completed within the operational area to inform the impact assessment.

The seabed within the area is generally flat, and devoid of any significant bathymetric features. Benthic habitats and fauna assemblages expected to be impacted are considered widespread throughout the region.

The 'Shelf break and slope of the Arafura Shelf' key ecological feature (KEF) overlaps a portion of the operational area. The estimated seabed disturbance represents a very small portion of this KEF (<0.002%). This key ecological feature is valued for its sea floor, which features the shelf break and patch reefs, hard substrate pinnacles and submerged reefs of the shelf slope. The sea floor features related to this key ecological feature have not been observed within the operational area.

There is no biologically important area for any marine fauna species within the operational area. Given the small scale of seabed disturbance and knowledge of the existing environment, significant impacts to marine fauna as a result seabed disturbance are not expected to occur.

There are no known heritage sites within the operational area. Studies indicate that no maritime heritage artifacts are present within the disturbance footprint. A 2023 survey revealed sonar anomalies within the operational area including one which may be the remains of a small shipwreck. The survey concluded that the anomalies identified as potentially holding cultural value are unlikely to be impacted by activities under the SURF EP.

Cultural values within the operational area and associated potential risks and impacts will continue to be identified, including through consultation with Indigenous people and their representative bodies, so that these can also be assessed.

Seabed disturbance is not expected to impact commercial fisheries based on the small size of disturbance compared with the large available fishing area.

How will Santos manage the impacts?

Santos' vessel planned maintenance system is designed to enable safe and accurate placement of infrastructure whilst vessels are on dynamic positioning. Santos also intends to maintain an inventory of all installed equipment to enable collection of all equipment during decommissioning (and thus removal of structures to limit ongoing impacts to the seabed). Santos continues to consider risks and impacts to cultural values and additional control measures may be adopted following consultation.

INTERACTIONS WITH OTHER MARINE USERS

Other marine users that may be in the vicinity of the Barossa field include commercial fishing, shipping and other incidental marine traffic. Tourism and recreational fishing vessels are not expected in the operational area given the water depth and distance offshore.

Around each wellhead there is an existing petroleum safety zone (PSZ). A PSZ is a circular zone with a 500-metre radius which limits access to other marine users. Activity vessels will also have a 500-metre radius cautionary zone. Santos plans to establish cautionary zones within the operational area to provide clarity and minimal inconvenience to other marine users.

Helicopter operations will be infrequent and at high altitude and unlikely to interfere with other marine users. Helicopters will not fly over the Tiwi Islands or Seagull Island unless in the case of an emergency.

What impacts may occur?

The area that other marine users will be excluded from is small when compared to the large area available for their use. Marine users have coexisted with previous Barossa petroleum activities (e.g., exploration drilling) and other nearby maritime activities (e.g., military exercises). Communication before and during the activity with other marine users is designed to reduce the likelihood of unplanned interactions.

How will Santos manage impacts?

Santos is to communicate with other marine users before, during and at the end of the activity. Standard maritime notifications (e.g., Notice to Mariners) are designed to inform other marine users of the activity.

The vessels are to use automatic identification systems to aid in their detection at sea. Support vessels are to actively communicate with third-party vessels to inform them of the activities under the SURF EP. Infrastructure locations are to be marked on nautical charts. These proposed control measures are designed to be consistent with maritime regulations and industry practices.

DISCHARGES

Discharges will occur from the SURF and moorings installation reel lay, construction and support vessels during activities.

Vessel discharges

The types of discharges are typical of most offshore commercial vessels and include deck runoff, treated sewage and grey water, machinery cooling water, bilge water (treated via the oily water system), ballast water, macerated food scraps and brine (from water making). These discharges will be small in volume and released into surface waters.

Activity discharges

Potential impacts may occur in the operational area from activity discharges from:

+ FCGT, dewatering, flushing and leak testing:
  - treated (see below) freshwater or sea water from production and service flowlines
  - MEG from production and service flowlines, risers, production and riser manifolds, spools and well jumpers
  - treatment chemicals including biocides, oxygen scavengers, corrosion inhibitors, MEG and dyes.
+ treated sea water from the STP Buoy deballasting
+ minor releases of microplastics to the sea from corrosion of sinter coating during flowline lay
+ Santos has included a contingency measure to use grout bags to stabilise infrastructure if needed (span rectification). If this stabilisation method is required, some grout may be discharged as part of the process. If grout bags are required, grout discharges may

occur. Grout consists of cement, sand and water and is not considered to be toxic in any way release of small volumes of microplastics from corrosion protection layers on flowlines (sinter coating).

What impacts are expected?

Vessel discharges

The small volumes of vessel discharges may cause localised nutrient enrichment, organic and particulate loading, ecotoxicological effects, and increased water temperature and salinity around discharge points and in the direction of the prevailing current. The environment that may be affected by vessel discharges will likely be within approximately 50m of the activity vessel and likely to be contained within the operational area, based on dispersion modelling.

Potential receptors include the physical environment (water quality, benthic habitats including KEF), threatened, migratory or local fauna (marine mammals, marine turtles, rays, sharks and other pelagic fish, and seabirds) and socioeconomic (cultural features).

Vessel discharges will be localised and limited to surface waters. Machinery cooling water discharge will be continuous, but all other operational discharges will be intermittent and of short duration (minutes to hours). The discharges are expected to be dispersed and diluted rapidly within the offshore waters. Discharges may cause short-term changes to behaviour in marine fauna (avoidance or attraction). For example, fish and seabirds may be attracted to macerated food scraps discharged by vessels.

Activity discharges

Potential receptors include physical environment (water quality, benthic habitat, KEF), threatened, migratory or local fauna and socioeconomic receptors (cultural features).

Activity discharges are expected to disperse rapidly and be diluted within the operational area. Water quality changes are expected to recover within hours to days following cessation of discharges.

How will Santos manage impacts?

Vessel discharges are to be managed to acceptable levels as regulated by maritime laws and conventions (e.g. management of sewage treatment systems and oily water systems), such as MARPOL and relevant Marine Orders. Santos also intends to implement management measures including waste management procedures and chemical management and selection procedures.

Activity discharges are to be managed through the application of Santos' Chemical Selection Process, designed so that only environmentally acceptable chemicals (which are likely to be discharged) are selected and used.

The release of small amounts of sinter coating (as microplastics) is unavoidable due to the installation process where corrosion protection and insulation must be maintained for flowline integrity.

These control measures are designed to reduce the environmental consequences to minor and as low as reasonably practicable.

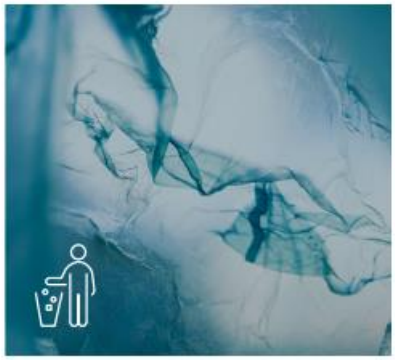
Unplanned events

Santos uses an environmental assessment guideline to identify, analyse and evaluate incident scenarios (unplanned events). Potential unplanned events have been identified and considered and the associated potential environmental consequences and the event likelihoods (i.e., the risks) have been assessed. Based on the assessment undertaken prior to preparation of the SURF EP, the following unplanned environmental risks have been identified for this activity:

- dropped objects
- introduction of invasive marine species
- interaction with marine fauna
- non-hydrocarbon liquid release
- marine diesel spill.

Santos proposes to adopt a suite of Santos and contractor systems, procedures and standard control measures to seek to reduce the impacts and risks associated with these unplanned events to a level that results in a minor or negligible environmental consequence. These consequence levels are considered by Santos to be acceptable and as low as reasonably practicable.

Santos continues to consult on the activities under the SURF EP to inform its understanding of environmental and cultural values and sensitivities, and the assessment of associated impacts, risks and control measures.



DROPPED OBJECTS

Objects that could be accidentally released to the marine environment from vessels or during installation activities include:

- 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 supplies, hard hats, tools or infrastructure parts or installation aids
- Polypropylene (PP) particles from breakdown of PP coating on flowlines (dropped onto the vessel deck and accidentally released overboard).

Release of these objects may occur as a result of the following:

- overfull or uncovered bins
- incorrectly disposed items
- incidents during transfers of waste or supplies
- accidentally dropped objects/lost equipment.

What environmental impacts could occur?

All non-buoyant objects are expected to sink to the seabed and remain within the operational area.

In the event of a dropped object, there will be localised and short-term damage to the seabed. The extent of the impact should be limited to the size of the object and given the size of the equipment used, any impact is expected to be very small. No significant seabed features or biota have been identified in the operational area. Therefore, it is highly unlikely that any object dropped during the activity would cause a significant impact to the ecological values associated with the seabed or benthic habitats.

Buoyant objects could potentially move beyond the operational area. In relevant recovery plans and conservation advice, marine debris (including plastics and microplastics) is listed

as a potential threat to several marine fauna species. Depending on debris size of the dropped object, there is potential for entanglement or ingestion by marine fauna, including turtles and vertebrate wildlife, which could result in injury or death. However, given the limited quantities, impacts to fauna would be limited to individuals and are not expected to result in a decrease of the local population size.

The release of microplastic particles (small plastic particles generally five millimetres or less in size) can occur due to the degradation of PP corrosive and topcoat coating. The release of microplastics from PP has the potential to contribute to the overall amount of marine microplastics in the ocean, which can have various impacts on marine fauna as they are absorbed by plants and animals and accumulate in the food chain. However, given the small maximum volume released, the overall impact marine microplastic pollution is relatively limited.

Release of hazardous solids may result in the pollution of the immediate environment, leading to detrimental health impacts to marine fauna (including potential injury or death)..

How will Santos manage the risk?

Santos has numerous control measures to reduce the risk of dropped objects, lost equipment or releasing waste to the environment. These measures include:

+ safety standards and procedures to reduce the risk of tools and other equipment being dropped during lifting operations
+ waste management procedures to reduce the risk of windblown waste entering the marine environment
+ implementation of chemical selection processes and the International Maritime Dangerous Goods Code
+ environmental implementation plan and subsea infrastructure inventory mitigate the risk of PP particles and debris release through measures such as monitoring, disposal methods, inspections and maintenance
+ dropped objects, regardless of size, must be reported and attempts made to recover the object according to safety and environment criteria.

These control measures are designed to comply with maritime legislation. In addition, these control measures are consistent with applicable actions described in the relevant fauna recovery plans and conservation advice, reducing the residual risk to low.

INTRODUCTION OF INVASIVE MARINE SPECIES

Invasive marine species (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. The majority of climatically compatible IMS to northern Australia 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. The risk of introducing IMS is common for all maritime activities. The introduction of IMS may occur due to the following:

+ biofouling on vessels, external/internal niches (such as sea chests and sea water systems) and routinely submerged equipment
+ discharge of STP Buoy ballast water
+ discharge of high-risk ballast water.

What environmental impacts could occur?

If successfully established, IMS can:

+ outcompete native species for food or space
+ prey on native species
+ impact fisheries or aquaculture
+ impact on human health through released toxins

+ reduce coastal aesthetics
+ cause damage to marine and industrial equipment and infrastructure.

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

The ability of invasive marine species to colonise a habitat depends on several environmental conditions. For example, highly disturbed environments (such as marinas) or shallower areas are more susceptible to colonisation than open-water environments. The operational area provides an unfavourable habitat for IMS due to water depths exceeding 200 metres and the vast distance to the coast. These conditions limit light availability and have low habitat biodiversity with sparse epibiota, therefore, it is highly unlikely that IMS would be able to survive or colonise.

How will Santos manage the risk?

The pathways and vessel mitigation measures for IMS introduction are well understood and known. Vessels contracted to Santos, and vessel ballast, are to be managed according to control measures that comply with maritime regulations, industry practices, and the Biosecurity Act 2015. Vessels will also have ballast water management, vessel biofouling management and anti-fouling systems in place. With these control measures adopted, the residual risk of introducing an IMS is assessed as being reduced to low and as low as reasonably practicable.

INTERACTION WITH MARINE FAUNA

How could interactions with marine fauna occur?

There is the potential for activity vessels, equipment (e.g. ROVs) or helicopters to unintentionally interact with marine fauna, including potential strike or collision, potentially resulting in severe injury or mortality. Vessel and helicopter movements between the operational area and Darwin are expected to be at a frequency of approximately 1-2 per day. There is also a potential for fauna to be caught during the process of collecting sea water for Flood, Clean, Gauge and Test (FCGT) activities. Seabirds and migratory birds may opportunistically rest on a vessel and may be attracted to activity vessels due to lighting and vessel discharges such as macerated food waste.

What environmental impacts could occur?

Marine fauna in surface waters that are most at risk from vessel collision include marine mammals, marine turtles and whale sharks. Some of these species are threatened, and some marine fauna may have cultural significance. The operational area does not intersect any biologically important areas or habitat critical to survival of any marine fauna species. Vessel or human caused disturbances are identified as potential threats to several marine species in relevant recovery plans and conservation advices.

It is possible that fauna may be caught while sea water is collected for FCGT activities. Santos intends to prevent this by installing screening/mesh protection barriers. Marine fauna interactions would be recorded and reported by Santos.

While injury or death to individual animals would be highly undesirable, this would represent a small proportion of any local population and not beyond any natural variation in population size.

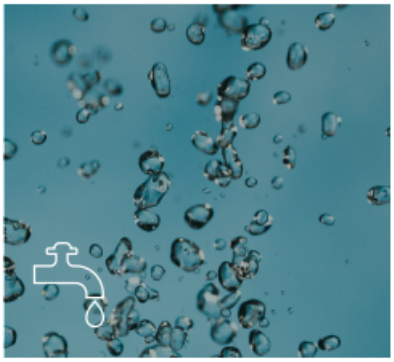
Disturbance from human activities to shorebirds may compromise energy reserved for migration, and attraction of seabirds to activity vessels due to increased feeding opportunities, could result in behavioural changes. However, these are unlikely to alter population dynamics or significantly change the habitat use of birds due to the short duration of the Barossa SURF and moorings installation campaign..

How will Santos manage the risk?

The likelihood of marine fauna interaction resulting in injury or death is considered unlikely given the proposed implementation of the following control measures:

+ Santos' procedure for interacting with marine fauna, which is designed to align with the *Environment Protection and Biodiversity Conservation Regulations 2000*. This procedure limits marine fauna approach distances and speed, allowing marine fauna to be avoided or to move away.
+ vessel speed restrictions
+ vessel standard operating procedure
+ contractor FCGT procedure.

The control measures are designed to align with management actions outlined in government-published fauna recovery plans and conservation advice. The risk of interactions with marine fauna is assessed as very low and reduced to as low as reasonably practicable and acceptable. The risk is no higher than for any other regional maritime or aviation activity.



NON-HYDROCARBON LIQUID RELEASE

How could non-hydrocarbon liquids be released?

Non-hydrocarbon liquids including miscellaneous chemicals and waste are used or stored on vessels during the activity. Examples of non-hydrocarbon liquids include water treatment chemicals, MEG for pre-commissioning activities, brine, cleaning and cooling agents, stored or spent chemicals and leftover paint materials. An example of the use of non-hydrocarbon liquids or chemicals during the activity is the transfer of MEG from a supply vessel to the construction vessel, which will occur via a floating hose.

An accidental release of chemicals and other non-hydrocarbon liquids into the marine environment has the potential to occur from:

+ transferring, storing or using bulk products (e.g. water treatment chemicals)
+ mechanical failure of equipment, such as tank or pipework failure
+ handling and storage spills and leaks due to insufficient fastening or inadequate bunding
+ floating hose failure or rupture, coupling failure or tank overfilling
+ lifting and incorrect handling (e.g. dropped objects damaging liquid vessels (containers))
+ firefighting foam during an unplanned incident.

A release of non-hydrocarbon liquids or chemicals may result in impacts to water quality and hence sensitive environmental receptors.

What environmental impacts could occur?

The maximum volume of non-hydrocarbon liquids or chemicals that could be released during routine operations is likely to be small and limited to the volume of individual containers. Hydrotest mixture chemical storage tank on the construction vessel, and intermediate bulk containers (IBCs) or drums stored on vessel decks.

Dilution from discharges in open waters is rapid, with one in 1,000 dilution usually occurring within 30 minutes. If the spill is not contained on deck, a release to the marine environment would likely disperse rapidly within the operational area.

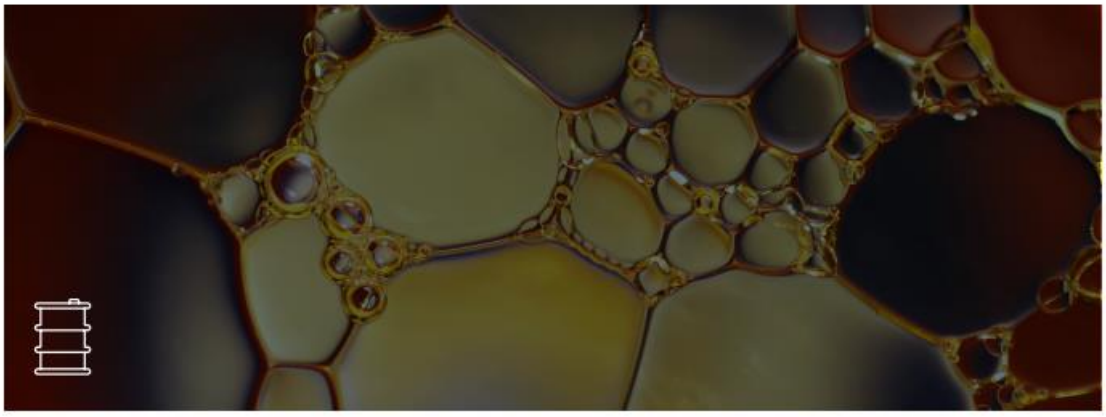
The environment that may be affected for non-hydrocarbon liquids or chemical release resulting in a decrease in water quality is likely to be restricted to around the vessel and contained within the operational area.

Potential receptors include the physical environment (e.g. water and sediment quality, benthic habitats), threatened, migratory or local fauna (e.g. marine mammals, marine reptiles, sharks and rays, other fish, and birds) and socioeconomic features of the environment (including cultural features).

How will Santos manage the risk?

Santos has a suite of procedures to manage the selection, storage, handling and clean-up of chemicals and other non-hydrocarbon liquids. In addition, vessels have spill response plans. The Santos chemical selection procedure is designed so that only environmentally acceptable chemicals are used for leak testing and pre-commissioning activities. These procedures assist to minimise the likelihood of non-hydrocarbon liquid spills, and subsequent environmental consequences should they occur.

The control measures proposed to be adopted are designed to be consistent with maritime and petroleum industry standards and appropriate to manage the residual risks to as low as reasonably practicable and acceptable levels.



MARINE DIESEL SPILL

How could a marine diesel spill occur?

A credible worst-case release scenario of marine diesel oil (MDO) to the marine environment could result from a collision between two activity vessels or an activity vessel and third party. Such a collision could rupture a fuel tank at the sea surface resulting in the release of MDO to sea. A vessel collision could occur due to factors such as human error, poor navigation, vessel equipment failure or poor weather. The worst-case spill volume has conservatively been modelled as approximately 500 cubic metres, consistent with the largest tank size on proposed installation vessels.

Santos has also considered a much smaller volume refuelling incident (fuel hose failure or rupture, coupling failure or tank overfilling) where vessel or helicopter fuel bunkering would need to be stopped manually. Fuel released before pumping stops and fuel remaining in the transfer line may be released to the environment. Worst-case spill volumes were determined from transfer hose inventory and spill prevention measures including 'dry-break' or 'breakaway' couplings, rapid shutdown of fuel pumps and spill response preparedness, with 10 cubic metres considered to be the maximum volume that could be released from the hose before shutdown.

What environmental impacts could occur?

MDO is characterised by a high percentage of volatile components (95 per cent), which will evaporate when on the sea surface over several days. It also contains five per cent persistent hydrocarbons, which will not evaporate, though will decay over time. The heavier components of MDO tend to become entrained into the upper water column as oil droplets in the presence of waves but can refloat to the surface if wave energies abate. Entrained MDO is largely concentrated in surface waters (0–10 metres deep).

Spill trajectory modelling indicated that there was some probability of a 500 cubic metres MDO release (using the moderate exposure value) extending as follows:

+ shoreline accumulation was not predicted to occur
+ surface oil was predicted to occur within approximately 136 kilometres of the release location
+ entrained oil (one-hour time-step, high threshold) was predicted to occur within approximately 591 kilometres of the release location
+ dissolved hydrocarbons (one-hour time-step) were predicted within 116 kilometres of the release location.

The modelling does not take into consideration any of the spill prevention, mitigation and response capabilities that would be implemented in response to the spill.

A 500 cubic metre release of MDO was modelled for a release over one hour, replicating the potential duration of a release arising from a significant collision. Hydrocarbons would persist within the environment for a longer period, although MDO is expected to weather quickly through evaporation and dispersion. The results from the modelling can be seen in Figure 3 above.

Potential receptors include physical environment (water quality, shoals and banks, benthic habitats), threatened or migratory fauna (marine mammals, marine reptiles, fish (including sharks and rays) and birds), protected and

significant areas (KEFs), socioeconomic receptors (fisheries, tourism, recreation, cultural features and other third-party operators).

A hydrocarbon release will cause a decline in water quality and may cause chemical (e.g. toxicity) and physical (e.g. coating of emergent habitats, oiling of wildlife at sea surface) impacts to marine species. The severity of the impact of a hydrocarbon release depends on the magnitude of the release (i.e. extent, duration) and sensitivity of the receptor. The nature and scale of a hydrocarbon release is described throughout this section for a vessel collision scenario, given smaller hydrocarbon releases (from refuelling) will impact a smaller area than a vessel collision.

Physical environment or habitat

Water quality changes would be temporary and localised due to the rapid MDO weathering and dispersion.

MDO will be limited to the upper water column (sea surface to 30 metres deep). Shallow water shoals and banks present at (less than 30 metres water depth) within the MEVA may be impacted. Potential impacts include sub-lethal stress and mortality of sensitive benthic organisms (e.g. corals) and the early life stages of resident fish and invertebrates.

Threatened or migratory fauna

A MDO spill from a vessel collision may impact marine fauna, including fauna which may have cultural significance.

Seabirds may contact surface MDO whilst foraging, potentially causing secondary effects through ingestion from eating oiled fish or after preening. The MEVA does not impact any bird breeding or foraging biologically important areas; hence potential impacts will be limited to individuals transiting the area.

Although there are no known significant feeding, breeding or aggregation areas for the pygmy blue whale within the MEVA, there is a biologically important area for distribution range and migration. Potential impacts to the pygmy blue whale and other whales are likely to be limited to individuals transiting through the area with the potential for coating of baleen (in whales), ingestion of oiled prey (plankton or fish) and behavioural impacts. No population-level impacts are expected.

No MDO is expected to contact shoreline or turtle nesting beaches at impact thresholds (there is some accumulation at low threshold levels on the Tiwi Islands). There are two BIAs for the flatback and olive ridley turtles and habitats critical to the survival of the flatback turtle that have been identified to intersect the outer extent of the MEVA. Turtles may occur in the MEVA but their presence is limited to transiting in deeper water. These turtles transiting through the area could be affected, but population-scale impacts are unlikely. Sea snakes may also be present. Sea snakes may be vulnerable to hydrocarbon spills due to their need to surface to breathe and may spend time at the sea surface to bask in the sun. The short-nosed sea snake and other species may occur in the limited shallow (up to 10 metres deep) banks and shoals within the MEVA. Therefore only low numbers are expected to be at risk of impact.

Protected areas

The MEVA intersects the Oceanic Shoals marine park. A hydrocarbon spill has the potential to impact water quality and a range of biological receptors. These environmental values are contained within the Oceanic Shoals marine park in Commonwealth waters. Impacts to the values of the marine park are anticipated to be temporary and localised due to the rapid evaporation rates of the volatile components of MDO and its rapid natural degradation and dispersion in the open ocean.

Socio-economic receptors

A vessel collision resulting in an MDO spill may temporarily disrupt fishing activities if it spreads to fishing areas. However, due to the high MDO evaporation rate any impacts are predicted to be localised. Other marine users that may be disrupted include regional oil and gas operations, military exercises and commercial shipping.

In the remote chance that a vessel collision does occur and results in an MDO spill, there is a low probability (0.33 per cent at low threshold) that MDO could accumulate on the west coast of the Tiwi Islands. As a result, the EMBA may overlap. EMBA may overlap cultural values such as sea country, songlines and totemic species. Cultural values within the EMBA and associated potential risks and impacts will continue to be identified, including through consultation with Indigenous people and their representative bodies.

How will Santos manage the risk?

Santos is to communicate with other marine users before and during the activity. Standard maritime notifications (e.g. notice to mariners) are designed to inform other marine users of the activity and relevant cautionary or exclusion zones. The vessels are to have automatic identification systems and minimum navigational lighting to aid in their detection at sea. Support vessels are to actively communicate with third-party vessels to inform them of the marine activities.

Operational procedures and equipment maintenance practices should minimise spills resulting from damaged or malfunctioning equipment and refuelling incidents.

Spill response plans will be in place and regular exercises conducted (including vessel specific spill response plans and the OPEP).

Santos has made a commitment to use MDO rather than heavier fuel oils on all SURF and moorings installation activity vessels.

These control measures are designed to comply with maritime regulations and standard industry practices. The risk of a MDO spill is low and has been reduced to as low as reasonably practicable.

CONTINGENCY SPILL RESPONSE OPERATIONS

In the event of a hydrocarbon spill, response strategies will be implemented to reduce environmental impacts to as low as reasonably practicable. The selection of strategies will be undertaken using the Net Environmental Benefits Assessment (NEBA) process. Spill response will be under the direction of the relevant control agency, as defined in the SURF and moorings installation oil pollution emergency plan (OPEP), which may be Santos, 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 considered to be appropriate for the worst-case spill scenarios identified for the activity are detailed in the OPEP and comprise:

+ source control
+ monitor and evaluate
+ mechanical dispersion
+ oiled wildlife response
+ scientific monitoring
+ waste management.

Response strategies are intended to reduce the environmental consequences of a hydrocarbon spill, but poorly planned and coordinated response activities can result in a lack of, or inadequate, information being available, upon which poor decisions can be made, exacerbating or causing further environmental harm. An inadequate level of training and guidance when implementing spill response strategies can also result in environmental harm beyond that caused by the spill.

What impacts are expected?

Spill response operations may be required at any location within the EMBA. Potential environmental impacts include:

Noise emissions

+ Spill response operations will involve aircraft and vessels, which will generate noise both offshore and in nearshore locations within the EMBA.
+ Underwater noise from vessels may impact marine fauna, such as fish (including commercial species), marine reptiles and marine mammals.
+ Cetaceans have been identified as the key concern for vessel noise, with the pygmy blue whale distribution and migration BIA intersecting the EMBA.

Light emissions

+ Spill response operations will involve vessels which are required, at a minimum, to display navigational lighting. Vessels may operate near shoreline areas during spill response operations.
+ Spill response activities may also involve onshore operations including vehicle use and temporary camps, both of which may require lighting.
+ Lighting may cause behavioural changes to fish, mammals, birds and marine turtles that can have a heightened consequence during key life cycle 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.

Atmospheric emissions

+ Using fuels to power vessel engines, generators and mobile equipment during spill response operations will result in emissions of GHGs, such as CO2, CH4 and N2O, along with non-GHGs such as sulfur oxides (SOx) and nitrogen oxides (NOx). Emissions will result in a localised decrease in air quality.
+ Atmospheric emissions from spill response equipment are expected to be localised, and using mobile equipment, vessels and vehicles is not considered to create emissions on a scale where noticeable impacts would be predicted.

Operational discharges and waste

+ Operational discharges include routine discharges from vessels used during spill response, such as:
  - deck drainage
  - putrescible waste and sewage
  - cooling water from operating engines
  - bilge water
  - ballast water
  - brine discharge
+ Other specific spill response discharges and waste creation may occur, including:
  - cleaning of oily equipment, vessels and vehicles
  - sewage and putrescible and municipal waste at offshore staging sites
  - creation, storage, transport and disposal of oily waste and contaminated organics
+ Operational discharges from vessels may create a localised and temporary reduction in marine water quality. Effects include nutrient enrichment, toxicity, turbidity, and temperature and salinity increases. Discharge could potentially occur adjacent to marine communities,

such as corals, seagrass and macroalgae, and in protected areas (i.e. receptors anywhere within the EMBA), which support a more diverse faunal community; however, discharges are still expected to be localised and temporary.

+ Cleaning of oil-contaminated equipment, vehicles and vessels has the potential to spread oil from contaminated areas to areas not impacted by a spill, potentially spreading the impact area, and moving oil into a more sensitive environment.
+ Sewage and putrescible and non-putrescible waste will be generated from offshore activities at temporary staging/mooring areas, which may include toilet and washing facilities. These wastes have the potential to impact water quality, impact habitats, and reduce the aesthetic value of the environment, which may be within protected areas.

Physical presence and disturbance

+ Moving and operating vessels during spill response operations has the potential to disturb the physical environment and marine habitats and fauna (e.g. vessel strike, behavioural changes), which may occur within protected areas. Disturbance may also impact socioeconomic values of an area. Vessel movement 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 also involve deliberately disturbing (hazing), capturing, handling, cleaning, rehabilitating, transporting and releasing wildlife, which could lead to additional impacts to wildlife.

Disruption to other marine users, coastal areas and townships

+ Spill response operations may involve using vessels and equipment in areas used by the general public or industry in affected areas. Mobilising spill response personnel into forward operating bases may also place increased demands on local accommodation and other businesses.
+ Using vessels in the offshore environment and undertaking spill response operations may exclude the general public and industry from using the affected environment. As well as impacting recreational activities (e.g. recreational fishing) of the general public, this may impact revenue with respect to industries such as commercial fishing. Mobilising personnel to regional 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.

How will Santos manage the risk?

Santos will rely primarily on the implementation of the SURF and moorings installation OPEP to manage the potential impacts associated with a spill response event. Other control measures that would be implemented include:

+ procedure for interacting with marine fauna
+ chemical selection process
+ minimum lighting to meet maritime safety and navigation requirements
+ air pollution prevention certification
+ sewage and oily water treatment systems on vessels
+ consultation with relevant persons.

The implementation of spill 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. The controls proposed are intended to reduce the consequences of the potential impacts to minor and as low as reasonably practicable and an acceptable level.

Summary of the risk management strategy

Santos has a management system that includes specific measures, to be used for the duration of the activities under the SURF EP, which seek to confirm that:

+ environmental impacts and risks continue to be identified for the duration of the activity are reduced to as low as reasonably practicable and acceptable levels
+ control measures are effective in reducing environmental impacts and risks to as low as reasonably practicable and acceptable levels
+ environmental performance outcomes and standards set out in the EP are being met
+ there will be ongoing appropriate consultation with relevant authorities and other relevant interested persons or organisations
+ the roles, accountabilities and responsibilities are defined and understood
+ workforce training is completed and competencies assured
+ emergency preparedness and response arrangements are in place
+ incident reporting, investigation and follow-up is monitored
+ audits, inspections, reporting and notifications and document management are appropriately undertaken.

Your feedback and what's next

In preparing an environment plan for submission to NOPSEMA, a titleholder must consult with each 'relevant person', including relevant Commonwealth, State and Northern Territory departments or agencies and persons (or organisations) whose functions, interests or activities may be affected by the activity proposed to be carried out under an environment plan.

Examples of 'functions, interests or activities' that may be affected by the activities to be carried out under an EP may include those arising in relation to a spiritual or cultural connection to land or to sea country, tourism, recreational and commercial fishing and local communities (though these are merely illustrative examples and not an exhaustive list). The information contained in this information booklet may assist your consideration of whether you are a relevant person.

More information about 'relevant persons' can be found on our website at www.santos.com/barossa/relevant-persons

Relevant persons being consulted on environment plans under the OPGGS Environment Regulations should note that they:

+ are entitled to be given sufficient information to allow them to make an informed assessment of the possible consequences of the activity on their functions, interests or activities
+ are entitled to be allowed a reasonable period for the consultation
+ may request particular information provided in consultation not be published. If you do ask this, Santos will respect that and the information will not be published under the relevant regulations. Information we need to give to NOPSEMA to assess our plan will be provided in a separate report (rather than in the published EP).

Your feedback and input is important to Santos. Santos wants to understand the appropriate consultation processes for different relevant persons. Santos also wants to provide information for people in an appropriate and accessible manner so that relevant persons may make informed assessments of the possible consequences of the proposed SURF activity for them, so that they can provide feedback to inform the environment plan.

We welcome input from relevant persons about additional information they seek and how they wish to be consulted. Such input may be provided by:

+ phone on 1800 267 600
+ email at offshore.consultation@santos.com
+ or by scanning the QR code below.

If you think you, your organisation or another person or organisation you know of may be a relevant person for the purposes of one of Santos's proposed activities, and we have not already contacted you (or the other person or organisation) in that capacity, please contact Santos to seek to be included in consultations and to provide feedback on how you would like to be consulted (if a relevant person). If you suggest other potential relevant persons to Santos and provide information as to how those relevant persons may be reached, we may also contact those persons or organisations and provide copies of this information. Santos also welcomes you to encourage other potential relevant persons to get in touch with Santos at the above contact details.

Santos

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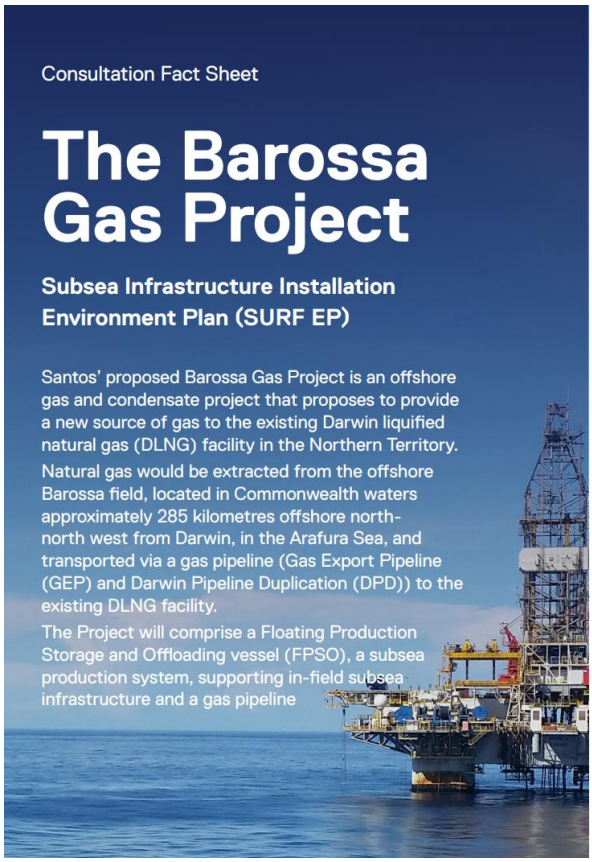
SURF Fact Sheet



Santos is currently preparing an environment plan (EP) in respect of a part of the Barossa Gas Project relating to the Subsea Umbilicals, Risers and Flowlines (SURF), manifolds and FPSO moorings installation (collectively referred to as the Subsea Infrastructure) and pre-commissioning activity. This is more simply referred to as the 'SURF activity'.

OVERVIEW OF PROPOSED SURF ACTIVITY

Santos proposes to undertake the SURF activity for the Barossa Gas Project within Commonwealth waters approximately 300km north-north west of Darwin, NT, within the boundaries of Commonwealth Petroleum Production Licence NT/L1.

SURF is a term used to describe the subsea infrastructure required to gather gas and condensate from the production wells and deliver these products to the FPSO for processing. Santos plans to install subsea infrastructure to support the connection of six subsea production wells to the FPSO, and moorings infrastructure required to securely anchor the FPSO in position.

Once Santos has secured all relevant approvals for this activity, specialist vessels will start installing this network of infrastructure under the sea. This will take approximately eight months to complete. From the surface of the ocean, these large vessels carefully lay steel pipes or flowlines, and what are referred to as 'umbilicals'.

The subsea umbilicals play an important role connecting the equipment on the sea surface to what is on the seafloor. They provide power and communications to the infrastructure beneath the sea (such as the Christmas Trees and manifolds), to enable it to be controlled remotely from the FPSO.

Once a well is drilled and completed (Barossa Drilling and Completions EP), flow control equipment (manifold) and piping (flowlines) are attached to the top of the well (via what is called a Christmas Tree). This equipment is designed to manage and control the flow of the natural gas up from beneath the seabed.

Individual wells are connected to the flowlines, and the production fluids (gas and condensate) travel through these pipelines to a 'riser'.

A riser is a specially constructed pipeline that delivers fluid from the subsea equipment to a large vessel on the sea surface, called a FPSO.

A FPSO is an offshore vessel that produces, processes and stores oil and gas before it's transported elsewhere. It requires a very strong mooring system so that it remains secured in one location, and this involves multiple anchors to the seabed. These anchors and mooring lines will also be installed as part of the SURF activity.

Following installation of the subsea infrastructure, Santos plans to complete pre-commissioning, which means testing the pipes to make sure that they do not leak, and testing the controls to make sure that safety systems function correctly.

We're Listening Santos

ACTIVITY DURATION

The total duration of the proposed SURF activity is estimated to be approximately nine months (eight months for installation and one month for pre-commissioning), subject to factors including vessel availability, operational efficiencies and weather conditions.

The preservation phase commences on completion of installation of key infrastructure and pre-commissioning activities. The preservation phase is designed to maintain the integrity of the infrastructure. The preservation phase for the SURF and moorings infrastructure will last up until commissioning.

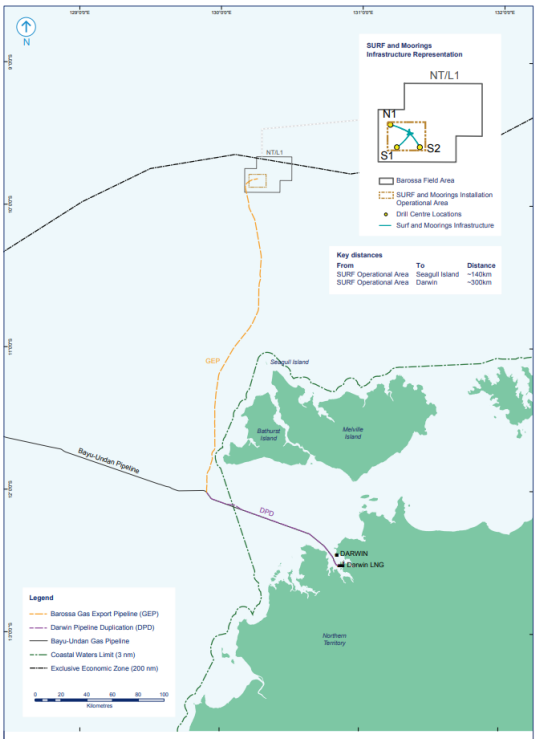
EQUIPMENT AND VESSELS

The below vessels and equipment will be used to support activity under the SURF EP:

+ Reel lay vessels
+ Construction vessels
+ Other support vessels
+ Remotely Operated Vehicles (ROVs)
+ Helicopters

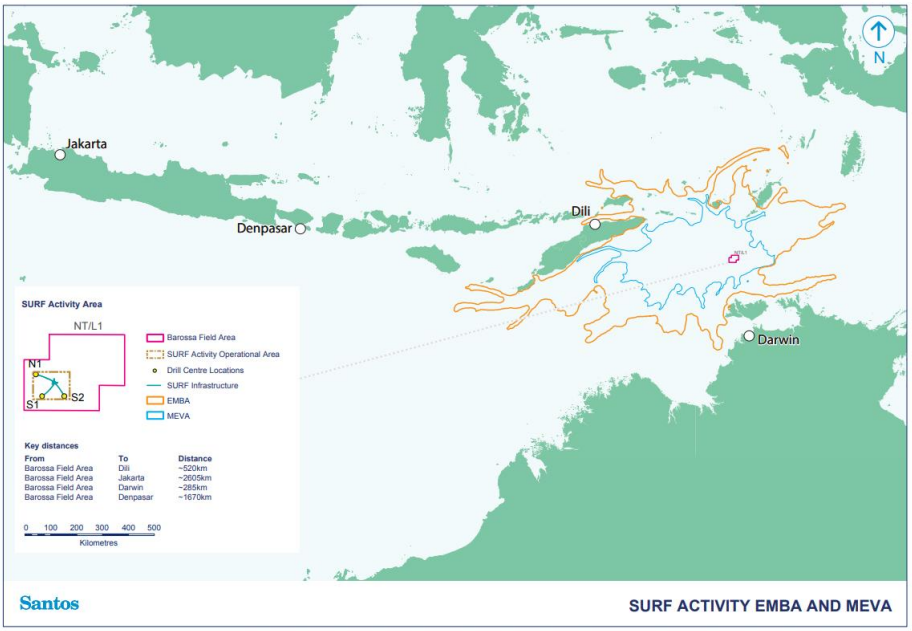
KEY ACTIVITIES INCLUDE:

+ Underwater acoustic positioning
+ Surveys
+ Moorings installation
+ Flowline lay
+ Manifold installation
+ Riser installation
+ Umbilical and flying lead installation
+ Pre-commissioning activities
+ Unplanned and non-routine inspection, maintenance and repairs



Environment that may be affected

This map depicts the proposed operational area for the activities to be carried out (brown box within the pink Barossa Field Area) and the broader environment that may be affected by the proposed activities (red line), referred to as the 'EMBA'. The 'EMBA' represents the greatest geographical extent that could be affected by the unplanned, 'worst case' spill scenario. The Moderate Exposure Value or MEVA (blue line) is used to inform environmental assessment, identify potential environmental consequences, and develop spill response plans. Beyond the MEVA, environmental impacts and risks are unlikely to result in measurable effects to receptors.



Environmental impact and risk assessment

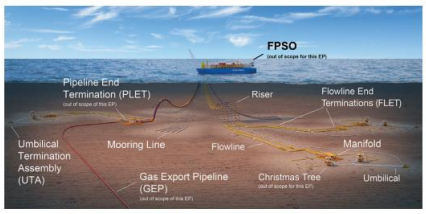
Environmental impact and risk assessment is the process by which events that will or may occur during an activity are assessed for their potential impacts on the environment (physical, biological, and socio-economic).

They are divided into planned and unplanned events.

Planned events are unavoidable impacts, such as light, noise, atmospheric emissions, seabed disturbance, discharges, and interactions with other marine users.

Unplanned events are not expected to occur but are planned for to manage risk. They are also assessed based on their likelihood of occurrence.

Unplanned events include dropped objects, invasive marine species, interactions with marine fauna, non-hydrocarbon discharges or a marine diesel spill.



Graphical representation of the Barossa Field layout

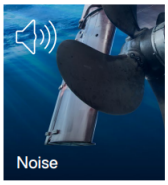

Construction Vessel *(Seven Oceanic)*


Reel-lay Vessel *(Seven Oceans)*

Known and/or planned events

Santos has identified potential impacts or risks as a result of the SURF activity. Outlined below is an overview of impacts and risks and controls we propose to use in seeking to reduce these to as low as reasonably practicable and to an acceptable level. This overview is high-level and not exhaustive. More detail can be found at www.santos.com/barossa. We are also available to answers questions or can provide further information upon request. The identification of potential impacts and risks, and the controls proposed to reduce these impacts and risks, may be developed as a result of consultation processes. This includes consultation to inform Santos' understanding and assessment of potential impacts and risks in light of cultural values within the EMBA and any appropriate control measures if needed.

POTENTIAL IMPACTS AND RISKS



Noise will be generated by activity vessels, helicopters and ROVs.

The majority of the noise sources involved in the activity are lower pressure and not subject to sharp increases or decreases (e.g. engine noise) and will therefore be typical of other marine noise in the region (commercial shipping, fishing, etc).

Studies supporting the risk assessment indicated potential temporary impacts to marine fauna are expected to be confined to 12 km from the noise sources, with no significant impacts at the species population level.

PROPOSED CONTROLS

Vessels are required to comply with Santos' Protected Marine Fauna Interaction and Sighting Procedure which requires compliance with regulatory requirements for managing noise impacts to fauna.

Control measures include:

+ Vessels are required to comply with Santos' Protected Marine Fauna Interaction and Sighting Procedure which requires compliance with regulatory requirements for managing noise impacts to fauna.
+ Compliance with vessel Marine Assurance Standards is required and Planned Maintenance is to be completed to manage excessive noise from vessels.

Artificial lighting is required for operational and navigational safety during the activity. Light sources include:

+ safety and navigational lighting on vessels (24 hours per day)
+ spot lighting when needed, such as when deploying or retrieving equipment
+ spot lighting when ROVs are working underwater

Light may impact threatened, migratory or local fauna (e.g. marine mammals, marine turtles, sharks, rays, other fish and seabirds) and socio-economic receptors (cultural features).

The vessels are expected to produce similar light levels to other marine vessels in the region. Light modelling studies estimate that light from the reel-lay and construction vessels is predicted to have the potential for behavioural impacts to turtles within 2.5 km. No nesting habitat or Biologically Important Area (BIA) occurs within this impact area. Due to distance of the operational area from turtle nesting beaches and from BIAs relevant for seabird species, lighting is expected to have a negligible impact on breeding or hatchling turtles and seabirds.

Lighting is to be limited to that required for safe operations and maritime regulations.

Known and/or planned events

POTENTIAL IMPACTS AND RISKS

Other marine users that may be in the vicinity of the Barossa field include commercial fishing, shipping and other incidental marine traffic. Tourism and recreational fishing vessels are not expected in the operational area given the water depth and distance offshore.

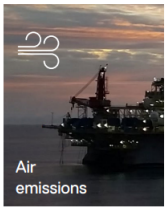
Interruptions to non-Santos vessel movement or commercial fishing activities due to petroleum safety zones and cautionary zones. Santos plans to establish cautionary zones within the operational area to provide clarity and minimal inconvenience to other marine users.

Helicopter operations will be infrequent and unlikely to interfere with other marine users. Helicopters will not fly over the Tiwi Islands or Seagull Island unless in the case of an emergency.

PROPOSED CONTROLS

Santos to notify and communicate with other marine users using standard maritime notifications (e.g., Notice to Mariners) before, during and at the end of the activity.

Vessels to have automatic identification systems to aid in their detection at sea. Infrastructure locations to be marked on nautical charts.



Air emissions may occur from:

+ fuel combustion to operate the vessels and helicopter
+ operation of vessel incinerators.

In the offshore environment, air emissions rapidly dissipate into the surrounding atmosphere. Impacts are very localised and not significant. Detectable environmental impacts are not predicted from greenhouse gas emissions during SURF activity. Indirect greenhouse gas emissions for the broader Barossa Project will be addressed in a separate environment plan on which there will be further consultation.

Santos proposes to adopt numerous control measures to manage vessel emissions, including requiring Contractor compliance with MARPOL requirements for use of low-sulphur fuel and air pollution prevention certificates. ('MARPOL' is a reference to the International Convention for the Prevention of Pollution from Ships.)

Known and/or planned events

POTENTIAL IMPACTS AND RISKS

Seabed disturbance will occur because of:

+ permanent placement of subsea infrastructure on the seabed (e.g. flowlines, manifolds, mooring anchors)
+ temporary placement and set down of equipment on the seabed (e.g. clump weights, ROV)
+ temporary disturbance and sediment disturbance during installation.

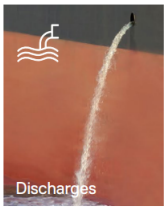
The activity may cause a temporary increase in water turbidity and will involve equipment directly contacting the sea floor resulting in localised impact to bethnic habitat (and associated fauna). Significant impacts to marine fauna as a result seabed disturbance are not expected. Total estimated seabed footprint is approximately 7 hectares, slightly larger than the area of a football field (the MCG playing surface is about 4 hectares). This seabed disturbance represents a very small portion of the operational area. Extensive marine studies have been completed within the operational area to inform the impact assessment. The seabed within the area is generally flat, and devoid of any significant physical seabed or habitat features.

Cultural values within the operational area and associated potential risks and impacts will continue to be identified, including through consultation with Indigenous people.

PROPOSED CONTROLS

Santos' vessel planned maintenance system is designed to enable safe and accurate placement of infrastructure. Santos also intends to maintain an inventory of all installed equipment to enable collection of all equipment during decommissioning to limit ongoing impacts.

Santos continues to consider risks and impacts to cultural values and additional control measures may be implemented following consultation.



The types of discharges are typical of most offshore commercial vessels and include deck runoff, treated sewage and grey water, machinery cooling water, treated oily water, ballast water, bilge water, macerated food scraps and brine (from water making). Additional discharges may occur in the operational area from activities associated with subsea construction, including, for example, flushing and leak testing the pipelines and risers.

During the activity, localised changes to water quality will occur, but water quality conditions will return to normal within hours to days after ceasing discharges. Activity discharges are expected to disperse rapidly and be diluted within the operational area.

Discharges may cause short-term changes to behaviour in marine fauna (avoidance or attraction). For example, fish and seabirds may be attracted to macerated food scraps discharged by vessels. Other potential receptors include physical environment (water quality, benthic habitat, KEF), threatened, migratory or local fauna (marine mammals, marine turtles, rays, sharks and other pelagic fish, and seabirds) and socioeconomic receptors (cultural features).

Vessel discharges are to be managed to acceptable levels as regulated by maritime laws and conventions (e.g. management of sewage treatment systems and oily water systems), such as MARPOL and relevant Marine Orders. ("MARPOL" is a reference to the International Convention for the Prevention of Pollution from Ships.) Santos also intends to implement management measures including waste management procedures and chemical management and selection procedures.

Activity discharges are to be managed through the application of Santos' Chemical Selection Process, designed so that only environmentally acceptable chemicals (which are likely to be discharged) are selected and used.

Unplanned events

POTENTIAL IMPACTS AND RISKS

There is the potential for objects to be accidentally released to the marine environment from vessels or during installation activities.

Buoyant objects could potentially interact with marine fauna, including turtles and vertebrate wildlife, risking entanglement or ingestion and potentially resulting in injury or death. However, given the limited quantities, impacts to fauna would be limited to individuals and are not expected to result in decrease of the local population size.

Release of hazardous solids may also result in pollution of the immediate environment affecting the health of marine fauna (including potential injury or death). The release of microplastic particles (small plastic particles generally five millimetres or less in size) can occur from protective coatings on the equipment. Marine microplastics in the ocean can have various impacts on marine fauna. However, given the small maximum volume released, the overall impact is relatively limited for this activity.

All non-buoyant objects are expected to sink to the seabed and remain within the operational area. This could cause localised and short-term damage to the seabed. No significant seabed features have been identified in the operational area to date.

Invasive marine species (IMS) are marine flora and fauna that could be introduced into a region that is beyond their natural range but would have the ability to survive and possibly thrive. The majority of climatically compatible IMS to northern Australia are found in south-east Asian countries. They can be introduced from biofouling on vessels and discharge of ballast water.

IMS, if successfully established, can have impacts such as outcompeting native species for food or space, preying on native species, impacting fisheries or aquaculture, impacting human health through released toxins, reducing coastal aesthetics, and causing damage to marine and industrial equipment and infrastructure. There may also be flow-on effects for marine parks, tourism and recreation.

The operational area provides an unfavourable habitat for IMS due to water depths exceeding 200 metres and the vast distance to the coast.

PROPOSED CONTROLS

Santos proposes to adopt numerous control measures to seek to reduce the risk of dropped objects, lost equipment or releasing waste to the environment. These include:

+ safety standards and procedures to reduce the risk of tools and other equipment being dropped during lifting operations
+ waste management procedures to reduce the risk of windblown waste entering the marine environment
+ implementation of chemical selection processes and the International Maritime Dangerous Goods Code
+ environmental implementation plan and subsea infrastructure inventory mitigate the risk of Polypropylene (PP) particles and debris release through measures such as monitoring, disposal methods, inspections and maintenance
+ dropped objects, regardless of size, must be reported and attempts made to recover the object according to safety and environment criteria.

Control measures to be designed to comply with maritime legislation and to be consistent with the relevant fauna recovery plans and conservation advice.

Vessels contracted to Santos, and vessel ballast, are to be managed according to control measures that comply with maritime regulations, industry practices, and the *Biosecurity Act 2015*. Vessels will also have ballast water management, vessel biofouling management and anti-fouling systems in place.

Unplanned events

POTENTIAL IMPACTS AND RISKS

There is the potential for vessels, ROVs and helicopters to unintentionally interact with marine fauna, including a potential collision that could result in injury or mortality to fauna such as marine turtles and whale sharks. There is also the potential for fauna to be caught during the process of collecting seawater for testing purposes.

Some potentially impacted marine fauna may have cultural significance and some may be threatened species. The operational area does not intersect any known biologically important area or habitat critical to the survival of any marine fauna species. Vessel and helicopter movements between the Operational Area and Darwin are expected to be at a frequency of approximately 1-2 per day.

A non-hydrocarbon release could occur from activities such as transferring, storing or using bulk products, mechanical failure of equipment, handling and storage spills, hose or coupling failure or rupture, or tank overfilling.

An accidental release could result in impacts to water quality that are expected to be short term and localised. Potential receptors include the physical environment (e.g. water and sediment quality, benthic habitats), threatened, migratory or local fauna (e.g. marine mammals, marine reptiles, sharks and rays, other fish, and birds) and socioeconomic features of the environment (including cultural features).

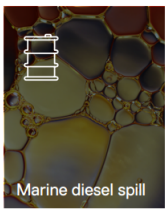
PROPOSED CONTROLS

Santos proposes to adopt a procedure for interacting with marine fauna to reduce risks of physical and behavioural impacts to marine fauna from vessels. If they are sighted, vessels can slow down, or move away and helicopters can increase distances from sighted fauna if required. Santos intends to install screening/mesh protection barriers to reduce the risk of accidentally catching fauna while collecting seawater. Marine fauna interactions would be recorded and reported by Santos.

Suite of procedures in place to manage the selection, storage, handling and clean-up of chemicals and other non-hydrocarbon liquids. Vessels have spill response plans. The chemical selection procedure is designed so that only environmentally acceptable chemicals should be used for leak testing and pre-commissioning fluids.

Unplanned events

POTENTIAL IMPACTS AND RISKS


Marine diesel spill

A marine diesel oil (MDO) spill could occur because of the following:

+ a significant vessel collision that ruptured a fuel tank
+ a refuelling incident due to fuel hose failure or rupture, coupling failure or fuel tank overfilling.

In the event of a vessel collision, the MDO spill volume has been modelled as approximately 500m3 consistent with the largest sized tank on the proposed installation vessels. A maximum spill volume from refuelling incidents of 10m3 is anticipated given hose couplings design and rapid shutdown of pumps.

A marine diesel spill would temporarily affect water quality and could have various environmental impacts, including on benthic organisms, fish, coral and invertebrates, seabirds, whales and turtles. Some potentially affected marine fauna may be threatened or migratory species and some may have cultural significance.

No shoreline accumulation of oil is anticipated based on spill modelling results at moderate threshold levels, but some shoals and banks may be contacted by hydrocarbons, with potential impacts limited to upper water column layers.

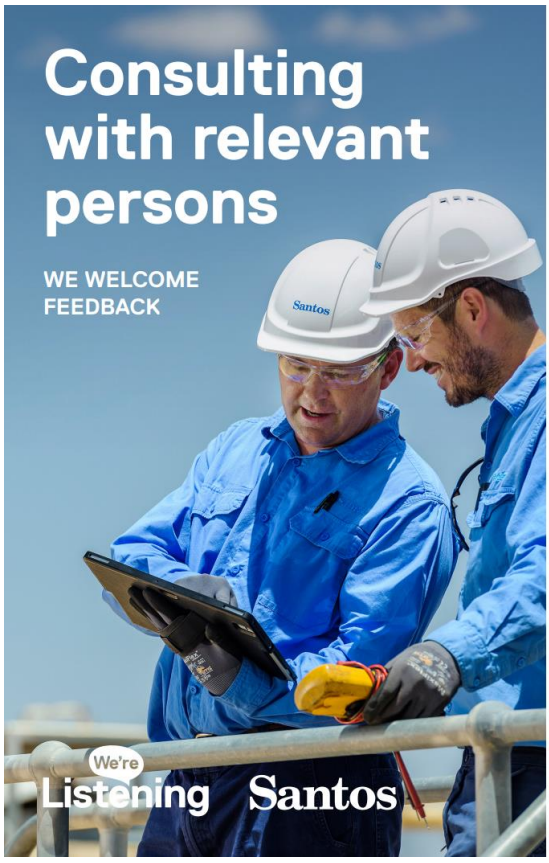
Fishing activities could be temporarily disrupted. There could also be disruption to other activities in the area such as commercial shipping, military exercises and other oil and gas operations.

There is a very low probability that hydrocarbon accumulations could reach the west coast of the Tiwi Islands in the event of a vessel collision spill (0.33% at low threshold levels). The EMBA may overlap cultural values. Cultural values within the EMBA and associated potential risks and impacts will continue to be identified, including through consultation with Indigenous people and their representative bodies.

PROPOSED CONTROLS

The risk of collision is reduced through controls that manage interactions with other marine users before and during the activity. This includes standard maritime notifications, automatic identification systems and navigational lighting. Cautionary zones will also be in place to manage vessel movements close to activities. Operational procedures are designed to minimise refuelling incidents.

Spill response plans to be implemented and regular exercises are planned to be conducted. These control measures are designed to comply with maritime regulations and standard industry practices. The risk of a MDO spill has been assessed as low and as having been reduced to as low as reasonably practicable.



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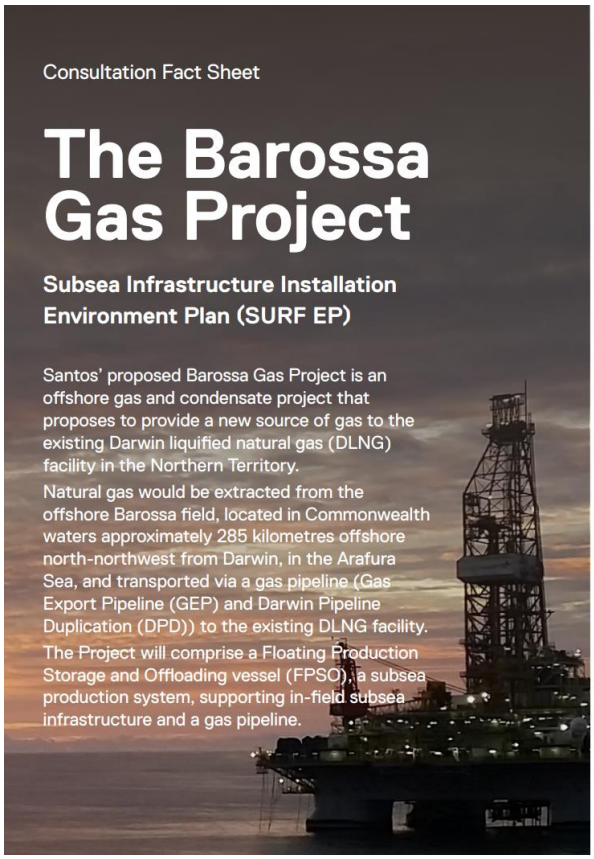
SCAN ME

SURF Fact Sheet – Tiwi Specific



Santos is currently preparing an environment plan (EP) in respect of a part of the Barossa Gas Project relating to the Subsea Umbilicals, Risers and Flowlines (SURF), manifolds and FPSO moorings installation (collectively referred to as the Subsea Infrastructure) and pre-commissioning activity. This is more simply referred to as the 'SURF activity'.

OVERVIEW OF PROPOSED SURF ACTIVITY

Santos proposes to undertake the SURF activity for the Barossa Gas Project within Commonwealth waters approximately 300km north-northwest of Darwin, NT, within the boundaries of Commonwealth Petroleum Production Licence NT/L1.

SURF is a term used to describe the subsea infrastructure required to gather gas and condensate from the production wells and deliver these products to the FPSO for processing. Santos plans to install subsea infrastructure to support the connection of six subsea production wells to the FPSO, and moorings infrastructure required to securely anchor the FPSO in position.

Once Santos has secured all relevant approvals for this activity, specialist vessels will start installing this network of infrastructure under the sea. This will take approximately eight months to complete. From the surface of the ocean, these large vessels carefully lay steel pipes or flowlines, and what are referred to as 'umbilicals'.

The subsea umbilicals play an important role connecting the equipment on the sea surface to what is on the seafloor. They provide power and communications to the infrastructure beneath the sea (such as the Christmas Trees and manifolds), to enable it to be controlled remotely from the FPSO.

Once a well is drilled and completed (Barossa Drilling and Completions EP), flow control equipment (manifold) and piping (flowlines) are attached to the top of the well (via what is called a Christmas Tree). This equipment is designed to manage and control the flow of the natural gas up from beneath the seabed.

Individual wells are connected to the flowlines, and the production fluids (gas and condensate) travel through these pipelines to a 'riser'.

A riser is a specially constructed pipeline that delivers fluid from the subsea equipment to a large vessel on the sea surface, called a FPSO.

A FPSO is an offshore vessel that produces, processes and stores oil and gas before it's transported elsewhere. It requires a very strong mooring system so that it remains secured in one location, and this involves multiple anchors to the seabed. These anchors and mooring lines will also be installed as part of the SURF activity.

Following installation of the subsea infrastructure, Santos plans to complete pre-commissioning, which means testing the pipes to make sure that they do not leak, and testing the controls to make sure that safety systems function correctly.

We're Listening Santos

ACTIVITY DURATION

The total duration of the proposed SURF activity is estimated to be approximately nine months (eight months for installation and one month for pre-commissioning), subject to factors including vessel availability, operational efficiencies and weather conditions.

The preservation phase commences on completion of installation of key infrastructure and pre-commissioning activities. The preservation phase is designed to maintain the integrity of the infrastructure. The preservation phase for the SURF and moorings infrastructure will last up until commissioning.

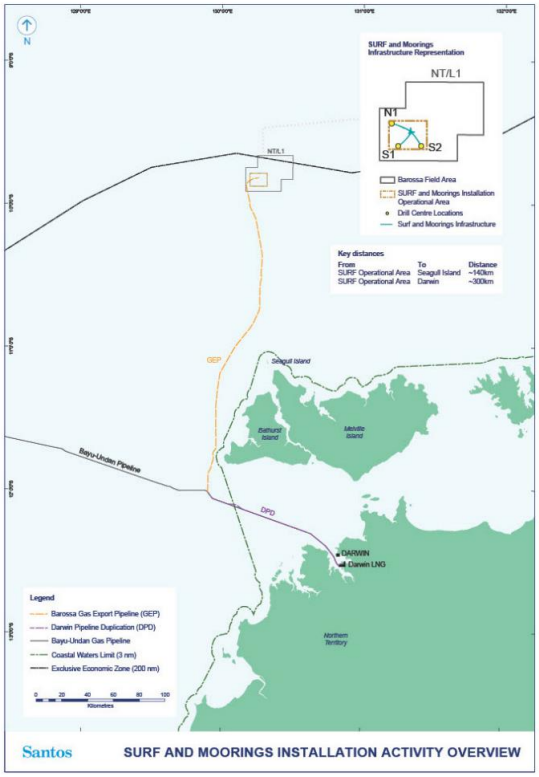
EQUIPMENT AND VESSELS

The below vessels and equipment will be used to support activity under the SURF EP:

+ Reel lay vessels
+ Construction vessels
+ Other support vessels
+ Remotely Operated Vehicles (ROVs)
+ Helicopters

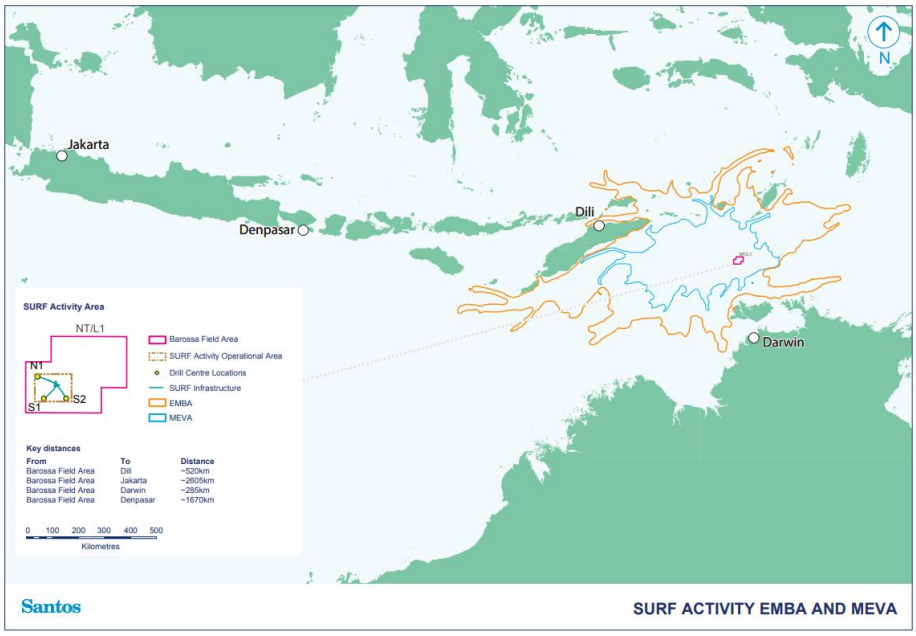
KEY ACTIVITIES INCLUDE:

+ Underwater acoustic positioning
+ Surveys
+ Moorings installation
+ Flowline lay
+ Manifold installation
+ Riser installation
+ Umbilical and flying lead installation
+ Pre-commissioning activities
+ Unplanned and non-routine inspection, maintenance and repairs



Environment that may be affected

This map depicts the proposed operational area for the activities to be carried out (brown box within the grey Barossa Field Area) and the broader environment that may be affected by the proposed activities (red line), referred to as the 'EMBA'. The 'EMBA' represents the greatest geographical extent that could be affected by the unplanned, 'worst case' spill scenario. The Moderate Exposure Value or MEVA (blue line) is used to inform environmental assessment, identify potential environmental consequences, and develop spill response plans. Beyond the MEVA, environmental impacts and risks are unlikely to result in measurable effects to receptors.



Environmental impact and risk assessment

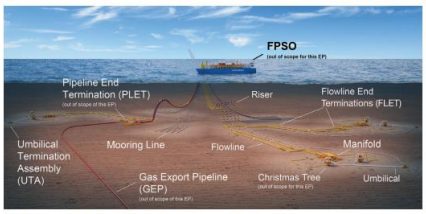
Environmental impact and risk assessment is the process by which events that will or may occur during an activity are assessed for their potential impacts on the environment (physical, biological, and socio-economic).

They are divided into planned and unplanned events.

Planned events are unavoidable impacts, such as light, noise, atmospheric emissions, seabed disturbance, discharges, and interactions with other marine users.

Unplanned events are not expected to occur but are planned for to manage risk. They are also assessed based on their likelihood of occurrence.

Unplanned events include dropped objects, invasive marine species, interactions with marine fauna, non-hydrocarbon discharges or a marine diesel spill.



Graphical representation of the Barossa Field layout

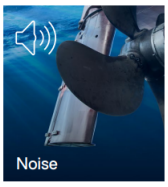

Construction Vessel *(Seven Oceanic)*


Reel-lay Vessel *(Seven Oceans)*

Known and/or planned events

Santos has identified potential impacts or risks as a result of the SURF activity. Outlined below is an overview of impacts and risks and controls we propose to use in seeking to reduce these to as low as reasonably practicable and to an acceptable level. This overview is high-level and not exhaustive. More detail can be found at www.santos.com/barossa. We are also available to answers questions or can provide further information upon request. The identification of potential impacts and risks, and the controls proposed to reduce these impacts and risks, may be developed as a result of consultation processes. This includes consultation to inform Santos' understanding and assessment of potential impacts and risks in light of cultural values within the EMBA and any appropriate control measures if needed.

POTENTIAL IMPACTS AND RISKS



Noise will be generated by activity vessels, helicopters and ROVs.

The majority of the noise sources involved in the activity are lower pressure and not subject to sharp increases or decreases (e.g. engine noise) and will therefore be typical of other marine noise in the region (commercial shipping, fishing, etc).

Studies supporting the risk assessment indicated potential temporary impacts to marine fauna are expected to be confined to 12 km from the noise sources, with no significant impacts at the species population level.

Artificial lighting is required for operational and navigational safety during the activity. Light sources include:

+ safety and navigational lighting on vessels (24 hours per day)
+ spot lighting when needed, such as when deploying or retrieving equipment
+ spot lighting when ROVs are working underwater

Light may impact threatened, migratory or local fauna (e.g. marine mammals, marine turtles, sharks, rays, other fish and seabirds) and socio-economic receptors (cultural features).

The vessels are expected to produce similar light levels to other marine vessels in the region. Light modelling studies estimate that light from the reel-lay and construction vessels is predicted to have the potential for behavioural impacts to turtles within 2.5 km. No nesting habitat or Biologically Important Area (BIA) occurs within this impact area. Due to distance of the operational area from turtle nesting beaches and from BIAs relevant for seabird species, lighting is expected to have a negligible impact on breeding or hatchling turtles and seabirds.

PROPOSED CONTROLS

Vessels are required to comply with Santos' Protected Marine Fauna Interaction and Sighting Procedure which requires compliance with regulatory requirements for managing noise impacts to fauna.

Control measures include:

+ Vessels are required to comply with Santos' Protected Marine Fauna Interaction and Sighting Procedure which requires compliance with regulatory requirements for managing noise impacts to fauna.
+ Compliance with vessel Marine Assurance Standards is required and Planned Maintenance is to be completed to manage excessive noise from vessels.

Lighting is to be limited to that required for safe operations and maritime regulations.

Known and/or planned events

POTENTIAL IMPACTS AND RISKS

Other marine users that may be in the vicinity of the Barossa field include commercial fishing, shipping and other incidental marine traffic. Tourism and recreational fishing vessels are not expected in the operational area given the water depth and distance offshore.

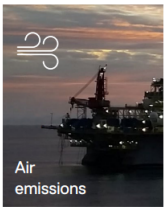
Interruptions to non-Santos vessel movement or commercial fishing activities due to petroleum safety zones and cautionary zones. Santos plans to establish cautionary zones within the operational area to provide clarity and minimal inconvenience to other marine users.

Helicopter operations will be infrequent and unlikely to interfere with other marine users. Helicopters will not fly over the Tiwi Islands or Seagull Island unless in the case of an emergency.

PROPOSED CONTROLS

Santos to notify and communicate with other marine users using standard maritime notifications (e.g., Notice to Mariners) before, during and at the end of the activity.

Vessels to have automatic identification systems to aid in their detection at sea. Infrastructure locations to be marked on nautical charts.



Air emissions may occur from:

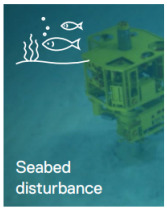
+ fuel combustion to operate the vessels and helicopter
+ operation of vessel incinerators.

In the offshore environment, air emissions rapidly dissipate into the surrounding atmosphere. Impacts are very localised and not significant. Detectable environmental impacts are not predicted from greenhouse gas emissions during SURF activity. Indirect greenhouse gas emissions for the broader Barossa Project will be addressed in a separate environment plan on which there will be further consultation.

Santos proposes to adopt numerous control measures to manage vessel emissions, including requiring Contractor compliance with MARPOL requirements for use of low-sulphur fuel and air pollution prevention certificates. ('MARPOL' is a reference to the International Convention for the Prevention of Pollution from Ships.)

Known and/or planned events

POTENTIAL IMPACTS AND RISKS



Seabed disturbance will occur because of:

+ permanent placement of subsea infrastructure on the seabed (e.g. flowlines, manifolds, mooring anchors)
+ temporary placement and set down of equipment on the seabed (e.g. clump weights, ROV)
+ temporary disturbance and sediment disturbance during installation.

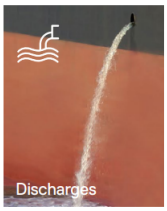
The activity may cause a temporary increase in water turbidity and will involve equipment directly contacting the sea floor resulting in localised impact to bethnic habitat (and associated fauna). Significant impacts to marine fauna as a result seabed disturbance are not expected. Total estimated seabed footprint is approximately 7 hectares, slightly larger than the area of a football field (the MCG playing surface is about 4 hectares). This seabed disturbance represents a very small portion of the operational area. Extensive marine studies have been completed within the operational area to inform the impact assessment. The seabed within the area is generally flat, and devoid of any significant physical seabed or habitat features.

Cultural values within the operational area and associated potential risks and impacts will continue to be identified, including through consultation with Indigenous people.

PROPOSED CONTROLS

Santos' vessel planned maintenance system is designed to enable safe and accurate placement of infrastructure. Santos also intends to maintain an inventory of all installed equipment to enable collection of all equipment during decommissioning to limit ongoing impacts.

Santos continues to consider risks and impacts to cultural values and additional control measures may be implemented following consultation.



The types of discharges are typical of most offshore commercial vessels and include deck runoff, treated sewage and grey water, machinery cooling water, treated oily water, ballast water, bilge water, macerated food scraps and brine (from water making). Additional discharges may occur in the operational area from activities associated with subsea construction, including, for example, flushing and leak testing the pipelines and risers.

During the activity, localised changes to water quality will occur, but water quality conditions will return to normal within hours to days after ceasing discharges. Activity discharges are expected to disperse rapidly and be diluted within the operational area.

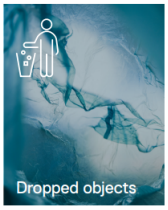
Discharges may cause short-term changes to behaviour in marine fauna (avoidance or attraction). For example, fish and seabirds may be attracted to macerated food scraps discharged by vessels. Other potential receptors include physical environment (water quality, benthic habitat, KEF), threatened, migratory or local fauna (marine mammals, marine turtles, rays, sharks and other pelagic fish, and seabirds) and socioeconomic receptors (cultural features).

Vessel discharges are to be managed to acceptable levels as regulated by maritime laws and conventions (e.g. management of sewage treatment systems and oily water systems), such as MARPOL and relevant Marine Orders. ("MARPOL" is a reference to the International Convention for the Prevention of Pollution from Ships.) Santos also intends to implement management measures including waste management procedures and chemical management and selection procedures.

Activity discharges are to be managed through the application of Santos' Chemical Selection Process, designed so that only environmentally acceptable chemicals (which are likely to be discharged) are selected and used.

Unplanned events

POTENTIAL IMPACTS AND RISKS



There is the potential for objects to be accidentally released to the marine environment from vessels or during installation activities.

Buoyant objects could potentially interact with marine fauna, including turtles and vertebrate wildlife, risking entanglement or ingestion and potentially resulting in injury or death. However, given the limited quantities, impacts to fauna would be limited to individuals and are not expected to result in decrease of the local population size.

Release of hazardous solids may also result in pollution of the immediate environment affecting the health of marine fauna (including potential injury or death). The release of microplastic particles (small plastic particles generally five millimetres or less in size) can occur from protective coatings on the equipment. Marine microplastics in the ocean can have various impacts on marine fauna. However, given the small maximum volume released, the overall impact is relatively limited for this activity.

All non-buoyant objects are expected to sink to the seabed and remain within the operational area. This could cause localised and short-term damage to the seabed. No significant seabed features have been identified in the operational area to date.

Invasive marine species (IMS) are marine flora and fauna that could be introduced into a region that is beyond their natural range but would have the ability to survive and possibly thrive. The majority of climatically compatible IMS to northern Australia are found in south-east Asian countries. They can be introduced from biofouling on vessels and discharge of ballast water.

IMS, if successfully established, can have impacts such as outcompeting native species for food or space, preying on native species, impacting fisheries or aquaculture, impacting human health through released toxins, reducing coastal aesthetics, and causing damage to marine and industrial equipment and infrastructure. There may also be flow-on effects for marine parks, tourism and recreation.

The operational area provides an unfavourable habitat for IMS due to water depths exceeding 200 metres and the vast distance to the coast.

PROPOSED CONTROLS

Santos proposes to adopt numerous control measures to seek to reduce the risk of dropped objects, lost equipment or releasing waste to the environment. These include:

+ safety standards and procedures to reduce the risk of tools and other equipment being dropped during lifting operations
+ waste management procedures to reduce the risk of windblown waste entering the marine environment
+ implementation of chemical selection processes and the International Maritime Dangerous Goods Code
+ environmental implementation plan and subsea infrastructure inventory mitigate the risk of Polypropylene (PP) particles and debris release through measures such as monitoring, disposal methods, inspections and maintenance
+ dropped objects, regardless of size, must be reported and attempts made to recover the object according to safety and environment criteria.

Control measures to be designed to comply with maritime legislation and to be consistent with the relevant fauna recovery plans and conservation advice.

Vessels contracted to Santos, and vessel ballast, are to be managed according to control measures that comply with maritime regulations, industry practices, and the *Biosecurity Act 2015*. Vessels will also have ballast water management, vessel biofouling management and anti-fouling systems in place.

Unplanned events

POTENTIAL IMPACTS AND RISKS

There is the potential for vessels, ROVs and helicopters to unintentionally interact with marine fauna, including a potential collision that could result in injury or mortality to fauna such as marine turtles and whale sharks. There is also the potential for fauna to be caught during the process of collecting seawater for testing purposes.

Some potentially impacted marine fauna may have cultural significance and some may be threatened species. The operational area does not intersect any known biologically important area or habitat critical to the survival of any marine fauna species. Vessel and helicopter movements between the Operational Area and Darwin are expected to be at a frequency of approximately 1-2 per day.

A non-hydrocarbon release could occur from activities such as transferring, storing or using bulk products, mechanical failure of equipment, handling and storage spills, hose or coupling failure or rupture, or tank overfilling.

An accidental release could result in impacts to water quality that are expected to be short term and localised. Potential receptors include the physical environment (e.g. water and sediment quality, benthic habitats), threatened, migratory or local fauna (e.g. marine mammals, marine reptiles, sharks and rays, other fish, and birds) and socioeconomic features of the environment (including cultural features).

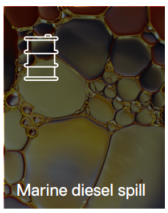
PROPOSED CONTROLS

Santos proposes to adopt a procedure for interacting with marine fauna to reduce risks of physical and behavioural impacts to marine fauna from vessels. If they are sighted, vessels can slow down, or move away and helicopters can increase distances from sighted fauna if required. Santos intends to install screening/mesh protection barriers to reduce the risk of accidentally catching fauna while collecting seawater. Marine fauna interactions would be recorded and reported by Santos.

Suite of procedures in place to manage the selection, storage, handling and clean-up of chemicals and other non-hydrocarbon liquids. Vessels have spill response plans. The chemical selection procedure is designed so that only environmentally acceptable chemicals should be used for leak testing and pre-commissioning fluids.

Unplanned events

POTENTIAL IMPACTS AND RISKS


Marine diesel spill

A marine diesel oil (MDO) spill could occur because of the following:

+ a significant vessel collision that ruptured a fuel tank
+ a refuelling incident due to fuel hose failure or rupture, coupling failure or fuel tank overfilling.

In the event of a vessel collision, the MDO spill volume has been modelled as approximately 500m3 consistent with the largest sized tank on the proposed installation vessels. A maximum spill volume from refuelling incidents of 10m3 is anticipated given hose couplings design and rapid shutdown of pumps.

A marine diesel spill would temporarily affect water quality and could have various environmental impacts, including on benthic organisms, fish, coral and invertebrates, seabirds, whales and turtles. Some potentially affected marine fauna may be threatened or migratory species and some may have cultural significance.

No shoreline accumulation of oil is anticipated based on spill modelling results at moderate threshold levels, but some shoals and banks may be contacted by hydrocarbons, with potential impacts limited to upper water column layers.

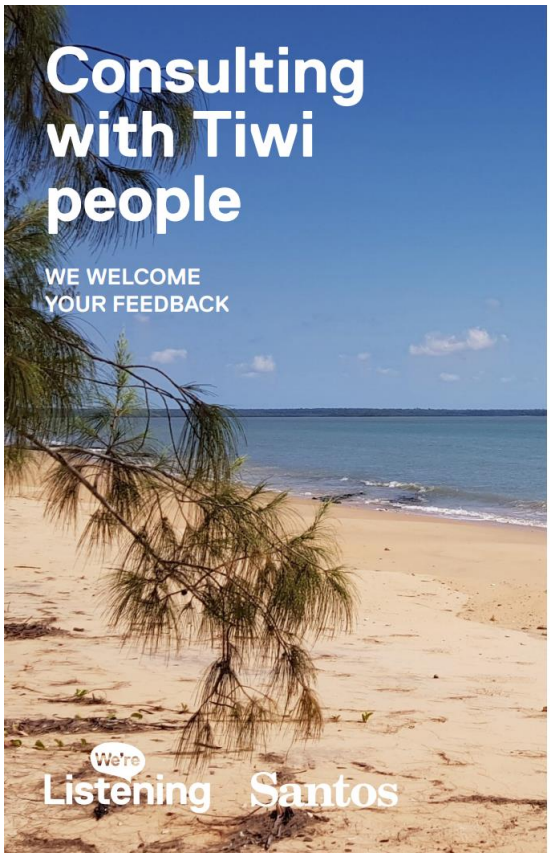
Fishing activities could be temporarily disrupted. There could also be disruption to other activities in the area such as commercial shipping, military exercises and other oil and gas operations.

There is a very low probability that hydrocarbon accumulations could reach the west coast of the Tiwi Islands in the event of a vessel collision spill (0.33% at low threshold levels). The EMBA may overlap cultural values. Cultural values within the EMBA and associated potential risks and impacts will continue to be identified, including through consultation with Indigenous people and their representative bodies.

PROPOSED CONTROLS

The risk of collision is reduced through controls that manage interactions with other marine users before and during the activity. This includes standard maritime notifications, automatic identification systems and navigational lighting. Cautionary zones will also be in place to manage vessel movements close to activities. Operational procedures are designed to minimise refuelling incidents.

Spill response plans to be implemented and regular exercises are planned to be conducted. These control measures are designed to comply with maritime regulations and standard industry practices. The risk of a MDO spill has been assessed as low and as having been reduced to as low as reasonably practicable.



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Santos is committed to undertaking genuine and meaningful consultation. Any feedback we receive will be considered and addressed as appropriate in our SURF Environment Plan that we submit to the regulator for assessment.

We are requesting relevant persons' feedback for our SURF Environment Plan by 14 July 2023. Relevant persons can give us feedback through any of these ways:

+ Tell us at our consultation sessions (listed at **santos.com/barossa**)
+ Call us on 1800 267 600
+ Email us on **offshore.consultation@santos.com**

Alternatively, please contact us by 16 June 2023 to seek further information or to discuss other consultation arrangements.

For more information, visit **santos.com/barossa** or use the **QR code**.

Santos

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Fishers' factsheet

Additional information for Commonwealth and Northern Territory managed commercial fisheries operating offshore from the Northern Territory.

In addition to Santos' other consultation material regarding the Subsea Infrastructure Installation Environment Plan (SURF EP), this fact sheet is for commercial fishers active in waters offshore from the Northern Territory coastline. The subsea infrastructure installation and pre-commissioning activity under the SURF EP (SURF activity) has the potential to affect the following commercial fisheries:

Commonwealth managed fisheries

- Northern Prawn Fishery
- Southern Bluefin Tuna Fishery
- Western Skipjack Tuna Fishery
- Western Tuna and Billfish Fishery
- North West Slope Trawl Fishery

Northern Territory (NT) managed fisheries

- Aquarium Fishery
- Spanish Mackerel Fishery
- Timor Reef Fishery
- Demersal Fishery
- Coastal Line Fishery
- Offshore Net and Line Fishery
- Small Pelagic (Development) Fishery

The locations of these Commonwealth and Northern Territory managed commercial fisheries relative to the proposed activities are illustrated in Figures 1 and 2, and bathymetric contours are illustrated in Figure 3.

A summary of Santos' knowledge of fishing efforts undertaken by these fisheries in relation to the Barossa Field is provided in Tables 1 and 2. A summary of key concerns about the proposed SURF activity raised with Santos that are relevant to commercial fisheries is provided in Table 3. These concerns include:

- Interference with commercial fishing activities and exclusion from fishing areas.
- Introduction of invasive Marine Species (i.e., marine pests).
- Vessel collision and refueling incidents.

Further assessment of potential impacts and risks associated with the proposed SURF activity will be included in the SURF EP.

Relevant Person Consultation

Santos is continuing its consultation efforts for its SURF EP to further ascertain, understand and assess values and sensitivities of the environment that may be affected by our proposed activities, and potential environmental impacts and risks.

There may be information Santos is not yet aware of but needs to properly understand to assess potential activity impacts and risks in its SURF EP. Consultation may inform this. It may also inform what control measures are to be proposed to reduce environmental impacts and risks to as low as reasonably practicable and to an acceptable level.

More information about environmental approvals associated with the Barossa Gas Project SURF EP is set out below.

Santos is committed to undertaking genuine and meaningful consultation. Any feedback we receive will be considered and addressed as appropriate in our SURF EP that we submit to the regulator for assessment.

We are seeking your input on whether you may be affected by the proposed SURF activity. We are seeking your feedback about the activities and especially:

- the environment that may be affected and any concerns or questions you may have
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If you do not wish to receive further information from Santos on this SURF activity, please advise Santos directly or through your representative body.

Contact
Santos Offshore Consultation Team Telephone: 1800 267 600
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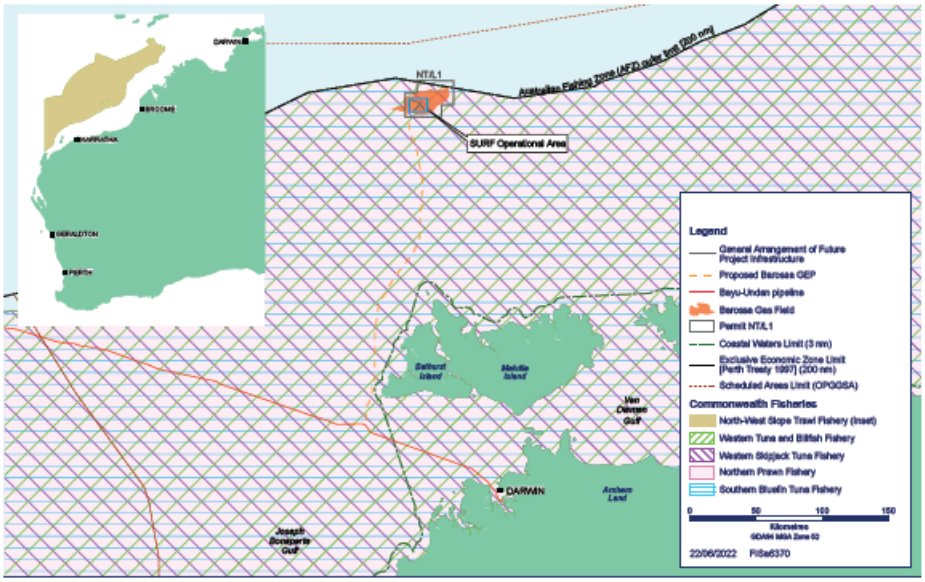
Table 1: Summary of Commonwealth managed fisheries

Fishery	Summary of Fishery in relation to the Barossa Field	Assessment of Potential SURF installation Impacts
Northern Prawn Fishery	The Northern Prawn Fishery management area extends over Australia's northern coast, between Cape York in Queensland and Cape Londonderry in WA, from the low water mark to the outer edge of the Australian Fishing Zone. The majority of the fishing effort within the Northern Prawn Fishery occurs in the area of the Gulf of Carpentaria, Joseph Bonaparte Gulf and along the Arnhem Land coast. The key target species are banana prawns, tiger prawns and endeavour prawns. There are two fishing seasons, with the season end date depending on catch rates: + Season 1 (mainly banana prawns caught): 1 April – 15 June + Season 2 (mainly tiger prawns caught): 1 August – end of November The areas of low, medium and high fishing effort are distant from the Barossa Field. Based on previous industry consultation prawn fishing is not expected in water depths greater than ~130 m. Scampi are targeted in deeper waters north of the Barossa Field. There is a low level of fishing spread across two to three months of the year.	No impact to the prawn fishery expected given the location and water depth of the Barossa Field. Scampi fishing occurs in deeper waters (>250 m) with recorded fishing effort to the north of the Barossa Field. SURF activity is not expected to displace trawl fishers or affect scampi catch.
Southern Bluefin Tuna Fishery	The Southern Bluefin Tuna Fishery operates around Australia and extends to the high seas fishing zone (out to 200 nm from the coast). The fishery targets southern bluefin tuna only. Fishing activity is focused in southern Australian waters with no activity expected across the Barossa Field or surrounds.	No impact to the fishery expected.
Western Skipjack Tuna Fishery	The Western Skipjack Tuna Fishery extends west from Cape York Peninsula and around Australia to the South Australian / Victorian border, out to the edge of the Australian Fishing Zone. Little fishing activity has been undertaken in this fishery since 2008. No fishing activity associated with this fishery is expected to occur within the Barossa Field or surrounds.	No impact to the fishery expected.
Western Tuna and Billfish Fishery	The Western Tuna and Billfish Fishery management area extends over a large area westward from Cape York Peninsula off Queensland, around the west coast of WA and eastward, across the Great Australian Bight to 141°E at the South Australian/Victorian border. The fishery has operated at low levels of effort since the early 2000's due to economic conditions. Target species include albacore, bigeye tuna, yellow fin tuna, swordfish and striped marlin. This fishery is not known to be active within the Barossa Field or surrounds.	No impact to the fishery expected.
North-West Slope Trawl Fishery	The North-West Slope Trawl Fishery operates off north-western Australia from 114°E to 125°E, between the 200 m isobath and the outer boundary of the Australian Fishing Zone. A large area of the Australia–Indonesia MoU Box falls within the North West Shelf (NWS) throughflow. The fishing method is trawling and the target species is scampi.	No impact to the fishery expected. Fishery intercepts the area of the environment that may be affected by the activity (EMBA) but does not overlap the operational area.

Figure 1- Commonwealth managed fisheries in northern Australia



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BAROSSA DEVELOPMENT
COMMONWEALTH FISHERIES

Table 2: Summary of Northern Territory managed fisheries

Fishery	Summary of Fishery in relation to the Barossa Field	Assessment of Potential SURF installation Impacts
Aquarium Fishery	The Aquarium Fishery is a small-scale, multi-species fishery that prospects freshwater, estuarine and marine habitats. The fishery extends to the outer boundary of the Australian Fishing Zone but the harvest of most marine species occurs within 100 km of Nhulunbuy and Darwin. One license holder does occasionally collect from offshore locations, including at Evans Shoal (approximately 65 km west of the Barossa Field). This fishery is not expected to be active across the Barossa Field or surrounds.	No impact to the fishery expected.
Spanish Mackerel Fishery	The fishery extends seaward from the high-water mark to the edge of the Australian Fishing Zone. The majority of the fishing effort occurs in the vicinity of reefs, headlands and shoals and includes waters near Bathurst Island, New Year Island, northern and western Groote Eylandt, the Gove Peninsula, the Wessel Islands, the Sir Edward Pellew Group and suitable fishing grounds on the western and eastern mainland coasts. This fishery is not expected to be active across the Barossa Field or surrounds.	No impact to the fishery expected.

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Fishery	Summary of Fishery in relation to the Barossa Field	Assessment of Potential SURF installation Impacts
Timor Reef Fishery	The Timor Reef Fishery (TRF) extends north-west of Darwin to the WA-NT border and to the outer limit of the Australian Fishing Zone. Fishing occurs primarily in the 100 to 200-m depth range. Previous consultation indicates that the main target species is goldband snapper, with other tropical snappers (e.g., crimson snapper and saddletail snapper) also making up part of the catch; there are two active fishing licence holders currently operating in the fishery; main fishing method is trap fishing; fishery is most productive between October and May, with less activity during the dry season months of June-August due to strong northerly winds. Due to the water depth and based on a review of available historical catch data, fishing activity is not expected across the Barossa Field and surrounds.	No impact to the fishery expected.
Offshore Net and Line Fishery	The Offshore Net and Line Fishery operates in NT waters from the low water mark to the boundary of the Australian Fishing Zone. Most fishing occurs in the coastal zone within 12 nautical miles of the coast, and immediately offshore in the Gulf of Carpentaria. Black-tip sharks and grey mackerel are the primary species taken in offshore net and line fishing. Fishing methods include longlines or pelagic nets (there are restrictions on where certain gear can be used).	Interaction with this fishery in the operational area is possible but considered unlikely due to the concentration of fishing effort in near coastal areas and distribution of the targeted species.
Small Pelagic (Development) Fishery	The Small Pelagic (Development) Fishery is operational under a development licence. Small pelagic species such as herring, sardine, anchovy, mackerel and squid are considered important to the commercial, recreational and Indigenous fishing sectors as a source of bait, for livestock and aquaculture feed, and increasingly for human consumption. Lift nets, drop nets and purse sein methods of fishing are being used. The fishery extends to the outer limit of the Australian Fishing Zone. A licence has not been issued to a specific commercial fishing licence-holder to date.	No impact to the fishery expected
Demersal Fishery	The fishery extends from waters 15 nm from the coastal waters mark to the outer limit of the Australian Fishing Zone, excluding the area of the Timor Reef Fishery. Hence, this fishery does not overlap with Barossa Field or surrounds.	No impact to the fishery expected.
Coastal Line Fishery	The Coastal Line Fishery extends from the NT coast between the high-water mark and 15 nautical miles out from the low water mark. Special restrictions apply in the western zone which extends from the Western Australian border to Vashon Head on Cobourg Peninsula, in the NT. Fishing is prohibited in reef fish protection areas. Access is also restricted around registered Aboriginal sacred sites and protected areas. Black jewfish and golden snapper are the main species taken in the coastal line fishery.	Fishery intercepts the area of the environment that may be affected by the activity (EMBA). No impact to the fishery is expected.

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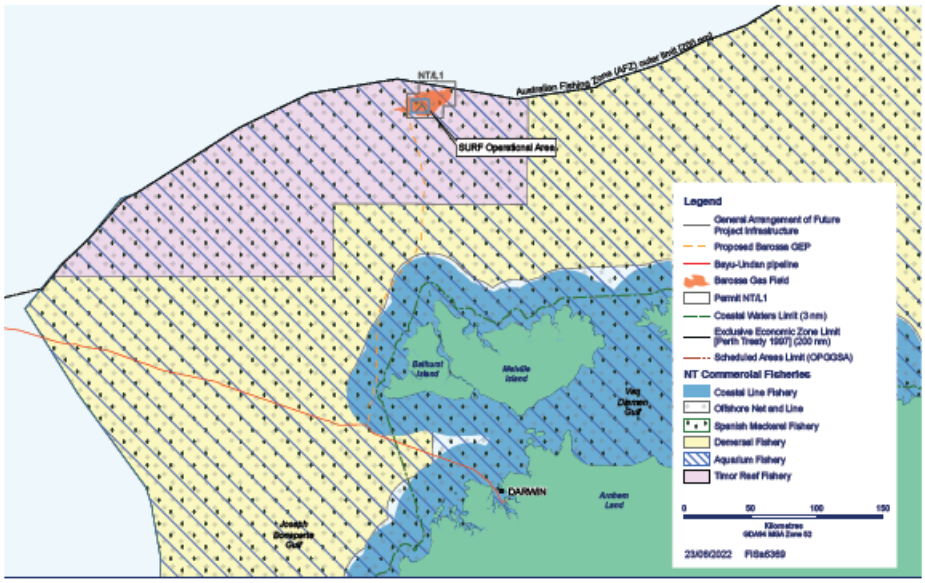
Figure 2- Northern Territory commercial fisheries



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The Small Pelagic Development Fishery licence boundary is not yet defined. No Pearl Oyster Fishery licences are active in the EMBA

BAROSSA DEVELOPMENT
NORTHERN TERRITORY COMMERCIAL FISHERIES

Table 3: Summary of potential impacts to commercial fisheries from the proposed Barossa Gas Project SURF activity and proposed control measures

Potential Impact	Proposed Control Measures
Interference with commercial fishing activities and exclusion from fishing areas	+ Northern Prawn and Timor Reef fishery licence holders will be notified in advance of SURF activity, and Santos commits to ongoing communications with licence holders as requested. + Australian Hydrographic Service (AHS) Notice to Mariners and AMSA Maritime Safety Information (MSI) will be notified in advance of the SURF activity. + A 500-metre radius Petroleum Safety Zone (PSZ) around the Barossa well locations which will incorporate some areas of SURF infrastructure installation. Santos will also request an exclusion zone around installation vessels during activities (via Notice to Mariners). + A PSZ will be established around the location of the STP buoy and subsea risers and umbilicals. + Santos will not restrict commercial fishing access to the Barossa Field, other than within PSZs, and is committed to concurrent operations where safety is not compromised. + Support vessels outside of the range of the SURF activities will avoid commercial vessels that are actively fishing. + The SURF installation and support vessels to have automatic identification systems to aid in their detection at sea.

Introduction of Invasive Marine Species (i.e. exotic marine pests)	+ Vessels contracted to Santos to be managed in accordance with the following controls:
	  + Santos Invasive Marine Species Management Procedure (international) to reduce risks of invasive marine species spread.
	  + Pursuant to the *Biosecurity Act 2015* and Australian Ballast Water Management Requirements 2020, activity vessels and support vessel(s) carrying ballast water and engaged in international voyages shall manage ballast water so that marine pest species are not introduced.
	+ Vessels will have a suitable anti-fouling coating in accordance with the Protection of the Sea (Harmful Anti-fouling Systems) Act 2006.
	+ Vessel ballast to be managed in accordance with the *Biosecurity Act 2015*.

Vessel collision and refueling incidents	The risk of collision is reduced through controls that manage interactions with other marine users before and during the activity. This includes: + standard maritime notifications; + automatic identification systems; and + navigational lighting. Operational procedures are designed to minimise refuelling incidents. Spill response plans to be implemented and regular exercises are planned to be conducted. + Support vessels will be equipped with an AIS and radar. + At least one support vessel is available at all times to monitor the proposed exclusion zones to identify approaching third-party vessels and communicate with the vessels. + Support vessels will be equipped and crewed in accordance with the Navigation Act 2012 and Marine Orders. + All vessels will have a dedicated Ship Oil Pollution Prevention Plan (SOPEP). + Diesel bunkering will be undertaken under a Permit-to-Work System and bunkering procedure to reduce the risk of a release to sea. These control measures are designed to comply with maritime regulations and standard industry practices. The risk has been assessed to be as low as reasonably practicable and of an acceptable level. + An Oil Pollution Emergency Plan (OPEP) will be implemented, if required. + The SURF OPEP details a range of spill response strategies and associated control measures, including those required to maintain preparedness and response arrangements. + The combination of the standard prevention control measures and the spill response strategies, as presented in the OPEP, together have been assessed as reducing the hydrocarbon spill risk to a low level. + A SURF Safety Case will be prepared to a standard accepted by NOPSEMA.

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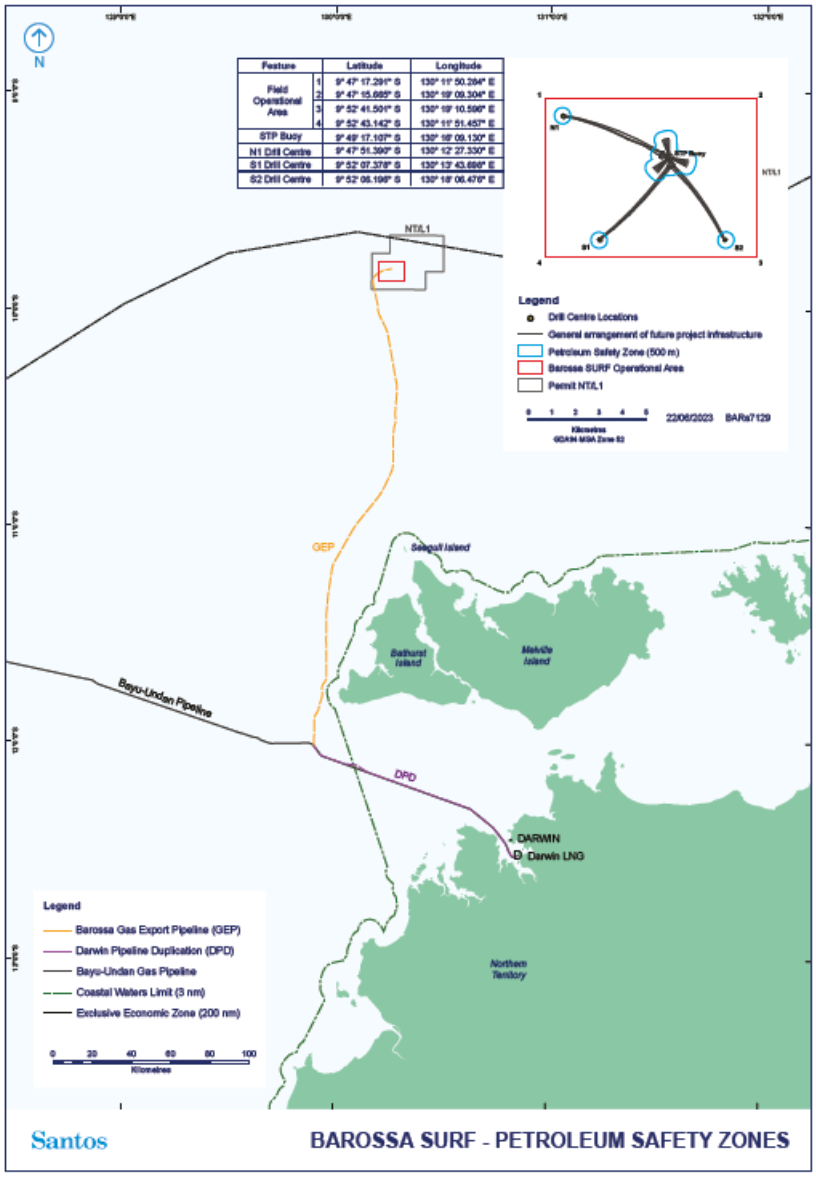
Figure 3- Barossa Gas Project SURF Activity Location Map



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Environment approvals

The Commonwealth Government's independent expert regulator for offshore oil and gas development, the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA), accepted the Barossa Offshore Project Proposal (OPP) in March 2018.

Acceptance of the OPP is the government's project-level environmental approval for offshore projects, with construction and operations subject to further acceptance of activity-level environment plans (EPs).

To be accepted by NOPSEMA, an EP must meet the requirements set out in the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS Environment Regulations)*.

The OPGGS Environment Regulations set out that an EP must (among other things):

- comprehensively describe the activity to be carried out under the EP
- describe the environment that may be affected by the activity, including the values and sensitivities of that environment
- detail and evaluate the environmental impacts and risks for the relevant activity
- demonstrate that the impacts and risks of the activity will be reduced to as low as reasonably practicable and an acceptable level (and detail the control measures to be used to achieve this)
- demonstrate that Santos has consulted, in accordance with regulatory requirements, with each relevant person, including those whose functions, interests or activities may be affected by the activities to be carried out under the EP
- demonstrate that the measures (if any) that Santos has adopted, or proposes to adopt, because of the consultations are appropriate.

The OPP is available at www.nopsema.gov.au

General Commitments

In the development of the EP, Santos will incorporate control measures to ensure environmental impacts and risks are acceptable and as low as reasonably practicable. The following control measures relating to interactions with other marine users are also proposed to be included.

Any additional control measures identified during relevant person consultation will be considered for inclusion in the EP.

Potential Area of Interest	Santos Commitments
Maritime notices + **Notice to Mariners (NTM)** + **AUSCOAST warnings**	A notification will be provided prior to vessels/vessel arrival in the Operational Area and following departure. Notifications are provided to the Australian Maritime Safety Authority (AMSA) Joint Rescue Coordination Centre, Australian Hydrographic Office and designated port authorities so the maritime industry is aware of activities.
Activity notifications	Other relevant marine users identified during relevant person consultation and listed in the EP will be provided a commencement notification at least two weeks prior to the activity commencing. Santos will have a process in place to ensure feedback is recorded, evaluated and responded to.
Support vessel in place during activity to reduce potential for collision or interference with other marine users	At least one support vessel will be on standby at all times to monitor the exclusion zone to identify approaching third-party vessels and communicate with the vessels.

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Barossa Quarterly Report

STAKEHOLDER CONSULTATION

Barossa Development

Quarterly Update: July 2023

Santos

The Barossa Gas Project will supply backfill natural gas to the existing Santos-operated Darwin Liquefied Natural Gas (DLNG) facility from 2025, enabling another 20 years of production and contribution to the Australian and Northern Territory economies. Stakeholder engagement on Barossa commenced in 2016. Santos continues to engage with stakeholders and keep them informed throughout the development life.

Work Progress Highlights

The Barossa Gas Project is now 66 per cent complete, excluding the Darwin Pipeline Duplication Project. The FPSO hull has been floated whilst fabrication of the FPSO topsides modules continues to plan.

Major equipment manufacturing continued to make good progress around the world, with equipment being delivered into Darwin and Singapore for further assembly.

Community and Work Opportunities

Santos has partnered with the Industry Capability Network NT (ICNNT) to assist with Australian vendor identification and raise awareness of the development. Barossa has established a presence on the Gateway website operated by ICNNT where development information and work opportunities are available. Details on the opportunities can be found on the Gateway website here. Information on Australian Industry Participation (AIP) requirements and a summary of the Barossa AIP Plan are available at www.industry.gov.au

Santos and its JV partners are also committed to establishing a community benefits fund that will be available to different groups once activities commence. This will include Community Grants to support grassroots community initiatives as well as Strategic Community Sponsorships that will be designed to build capacity in communities.

Upcoming Activities

No offshore construction activities are currently planned for Q3 2023.

Drilling Update

As reported in the Q4 2022 Quarterly Update, Barossa drilling was suspended on 6 October 2022 pending resubmission of the Development Drilling and Completions Environment Plan and its acceptance by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA).

Gas Export Pipeline Installation Update

As reported in the Q4 2022 Quarterly Update, Santos planned to commence the Gas Export Pipeline (GEP) installation activities in late January 2023. The installation activities have now been deferred until completion of a cultural heritage assessment as detailed below.

Cultural Heritage Assessment

Before the GEP installation starts, an assessment will be undertaken to identify "any underwater cultural heritage places" along the Barossa GEP route to which "people, in accordance with Indigenous tradition, may have spiritual and cultural connections that may be affected" by the future activities covered by the Barossa GEP Installation Environment Plan.

The assessment is being undertaken in accordance with a General Direction issued by NOPSEMA in January 2023. As required by that Direction, Santos has engaged independent experts to undertake the assessment and obtain relevant information for the purposes of the assessment.

Santos has engaged independent underwater archaeological experts, Wessex Archaeology and Extent Heritage, to inform and support the cultural heritage assessment by reviewing underwater surveys of the seabed to see if there are any features that might indicate "any underwater cultural heritage places".

To further inform and support the cultural heritage assessment, Santos has engaged independent expert, Dr Henry Posamentier, to review underwater surveys of the seabed and prepare a report on the depositional and erosional history of the Arafura Sea (particularly, along the Barossa GEP route).

Santos has also engaged independent anthropologist (Dr Brendan Corrigan, supported by a team comprising independent archaeologists) to obtain information from people and/or organisations "who have, in accordance with Indigenous tradition, spiritual and cultural connections to any underwater cultural heritage places" along the Barossa GEP route.

A report recording the cultural heritage assessment will be prepared and provided to people and/or organisations who provided information for the assessment, and to NOPSEMA.

Pipeline Licence

The National Offshore Petroleum Titles Administrator (NOPTA) granted Pipeline Licence NT/PL5 under the Commonwealth *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (Cth) on 3 November 2020. As reported in the Q4 2022 Quarterly Update, Santos has taken a decision to extend the Barossa GEP to the Darwin LNG facility via the Darwin Pipeline Duplication Project to facilitate future carbon capture and storage options. This requires the installation of an additional 23-km segment of pipeline in Commonwealth waters and negates the need to tie-in to the Bayu Undan to Darwin Pipeline. Santos is progressing relevant pipeline licence applications with NOPTA, including engagement with Commonwealth agencies and Native Title stakeholders, for this additional pipeline segment.

Environmental Approvals

Santos intends to make the following environmental submissions to government for acceptance in relation to the Barossa Gas Project during 2023.

Subsea Infrastructure Installation Environment Plan (SURF EP)

Consultation on the SURF EP commenced during Q2 2023. Santos has been identifying relevant persons for this activity and has commenced sharing information and seeking feedback to assist with the preparation of the EP. Once the EP has been finalised it will be submitted to NOPSEMA for assessment. Installation activities are proposed to commence in early 2024 once all relevant approvals have been secured.

Development Drilling and Completions Environment Plan (Drilling and Completions EP)

Following Federal Court proceedings in late 2022, NOPSEMA's decision to accept Revision 3 of the Drilling and Completions EP was set aside. As at that time, Santos had partially drilled and completed one development well.

Santos is finalising a new revision of the EP for submission to NOPSEMA in July 2023. The new revision has been prepared having regard to the guidance of the Full Federal Court in relation to Revision 3 of the EP and in particular, guidance concerning consultation with relevant persons under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth). Santos commenced consultation processes for the revised EP in Q1 2023.

Darwin Pipeline Duplication (DPD) Project

Santos is progressing the environmental approval requirements for the Darwin Pipeline Duplication (DPD) Project. A DPD Project Supplementary Environmental Report has been submitted to Northern Territory (NT) Environment Protection Authority for assessment and approval under the *Environment Protection Act 2019* (NT). The public comment period for this document has now concluded.

Additionally, a DPD Project Preliminary Documentation Report will be submitted to the Commonwealth Department of Climate Change, Energy, the Environment and Water for assessment and approval under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth). This document is being developed and is expected to be published for public comment in August 2023.

Santos is also preparing an Environment Plan for DPD Installation in Commonwealth Waters. Consultation on this EP will commence during late 2023. Santos intends to identify relevant persons for this activity and begin sharing information and seeking feedback to develop the EP. Once the EP has been finalised it will be assessed by NOPSEMA. DPD Installation in Commonwealth Waters activities are proposed to commence in late 2024 once all relevant approvals have been secured.

Other Approvals

Santos intends to submit further environmental approvals to government for acceptance in relation to other aspects of, and activities in connection with, the Barossa Gas Project during 2023. This includes submitting the Barossa Production Operations Environment Plan to NOPSEMA following additional consultation. Consultation is planned to commence in Q3 2023. We will provide further information and advertising about this at a later date.

Tiwi Island Consultation

Further to the meetings held on the Tiwi Islands in February and March, Santos has visited and conducted a number of meetings and consultations on the Tiwi Islands in April, May and June. Santos is grateful to the communities for welcoming us and for constructively engaging with us during the consultation process.

During late April and early May Santos presented information about the Project, the proposed Drilling and Completions EP and the proposed Subsea Infrastructure Installation EP at clan group meetings held across the two main Islands, Melville and Bathurst. These meetings were attended by more than 800 people. During these meetings, Santos provided information about the activities proposed under each of these environment plans, the environment that may be affected by each activity, their potential environmental impacts and risks and related control measures. Santos also asked for feedback about the same for each environment plan.

From 13-16 June Santos consulted with more than 650 Tiwi people during eight clan group consultation sessions. During the sessions, Santos sought final feedback for the proposed Drilling and Completions EP and explained how the feedback already provided by Tiwi people had been assessed and considered . Santos also continued to consult with Tiwi people in relation to the proposed Subsea Infrastructure Installation EP.

The next consultation sessions on the Tiwi Islands are planned for late July/early August.

Relevant Person Identification

When preparing an environment plan, Santos is required, under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth), to consult with 'relevant persons', including those whose functions, interests or activities may be affected by the activities to be carried out under the environment plan. This may include those arising in relation to spiritual or cultural connections to land or to sea country, tourism, recreational and commercial fishing and local communities (though these are only illustrative examples and not an exhaustive list). As mentioned above, Santos has been consulting with relevant persons for its Drilling and Completions EP and Subsea Infrastructure Installation EP.

As part of the upcoming consultation process for the Production Operations and DPD Installation in Commonwealth Waters EPs, Santos will be seeking to identify relevant persons whose functions, interests or activities may be affected by activities proposed under those EPs.

Consultation

In relation to environment plans for which consultation is ongoing, identified relevant persons are being or will be contacted to exchange information about for the environment plan consultation, including the consultation process.

Santos is committed to undertaking genuine and meaningful consultation. We want to provide information for people to make informed assessments of the possible consequences of the proposed activity on them. Relevant persons' input is important to us and will be considered during the development of our environment plans.

We have also updated our website to include more information on the Barossa Gas Project. We will continue to update it with information about our upcoming activities – www.santos.com/barossa The **QR code below** links directly to this site.

SCAN ME

Contact Us

We are committed to ongoing engagement about our activities. If you require further information or would like to speak to us, please do not hesitate to contact us.

Phone: 1800 267 600

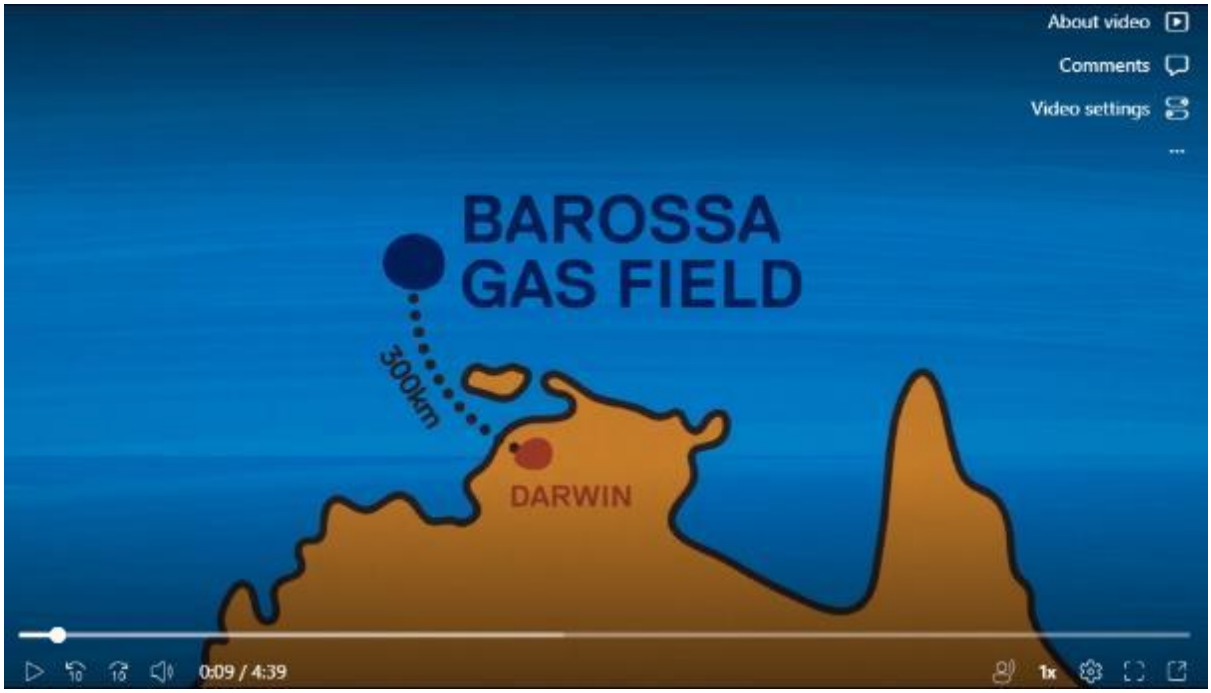
Email: Offshore.Consultation@santos.com

Website: www.santos.com/barossa

3. Videos

Consultation Video

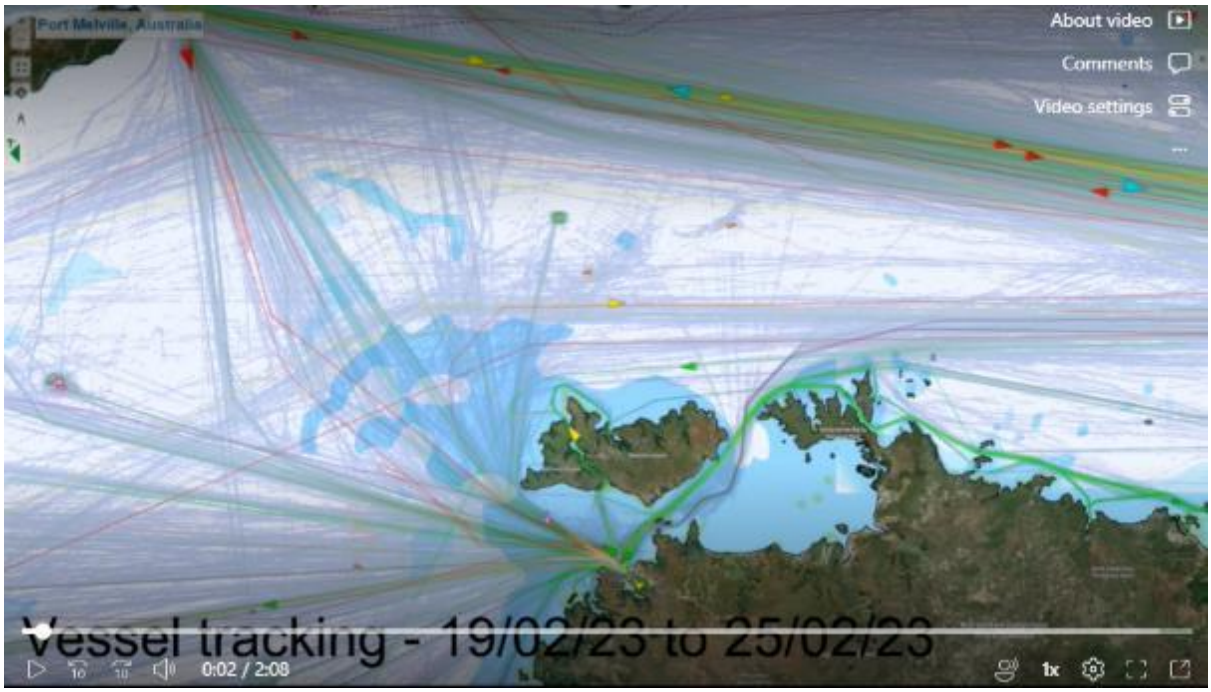
Project overview video



Condensate vs oil video

Risks and management video

Vessel movement tracking video 2 weeks



4. PowerPoint presentations

Presentation April 2023

Barossa Gas Project
April Consultation Session

Santos

Barossa Gas Project

Welcome and Introductions

Brett Darley and Peter Kirkpatrick

Santos

Barossa Gas Project

Feedback and Responses to Questions From Last Visit

Peter Kirkpatrick, Norman Scott and Ben Fischer

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Barossa Project Overview Video

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Spill Response

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Drilling EMBA

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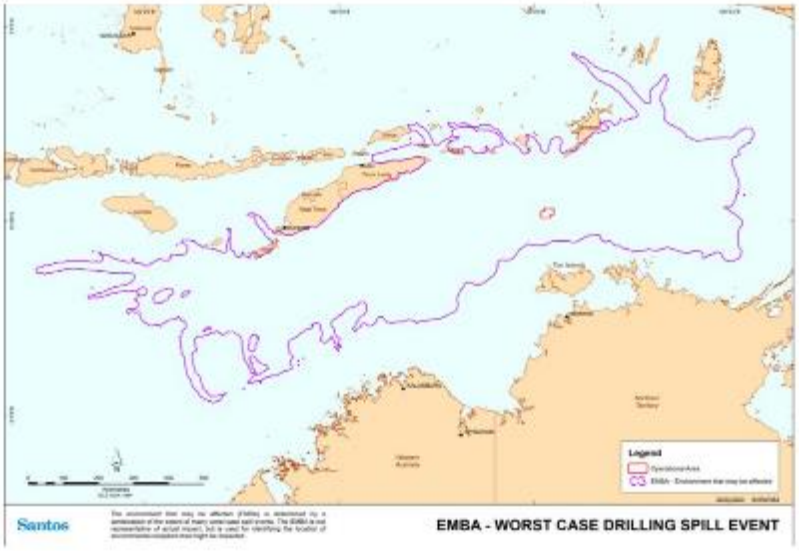
Norman Scott



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Condensate vs Oil

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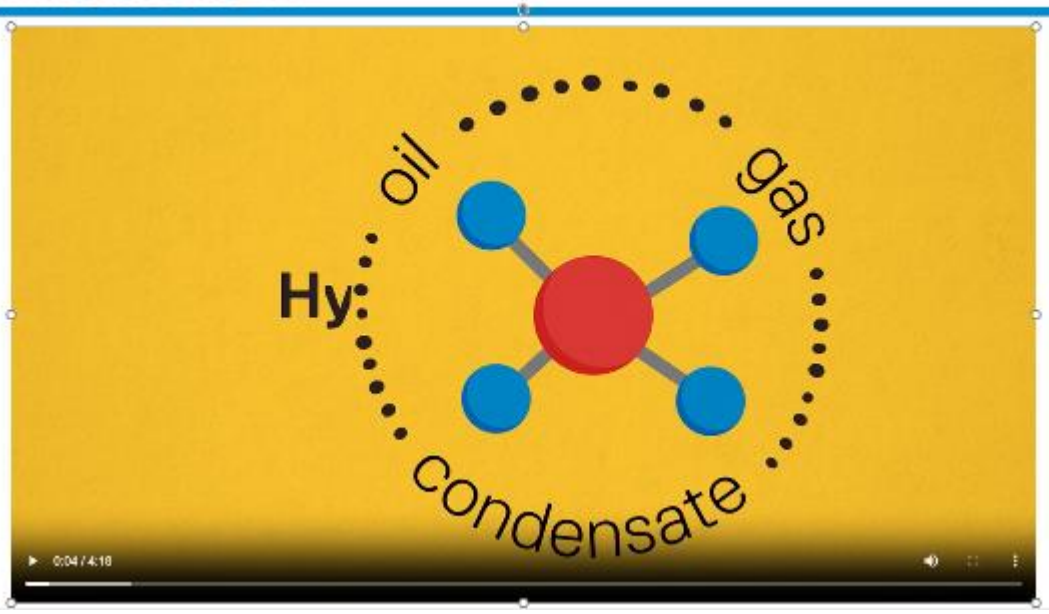

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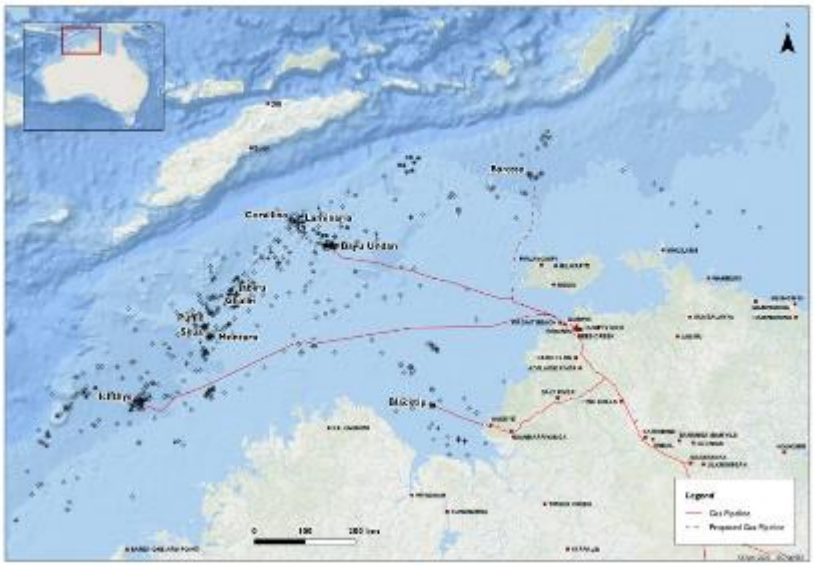

Barossa Gas Project

Drilling and Completions EP Reg 11 A Consultation

Norman Scott and Ben Fischer

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Drilling Risk and Controls Video

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12

Barossa Gas Project

Subsea Infrastructure Installation Environment Plan Reg 11A Consultation

Chris Galway and Nick Philips

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SURF Overview Video

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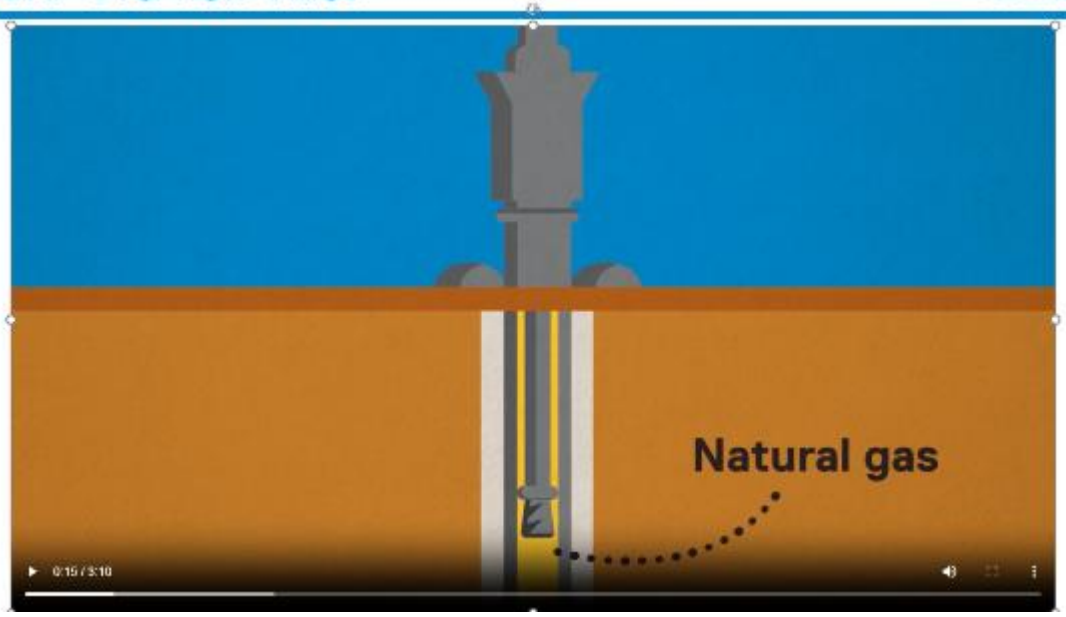

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SURF Risks and Controls Video

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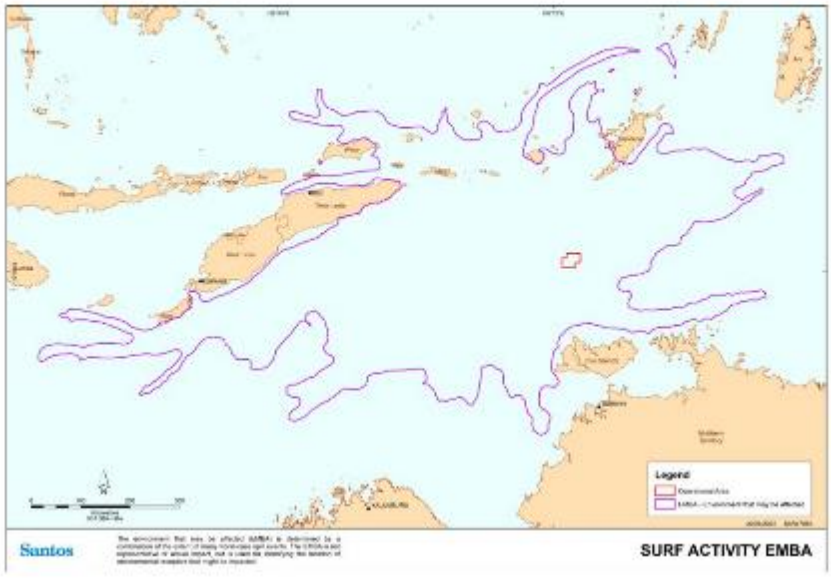

Barossa Gas Project

Community Engagement

Carly Sherren

Santos

Training and Employment – Darwin LNG

Santos

- ~100 Darwin Santos based employees
- 100% residential Santos employee workforce

- DLNG established the NT's first LNG Process Operator Traineeships in 2010
- ~10% of those who have completed identified as an Aboriginal or Torres Strait Islander

- Electrical/ Instrumentation and Mechanical Trade Apprenticeships
- Dedicated Indigenous Warehouse and Administration Traineeships

Community Partnerships

Santos

We partner with the communities where we operate to understand each community's needs and priority areas for investment and capacity building.

- We partner in different ways:
  - **Santos Foundation (PNG)** – health care capacity, youth opportunities, literacy libraries and support for those affected by family violence
  - **Supporting local businesses** – landowner companies in PNG and indigenous businesses in Australia and Alaska
  - **Supporting grassroots community needs** in all our operating areas

Worked with US AID to deliver solar power to Pimaga Hospital

Community Partnerships

Santos

Vocational training

Vocational Training:

- Timor-Leste:
  - Trained 40 young Timorese graduates in electrical and instrumentation skills
  - 21 trainees are due to graduate in May 2023
- PNG – 13 youth trained and supported to work in Australian seasonal workers program

Scholarship Program:

- 26 Timorese students have graduated from overseas universities and returned to Timor-Leste

Environmental

- Darwin Harbour Clean up in partnership with the Larrakia Rangers
- Partnered with Traditional owners in Qld – 5,000 hectares conserved in biodiversity offsets





Barossa Gas Project

Thank you and next steps...

Carly Sherren, Nick Fox and Peter Kirkpatrick

Santos

Presentation June 2023

Barossa Gas Project
June Consultation Session

Santos

Barossa Gas Project

Welcome and Introductions

Brett Darley and Peter Kirkpatrick

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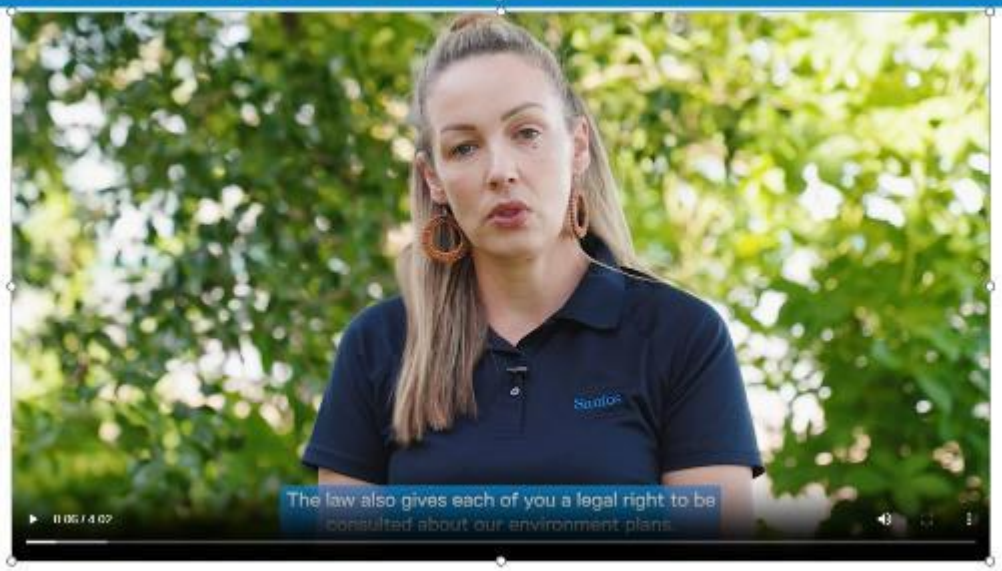

Barossa Gas Project

Feedback and Responses to Questions From Last Visit

Peter Kirkpatrick and Ben Fischer

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Barossa Gas Project Overview Video

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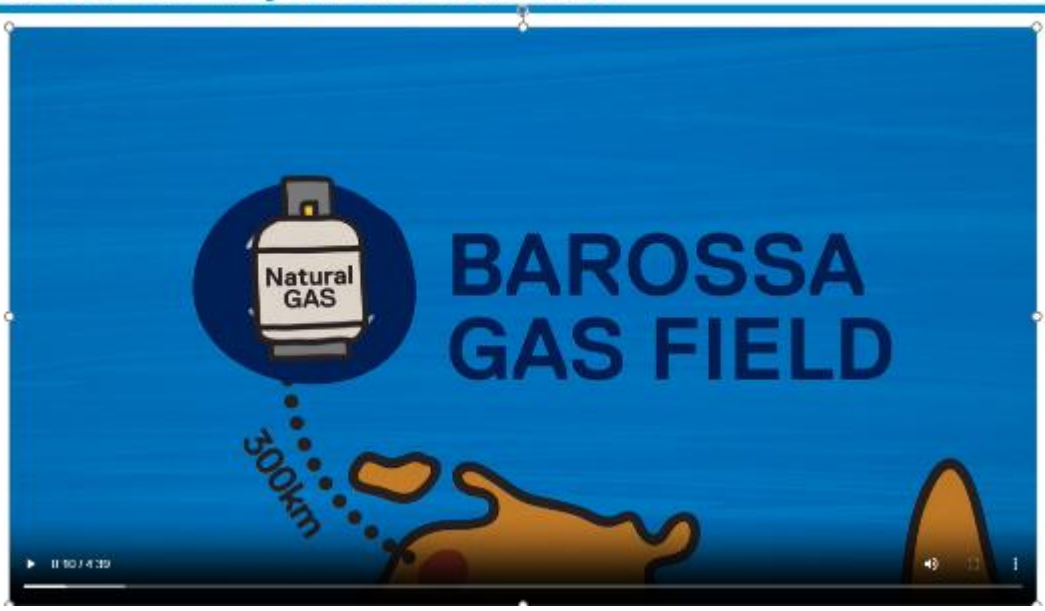
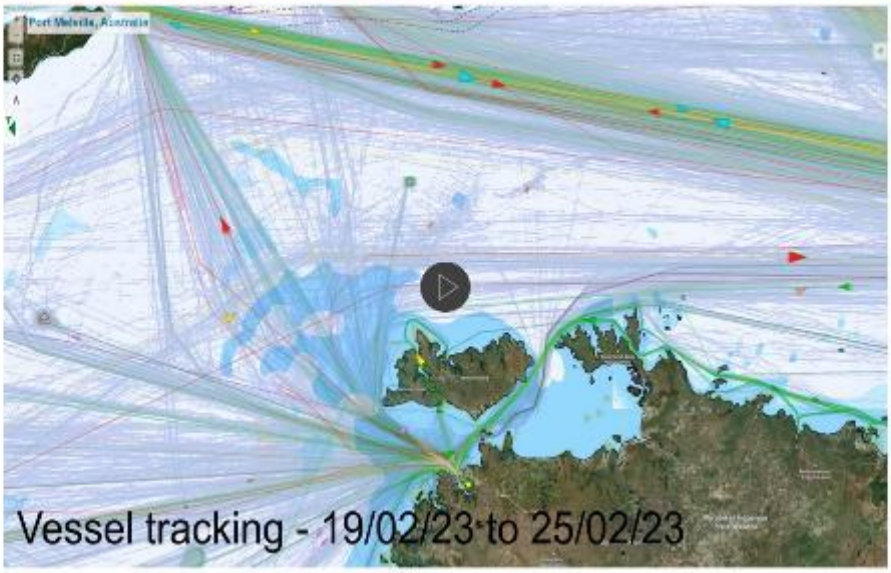


Vessel Movements (2 week period)

Santos



Barossa Gas Project

Drilling & Completions Environment Plan Reg 11A Consultation

Ben Fischer

Santos

Drilling & Completions EP – Consultation Feedback

Santos

Tiwi Island feedback	Santos' response	Environment Plan (EP) Oil Pollution Emergency Plan (OPEP) Controls
Request to be notified prior to drilling recommencement	Santos will notify Tiwi Resources (Ranger Coordinator) and Tiwi Land Council at least 10 days before the re-commencement of drilling activity. Santos will provide a follow-up confirmation email.	Referenced in Section 8.9 of the Drilling and Completions EP
Request to have spill kits located on the Islands	Santos will make rapid assessment kits available on the Tiwi Islands, to perform sampling and monitoring.	Referenced in Table 5-7 of the Drilling and Completions OPEP
Request to be trained in spill response	Santos will deliver rapid assessment training in consultation with Tiwi Ranger groups prior to the commencement of the activity.	Referenced in Table 5-7 of the Drilling and Completions OPEP

Drilling & Completions EP – Consultation Feedback

Santos

Tiwi Island feedback	Santos' response	Environment Plan (EP) Oil Pollution Emergency Plan (OPEP) Controls
Request to be notified in the event of a spill incident	Santos will notify Tiwi Resources (Ranger Coordinator) and Tiwi Land Council via phone call within eight hours of a spill incident being identified. Santos will provide a follow-up email.	Referenced in Table 5-7 of the Drilling and Completions OPEP
Raised concerns about potential impacts to marine life	Santos acknowledges feedback received with respect to concerns about potential impacts to marine life in the event of a hydrocarbon spill. Santos has provided information about the likelihood of an incident and the response strategies to be used in the unlikely event of a spill.	Prevention and mitigation control measures in the Drilling and Completions EP (Section 7.6.3) are considered sufficient to reduce risks and impacts to as low as reasonably practicable and to an acceptable level
Raised concerns about impacts of natural disasters on drilling activity	Santos acknowledges feedback received regarding natural disasters. The Barossa wells are designed and will be drilled to reduce the risk of impacts to as low as reasonably practicable.	Wells engineering design safeguards and drilling safety control measures are considered sufficient to reduce the risks and impacts to as low as reasonably practicable and to an acceptable level

Rapid Assessment Kits

Santos

Barossa Gas Project

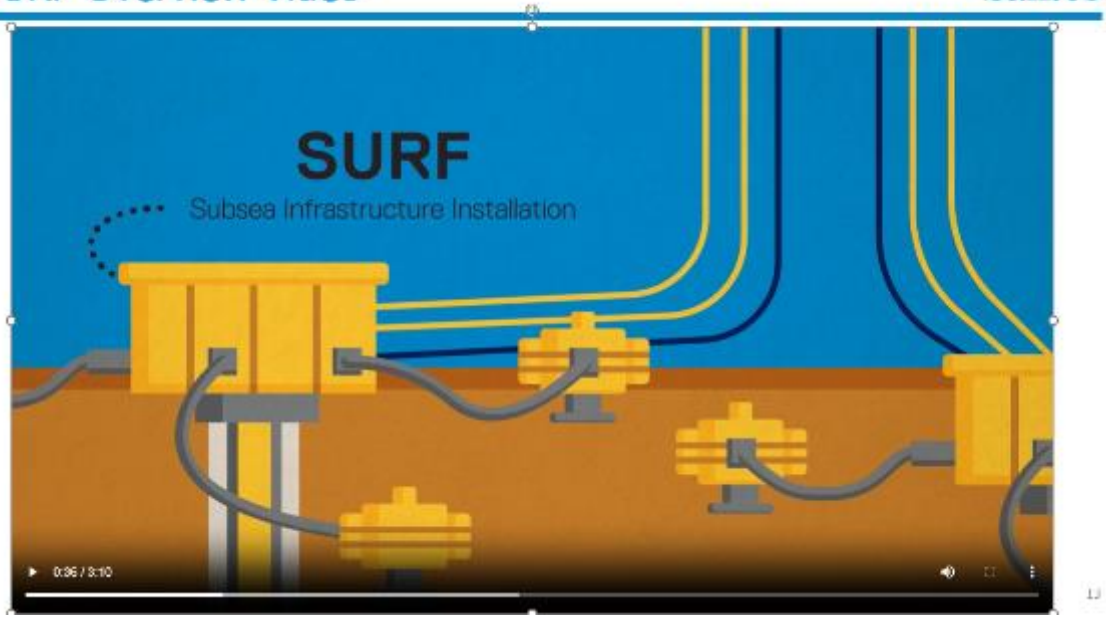
Subsea Infrastructure Installation Environment Plan Reg 11A Consultation

Chris Galway and Joe Sanderson

Santos

SURF Overview Video

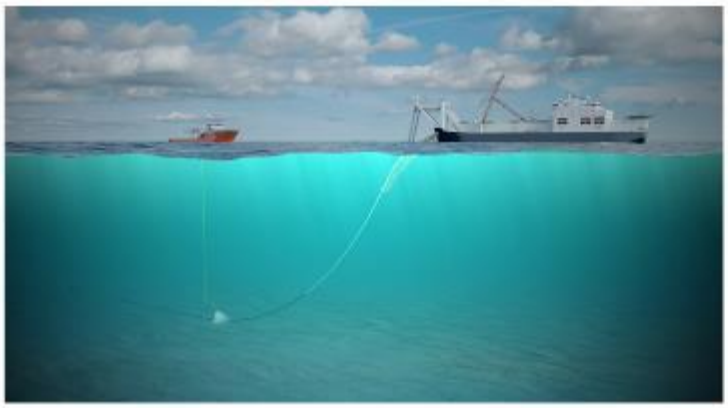
Santos

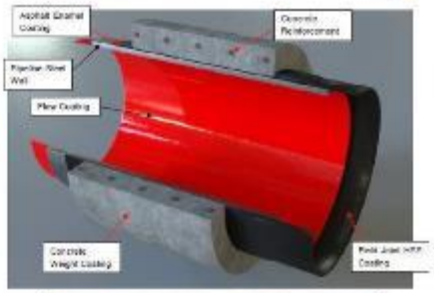


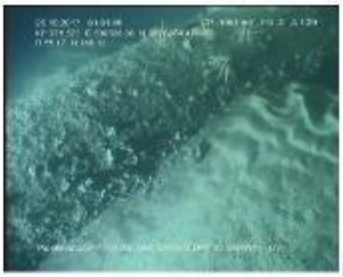
Imagery and Explanation of Offshore Construction

Santos

Pipeline Images







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Imagery and Explanation of Offshore Construction

Santos

SURF Images

Subsea Xmas Tree

Production Manifold Module

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SURF Risks and Controls Video

Santos

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Barossa Gas Project

Thank you and next steps...

Carly Sherren

Santos

Presentation August 2023

Santos

BAROSSA GAS PROJECT

WELCOME AND INTRODUCTIONS

Click to add subtitle

Presentation date year

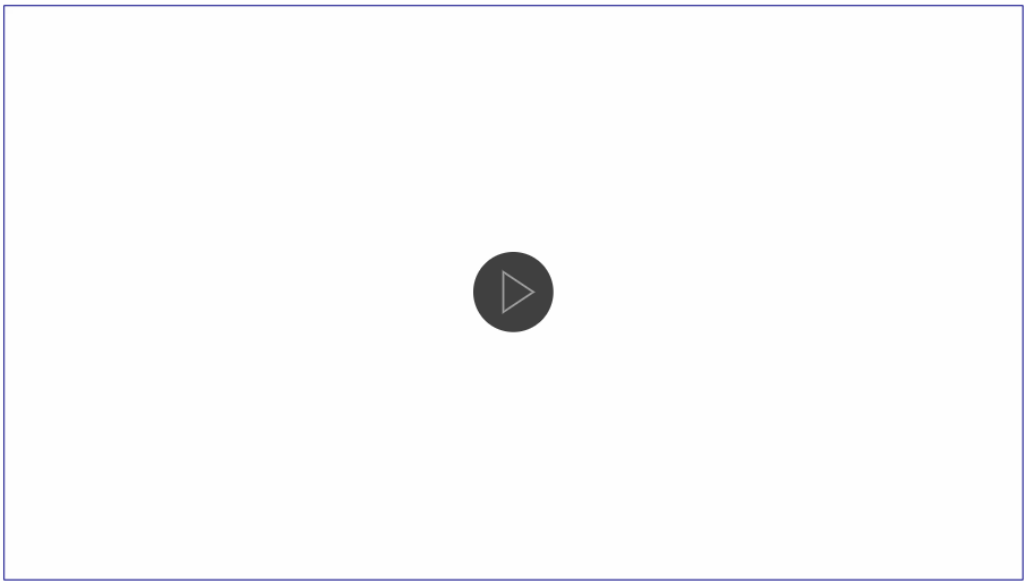
Peter Kirkpatrick

Santos

BAROSSA GAS PROJECT AUGUST CONSULTATION SESSIONS

Santos

Barossa Gas Project



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Barossa Gas Project

Santos

BAROSSA GAS PROJECT

SUBSEA INFRASTRUCTURE INSTALLATION ENVIRONMENT PLAN REG 11A CONSULTATION

Presentation date year

Joe Sanderson

Santos

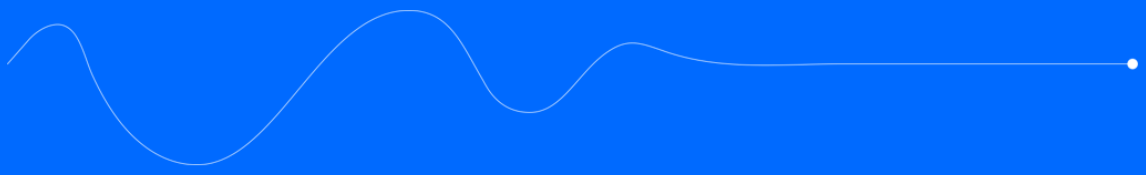
SURF EP – Consultation Feedback

Tiwi Island Feedback	Santos' Response	Environment Plan (EP) Oil Pollution Emergency Plan (OPEP) Controls
Request to have spill kits located on the Islands	Santos proposes to make rapid assessment kits available on the Tiwi Islands, to perform sampling and monitoring.	This commitment will be included in the SURF OPEP
Request to be trained in spill response	Santos proposes to deliver rapid assessment training in consultation with Tiwi Ranger groups prior to the commencement of the activity.	This commitment will be included in the SURF EP and OPEP
Request to be notified in the event of a spill incident	Santos will notify Tiwi Resources (Ranger Coordinator), Tiwi Land Council and Munupi Clan Members Dennis Murphy, Marius Puruntatameri and Therese Walker via phone call within eight hours of a spill incident being identified that may be moving towards the Tiwi Islands. Santos will provide a follow-up confirmation email.	This commitment will be included in the SURF EP and OPEP
Raised concerns about potential impacts to marine life	Santos acknowledges feedback received with respect to concerns about potential impacts to marine life from aspects such as lighting, noise or in the event of a hydrocarbon spill. Santos has provided information about the likelihood of an incident and the response strategies to be used in the unlikely event of a spill.	Prevention and mitigation control measures we are proposing are considered sufficient to reduce risks and impacts to marine fauna to as low as reasonably practicable and to an acceptable level. These were described during our previous consultation sessions and in our factsheet and more detailed information booklet.

Santos

BAROSSA GAS PROJECT

THANK YOU AND NEXT STEPS...



Presentation date year

Carly Sherren

5. Questions and answers

Responses to queries and feedback as part of the consultation process, published online and provided in person or to relevant persons.

Barossa Gas Project
Frequently Asked Questions

Santos is committed to providing all Relevant Persons access to information about the Barossa Gas Project in a timely and consistent manner. The following list of Frequently Asked Questions (FAQs) has been developed based on questions provided to Santos. This document will be updated on an ongoing basis during the development and delivery of the project as new information becomes available. The answers provided in this document are intended to provide clear, summary responses to the questions. Should you require more detailed information, further explanation or have any other questions, please ask one of the Santos team, contact us via telephone on 1800 267 600 or via email at offshore.consultation@santos.com.

This document was updated on 21/07/2023 with answers to additional questions and minor changes to questions previously asked. FAQs that have been added or changed are marked in blue text.

Question	Answer
Spill (oil, gas, condensate)	

How do you plan to clean up a spill?	Barossa is a gas and condensate field. Condensate is a very low viscosity (thin) and low density (light weight) liquid that evaporates quickly, particularly considering both the atmospheric and sea surface temperatures in the Arafura Sea. As such, if spilt on the sea surface, condensate would be expected to rapidly spread out, with a large proportion evaporating. Condensate spills are usually left to evaporate and dissipate at sea rather than using containment or dispersants. The International Tanker Owners Pollution Federation (ITOPF), which advises industry and governments worldwide about marine hydrocarbon spill cleanup, states: *"Condensates typically break up naturally in wind and waves with the majority evaporating within a matter of days. Traditional containment and recovery operations are not typically recommended. Any attempt to concentrate the condensate would reduce the rate of evaporation and, if the concentration of vapour becomes high, could cause the oil to ignite."* ITOPF goes on to say: *"Dispersants are ineffective on condensate spills as they will 'herd' the sheen rather than promote the formation of droplets in the water column. Spills of condensate in the marine environment are best left to evaporate and dissipate at sea.* In the event of a spill, up to 57% of the condensate is expected to evaporate over the first few hours/days and up to 79% after a few days, depending on weather conditions, sea state and time of year. Santos is required to prepare an Oil Pollution Emergency Plan (**OPEP**) for each activity, which forms part of the Environment Plan (**EP**) and is assessed by the offshore regulator (**NOPSEMA**). The OPEP sets out the process to manage a spill. The OPEP identifies and prioritises spill response strategies for all potential spill events and describes how Santos prepares to respond in the remote event of a spill. The response strategies in the OPEP are based on spill modelling, which is used to forecast the potential extent of a range of spill scenarios for each drilling activity. The first priority under the OPEP when responding to a spill event is to employ source control strategies, which include shutting in the well at the Blow Out Preventers to prevent loss of gas and condensate from the well into the environment. For condensate that has already been released to the environment the recommended primary response strategy under the OPEP is to monitor and evaluate the situation. Numerous resources are used to monitor the behaviour and direction of any released condensate, such as real-time, updated spill trajectory modelling, tracking buoys, vessel surveillance, aerial surveillance, satellite imagery and water quality monitoring to determine the effectiveness of the source control methods which may be required. Because of the low viscosity (thin nature) of condensate, natural weathering processes are most effective and have the highest net environmental benefit when compared to other recovery strategies which require human intervention. It is unlikely that condensate from a spill at Barossa associated with drilling and completions activity would reach any shoreline. The closest distance from the edge of the predicted movement of a spill to the edge of the Tiwi Islands (Seagull Island) is 54km. Marine Diesel Oil (**MDO**) Spill Information MDO is a thin liquid which will evaporate quickly. Up to 60% will generally evaporate over the first two days. Approximately 5% of MDO is unlikely to evaporate and will instead decay over time. MDO spills are usually left to spread out, evaporate and naturally dissipate. Chemical dispersants are not recommended for MDO spills. Because the MDO spreads and thins out, it evaporates quickly, and chemical dispersants would have little to no environmental benefit whilst potentially increasing localised toxicity in the water. Spill response options are included in the SURF OPEP and will be implemented in the event of a spill.

Can you provide insurance to cover all costs to clean up a spill and rehabilitate the sea and coastline affected? And compensate us for our loss of food?	Santos and its Barossa joint venture partners are required to demonstrate a minimum level of financial assurance to be able to cover costs when responding to a spill event. The offshore regulator, NOPSEMA, will not accept the Drilling and Completions Environment Plan without Santos first demonstrating a minimum level of financial assurance for a spill response. Santos relies on a combination of its own financial resources and insurance to meet its financial assurance requirements, including third party liability insurance for its activities. For each OPEP there is a comprehensive scientific monitoring program to measure impacts to the physical/biological environment and socio-economic receptors. The results of monitoring inform the extent of impacts. Whether any claim or any compensation may be available will depend on the specific circumstances. Any claim would be determined based on the evidence (as with any claim).
Who will receive the insurance and the compensation?	Whether any claim or any compensation may be available will depend on the specific circumstances. Any claim would be determined based on the evidence (as with any claim).
Will you provide training to local communities on the coastline to be able to respond immediately? And will you provide us with the equipment needed to clean up the spill. Who decides where this equipment will be located and stored? We understand that in your Environment Plan you've said that the equipment will be stored in Darwin – how long will it take for you to get this equipment to the spill site which is 260km from Darwin?	Santos has access to a wide network of spill response equipment across Australia and internationally to support its primary and secondary response strategies, which are outlined in the Barossa OPEPs, to monitor and evaluate any spill. Depending on the spill response resources required, Santos would be able to mobilise these resources rapidly, relying on its established logistics networks. Due to natural weathering and based on conservative modelling, it is unlikely that condensate from a spill at Barossa would reach any shoreline. Santos will make rapid assessment kits available on the Tiwi Islands, to perform sampling and monitoring (in the unlikely event a D&C spill occurs that has the potential to reach the Tiwi Islands). The kits will contain: 1. Rapid Assessment Team Document Holder – Containing all the relevant documentation and 'How to Guides'. 2. Rapid Oil Sampling Kit – Used to take samples of possible hydrocarbons for lab analysis. 3. Wildlife Sampling Kit – Used to take samples of deceased wildlife for lab analysis. 4. PPE Kit – To protect team members when collecting samples. Currently we are in discussions with Tiwi Resources and the TLC about inviting the Tiwi Rangers to meet about what's involved in the Rapid Assessment Testing activities and the training that's involved.

How will you tell us when something goes wrong? Where does it say in the Environment Plan how many days after an oil spill that you are required to tell us that the spill has happened and who will you notify?	Santos is required to notify NOPSEMA, the offshore regulator, and a number of other government agencies, as soon as practicable if a spill was to occur. Santos is aware that Tiwi Island communities will want to know about any spill event. Santos therefore proposes to include Tiwi Island community organisations in its first round of notifications if a spill was to occur.
What is condensate?	Condensate is a very low viscosity (thin) and low density (light weight) liquid, which is referred to as a light "hydrocarbon". It is straw-coloured, flammable and is similar to cigarette lighter fluid. Condensate evaporates quickly when it is spilled into the sea, especially in environments such as those surrounding the Barossa field.
How does a spill of condensate impact marine life?	Condensate has the potential to impact marine life in the event of an unplanned release of condensate from a well during well construction. Many factors affect the extent of condensate impact on marine life, including the spill location, volume, duration, type, trajectory, season and atmospheric and oceanic conditions. Depending on how much condensate is released and the extent of exposure, condensate can cause stress to marine life, such as seabirds and marine mammals, including irritation of eyes/mouth and illness. In extreme situations with large volumes of condensate spill in an enclosed area, the impact could be fatal. Two areas are relevant to marine life impact associated with the drilling and completions activity at Barossa: • The MEVA" is an area surrounding the drilling site of the Barossa project which is used to inform environmental assessment, identify potential environmental consequences and develop spill response plans. • The EMBA" is a broader area surrounding the MEVA which represents the broadest area which could be affected by an unplanned 'worst case' spill event during drilling without any spill response actions. The EMBA is larger than the MEVA. A condensate release could impact on benthic organisms, fish, coral and invertebrates. Other marine life such as turtles, whales (including the pygmy blue whale) and seabirds which infrequently transit through the MEVA or EMBA may also be adversely impacted by a spill of condensate, but these species are less likely to be present in the MEVA. A spill is not anticipated to impact key areas for marine turtle breeding and nesting. The impacts of one of Australia's largest oil spills have been assessed over a number of years. The results of scientific monitoring after the Montara oil spill can be found at: https://www.dcceew.gov.au/environment/marine/marine-pollution/montara-oil-spill/scientific-monitoring-studies. Environmental monitoring following the Montara oil spill has found no significant long-lasting impacts.

We've already seen the impacts of the Montara oil spill. Is there a chance of an oil spill for this project?	Santos was not involved in the Montara oil spill in August 2009. It resulted from a series of operator and regulatory failures which have now been comprehensively addressed through improved practices across the industry and improved regulatory regimes, now administered by NOPSEMA. More detail as to the initiatives undertaken by governments, regulators and industry following the Montara oil spill are available in the Australian Government Report on the implementation of the recommendations from the Montara Commission of Inquiry (September 2017) https://www.industry.gov.au/sites/default/files/2022-09/australian-government-report-on_the_implementation_of_the_recommendations_from_the_montara-commission-of-inquiry.pdf. Barossa is very different from Montara. Barossa is a gas and condensate field rather than oil. The well design and type of drilling rig for the Barossa field are different to those used at the Montara field. For example, the Barossa wells will not be suspended for the rig to depart the field and return at a later date (as occurred at Montara). Further, the aspects of well design and operations at Montara which were significant contributors to the Montara spill are not permitted under the current regulatory regime and Santos' drilling standards and procedures. The likelihood of a gas and condensate spill event during Barossa drilling is remote. The drilling at Barossa is subject to strict regulation, including in respect of the design of the wells and safety shutdown systems, regular inspection and maintenance schedules and operation by well-trained and highly competent staff. Well blowout events during development drilling, that could result in a spill, have been reported at a frequency of approximately one event for every 29,000 wells drilled. The Australian Government, along with PTTEP Australasia (operator of the Montara oil field), developed a long-term environmental monitoring program to understand the longer-term impacts of the Montara oil spill on the marine environment. There were seven scientific monitoring studies under the environmental monitoring program. Santos understands the key findings include: o no confirmed reports of impacts to marine wildlife in the vicinity of the oil spill. o presence of hydrocarbons in submerged marine banks in the region of the spill but the levels identified were very low and significantly lower than would be expected to cause biological effects. o no evidence of hydrocarbon residue on beaches, coral reefs or seagrass beds at any of the study sites. o no evidence of the Montara spill having long-term impacts on seas snakes or marine turtles in the region. More detail as to the scientific monitoring following the Montara oil spill can be found at: https://www.dcceew.gov.au/environment/marine/marine-pollution/montara-oil-spill/scientific-monitoring-studies

What happens if there is a gas leak?	If a gas leak from a well was to occur during well construction, any escaped gas would rapidly float to the sea and then disperse into the atmosphere. Operations would be suspended to identify and control the source of the leak. The greatest risk from a gas leak is the safety of the workers on the drilling rig, nearby support vessels and their crew, due to the potential ignition of gas resulting in fire or explosion. Santos has detailed emergency response and evacuation procedures designed to protect the safety of all in such a situation, including trained firefighting teams.
Marine life	
How will you stop turtles getting killed by your ship's propellers? Our turtles are already suffering from climate change – can you guarantee that the Barossa project won't make this worse? What will you do to make sure they survive this?	Santos must adhere to practices under relevant legislation and regulations to avoid collisions with turtles and other marine fauna. This includes reducing vessel speeds and maintaining minimum distances when marine fauna is sighted. Interactions between vessels associated with the drilling and completions activity for the Barossa project and marine fauna are considered under the current Drilling and Completions EP. Any unplanned interactions with marine fauna in the drilling operational area are expected to be limited to a small number of individual animals transiting through the area. The operational area does not intersect any biologically important area or habitat critical to the survival of any marine fauna species. The risk to marine turtles in the drilling operational area is very low. All Santos contracted vessels are required to maintain a marine fauna sighting record and record any interactions with marine fauna.

We want you to keep us updated on the whole process. We want you to come in person and host clan group meetings to share these updates. What is your plan for ongoing consultation with us?	Santos is committed to developing a strong, beneficial relationship with Tiwi Islands People and your feedback is important to achieving this. Your input during consultation is important to assist Santos to understand and evaluate environmental impacts and risks and to develop control measures to reduce these impacts and risks to as low as reasonably practicable and acceptable levels. At our sessions in February 2023, Tiwi Island communities told us that they would like to consult on environmental plans through clan group consultation sessions and for Santos to use videos and other visual aids to help explain the Barossa project. We have taken on board that feedback. We will keep you informed through, for example: • clan or community meetings (to be scheduled considering feedback as to appropriate regularity/frequency). • project updates/newsletters. • notices or updates posted on Tiwi community notice boards. • updates or articles in the Tiwi Newsletters. • social media posts. • the Santos website and "Barossa Hub" (https://www.santos.com/barossa/). We will provide opportunities for feedback, including through: • talking to our team when they are on the Islands. • talking to us at any scheduled Santos community meetings. • telephoning us on 1800 267 600. • emailing us at offshore.consultation@santos.com. • using the relevant person nomination/feedback form and portal at https://www.santos.com/barossa/. • the Tiwi Land Council. If you have any other suggestions, please let us know.

We don't want your choppers flying over the Tiwi Islands – we don't want to be able to hear the helicopters. We also don't want you to fly near Seagull Island so that our seagulls don't get killed.	Santos will not fly any helicopters directly over the Tiwi Islands* (including Seagull Island), unless there is an emergency. The only time Santos contracted helicopters would need to overfly or land on the Tiwi Islands would be due to the following scenario's: • To maintain the safety of the Aviation operation (aircraft emergency, fuel issue etc). In these circumstances, due to the urgency there will be no time to engage with or notify the Tiwi Island community prior. This includes landing at any of the Tiwi Island airfields, or on the islands themselves (in the bush). • In an event where there is a requirement for the flight time to be completed as quickly as possible such as is in the unlikely event of an emergency (for example if someone falls into the water and Santos needs to conduct a search and rescue operation) or during evacuation of offshore installations due to cyclone activity, overflight of the Tiwi Islands will be required to enable rapid evacuation of personnel for their safety. Like all aircraft, helicopters will need to comply with all relevant aviation standards and regulations. * Santos, with agreement from some Tiwi people and the Environmental Defenders Officer, used helicopters recently to assist with an important cultural heritage assessment. This was used because there were no other viable transport options available at the time. The helicopter flew over the Tiwi Islands but not over Seagull Island.
Consultation	

When this consultation happens, we want to have Santos, Environment Centre NT, Tiwi Land Council senior management (CEO and Chairperson), Tiwi Islands Regional Council members and we want to be able to engage any relevant expert advisors based on the information provided to us before the meeting happens.	The Tiwi Islands consultation sessions have been well attended with Tiwi Islanders, senior representatives from Santos, Tiwi Land Council, Tiwi Regional Council and ECNT present. Anyone is welcome to attend the consultation sessions (though in the case of clan meetings, with clan Trustee consent). Experts such as internal expert Benjamin Fischer (Drilling Superintendent), and external expert Dr Kellie Pendoley (marine turtle expert), have attended consultation sessions. Santos will continue to bring both internal and external experts to the consultation sessions to assist with explaining the detail of, and answering questions about, our proposed activities.
If it's about turtles, we want a local expert such as professors or scientists from CDU and As Turtle. We will not accept desktop reviews from interstate.	Santos has engaged a world-renowned marine turtle expert Dr Kellie Pendoley, of Pendoley Environmental, to provide expert advice on marine turtle impacts and management. Dr Pendoley has more than 30 years' experience in marine conservation biology and artificial light assessment. Dr Pendoley has visited the Tiwi Islands on two occasions in the context of consultation and has been assisting Santos with additional data and information collection and assessment to develop the understanding of marine turtle behaviours around the Tiwi Islands. Dr Pendoley is familiar with the turtle habitats in the region as a result of contributions to Barossa environmental impact assessment studies and from her extensive experience studying marine turtles around Australia and other locations globally.
Will you provide an interpreter?	Santos has engaged a qualified interpreter referred by, and engaged through, the NT Government's Aboriginal Interpreter Service (**AIS**) to attend consultation sessions (including the upcoming April 2023 sessions), wherever feasible. Interpreters qualified through AIS are trained to interpret accurately and be impartial. We have been advised by the AIS that Tiwi culture is focused on oral storytelling and as such there is no agreed written language. The AIS has recommended that Santos provide audio translation of materials where appropriate, and Santos is taking the necessary steps to do so. Santos welcomes feedback from the local community as to the best means of communicating in a productive manner throughout the consultations.

Has Santos been involved in consultation with any non-English speaking communities?	Yes. Santos has positive relationships with non-English speaking communities in the areas in which it operates throughout Australia, Papua New Guinea, Timor-Leste and North America. Santos has partnerships with a range of local, non-English speaking communities, including providing local jobs and business opportunities. Santos wants to build strong, positive and productive relationships with the Traditional Owners and communities of the Tiwi Islands. We're here to learn more and seek input and feedback on cultural values in the context of the Barossa project.
Did Santos prepare the Offshore Project Proposal?	The Offshore Project Proposal (**OPP**) for the Barossa Development was prepared by the ConocoPhillips Australia-West Business Unit that Santos now owns. NOPSEMA, the offshore regulator, accepted the Barossa Development OPP in 2018. When Santos acquired ConocoPhillips' Australia-West Business Unit in 2020, all associated licences, permits and approvals were included in the acquisition (including the Barossa Development OPP) and became the responsibility of Santos following the acquisition.

Drilling	
What happens to the wells if there is an earthquake, tsunami or other natural disasters?	The wells are all designed and drilled so that they meet government regulations and international standards for well design and operations. Historical evidence shows that wells do not leak because of earthquakes (both in the area where the Barossa wells are planned, which is not near any major faults, and around the world). Since 1969, approximately 880 wells have been drilled in the area to the west of the Tiwi Islands and none of these have experienced issues related to earthquakes or tremors. The closest long-term producing oil and gas wells are located at the Bayu-Undan Field, where 29 wells have been in production at different times since 2004 and none have been affected by earthquakes. The Bayu-Undan field is approximately 400km from the Barossa field. Tsunamis do not affect drilling rigs or vessels located in deeper water such as the Barossa field, where the water depth is over 200m. Waves created by tsunamis cause damage when the wave reaches land, and the shallower water causes a large wave to form above the normal level of the ocean.
Can drilling cause earthquakes?	This is very unlikely based on the depth of the wells, the relatively small number of wells being drilled into the field, the location of the operations, the low level of seismic activity in the area, and on historical effects of drilling activities in Australia.

What lubricates the drill?	A drilling fluid (sometimes referred to as "drilling mud") is circulated in the borehole and provides cooling and lubrication to the drill bit and carries the rock cuttings/chips out of the well.
What is in the drilling fluid?	A water-based drilling fluid (or drilling mud) is planned to be used to drill the wells for the Barossa project. This mud is mainly a mixture of fresh water and salt that is then combined with other additives that make the mud thicker, heavier or control how the mud affects the natural clays in the rocks that are drilled. The additives are not harmful to humans nor sea life in small quantities and in diluted form (as they are used in the drilling mud). Santos relies on a recognised industry chemical classification system run by a specialist agency, the UK Government Department of the Environment Food and Rural Affairs and uses additives in the mud which have the lowest environmental impact rating. Sometimes water-based drilling fluid or drilling mud is insufficient for drilling activities in deep water. In that case, Santos will use a Non-Aqueous Fluid (**NAF**). NAF uses a base fluid that is a synthetic oil. The additives used in the NAF are, on the whole, the same as those used in the water-based mud. Where NAF is required to be used, equipment is used on the rig to remove the NAF from the drilled-up pieces of rock that come out of the well, so that the NAF can be reused. This equipment is similar to a clothes dryer. The drilled-up pieces of rock are returned to the sea only when the amount of NAF is below a certain amount. The process is the same as that for other wells that use NAF offshore in Australia and in many parts of the world.
When you are drilling, what do you hit first (before you reach the gas)?	The drill bit goes through a series of limestone and claystone rocks before reaching the sandstone reservoir that contains the gas. The limestone and claystone rocks above the gas reservoir are impermeable and have trapped the gas and condensate in the Barossa reservoir for tens of millions of years. The steel pipe (casing) is cemented into place before drilling into the gas reservoir contained within the sandstone formation. The steel pipe is cemented into place like this to seal off the shallower rock formations from the gas reservoir. None of the eight exploration wells drilled so far in the Barossa field have found any oil reservoirs and reviews conducted by our geologists of the area indicate that no oil exists in the Barossa field.
Why haven't you spoken about climate change as a risk (of the drilling and completions environment plan)?	Santos is very conscious of limiting the impact of its operations on the environment. Santos will follow industry practices and procedures to minimise greenhouse gas emissions from fuel combustion and flaring during drilling operations. The current Drilling and Completions Environment Plan considers the impact and risk of greenhouse gases and atmospheric emissions from drilling and completion operations. Likewise, emissions from production operations will be further considered and assessed in the Barossa Production and Operations Environment Plan.

How long will the drilling consultation process take? When will you start drilling and will you advise us before you start?	The regulations require that Santos provide a reasonable period for relevant persons to consider information provided by Santos about the proposed drilling and completions activity, environmental impacts and risks and control measures before commencing such activity. As advised at the March 2023 clan group consultation meetings, Santos is holding another series of meetings in late April and early May 2023 to invite input and feedback and also to provide feedback on questions and requests for information received so far. There will be another series of meetings later in May 2023 to explain how the feedback from consultation is proposed to be addressed in the revised Drilling and Completions EP to be submitted to NOPSEMA, the offshore regulator, for assessment. Once acceptance of the revised Drilling and Completions EP by NOPSEMA has occurred, this will be communicated. Following acceptance by NOPSEMA, Santos anticipates commencing drilling, and this will be communicated in advance.
How long will it take to drill the wells?	Each well is expected to take around 90 days to drill and complete (and Santos intends to drill 6 wells, with contingency for two additional wells, if needed). We anticipate that our proposed Drilling and Completions activities will take approximately 2 years, subject to weather and operational performance.
What happened with the exploration drilling?	Eight wells have already been drilled in the Barossa field as part of the initial exploration and appraisal of the field. The first well was drilled in 1973, followed by another in 1998, another in 2006, three more in 2014 and 2015 and then the two final wells in 2017. The wells were evaluated and safely decommissioned as planned. The exploration work confirmed that a large gas reserve exists in the area. After the exploration wells were drilled and safely decommissioned, equipment at the seabed was removed. The decommissioning process for most wells involved plugging the wells with cement, cutting the casing approximately 2 meters below the seafloor and removing all equipment, before inspecting the wellsite and surrounding seabed with a remotely operated vehicle (a small remote controlled submarine). In 1973, oilfield practices were somewhat different, but the well was still safely and permanently decommissioned.
Will you keep drilling more wells if you can't find gas in the wells you have planned?	Santos has a high degree of confidence that the wells planned for the Barossa project will successfully encounter gas. This is based on the information we have gained over a long period of time—since 1973—from different exploration processes, such as seismic acquisition and the exploration wells. There is provision for eight wells in the current Drilling and Completions EP for the Barossa project, but only six are planned to be drilled (with two additional wells being provisioned in case they are necessary).

Will the drilling impact marine life?	Environmental impacts and risks from all planned and unplanned events are assessed in the current Drilling and Completions EP and control measures will be implemented to reduce impacts and risks to as low as reasonably practicable and acceptable levels. We are consulting on these impacts and risks and proposed controls. While there is potential for impacts to marine life from drilling, impacts from planned events are localised and risks from unplanned events such as a condensate spill are very low. With consideration of proposed control measures to mitigate impacts to marine life, the impacts are considered to be reduced to as low as reasonably practicable and an acceptable level.
How far down do you drill?	The wells will be drilled to about 4000m below the surface of the sea.
What category was the storm in the animation? (The animation showed what would happen to the FPSO in a storm)	In the area around the Barossa field, most of the storms are tropical lows or developing storms, with most of them passing to the south of the Barossa field. Fully developed storms (Australian Category 4 and 5) are not normally experienced at the location of the Floating Production Storage and Offloading (**FPSO**) facility. The FPSO is designed to survive a 10,000-year storm (involving the equivalent of wind speeds attributable to a Category 4 cyclone).
How many wells are you drilling?	Six development wells are planned with contingency for two additional wells, if needed. No more than eight wells can be drilled under the current Drilling and Completions EP.
What is a Christmas Tree?	A "Christmas Tree" is the slang name for the arrangement of metal pipes and valves that sit on top of the well to control the flow of gas and condensate out of the well and to allow safe access to the well for maintenance. Its proper name is a "Subsea Vertical Tree", and it is a piece of equipment installed on top of the well with valves and pressure and temperature gauges that is used to monitor and control the production of gas and condensate from that well.
How many wells has Santos drilled, both locally and internationally?	Founded in 1954, the South Australia Northern Territory Oil Search (**Santos**) has been developing resources first across Australia, then the Asia Pacific and is now a global energy company. Since 1954, Santos has drilled and still operates more than 6,000 wells onshore and offshore in Australia and additional wells internationally.

Will the drilling be like Deepwater Horizon?	The drilling activity for the Barossa project is different to the drilling at Deepwater Horizon. Further, Barossa is a gas and condensate field, not crude oil. The well design for the Barossa wells is different from the wells of the Deepwater Horizon which experienced a well blowout. For example, unlike the Deepwater Horizon well, at Barossa the drilling stops before the well is drilled into the gas zone, casing is then installed and cemented into place, then the next smaller hole is drilled into the gas zone. This enables effective barriers to prevent the flow of gas to surface. Further, Macondo, the well that blew out on the Deepwater Horizon, was an over-pressured oil exploration well, not normally pressured gas and condensate like Barossa. The reservoir pressure at Macondo is approximately three times the reservoir pressure in Barossa and these higher-pressure wells have a higher likelihood of well integrity issues. In the event of a loss of well control, the fluids expelled from Barossa would be gas and condensate, not crude oil. These substances have very different impacts and spill response. Santos undertakes drilling activity in a strict regulatory environment. There are numerous control measures in place to control the flow of extracted substances including well design, safety shutdown systems, regular inspection and maintenance and trained and competent personnel.

Will the drilling affect the aquifer we share with PNG?	In simple terms, an aquifer is a body of rock and/or sediment that holds groundwater. There is no connection between the Barossa Gas field and the Tiwi Islands aquifers. For this reason, the Barossa Gas Field is extremely unlikely to impact the Tiwi Islands aquifer. More detail on this is set out below. The Van Diemen Sandstone has been identified as the regional, shallow, unconfined aquifer on Tiwi Islands that is water bearing and the primary target for production bores for human consumption. The hydrocarbon bearing reservoir at the Barossa field (Elang Formation) is not geologically connected to the Tiwi Island aquifers owing to the fact: • The Barossa reservoir does not extend south to the Tiwi Island's. • The aquifers on the Tiwi Island are at least 65 million years younger than the Barossa reservoir. • Complex geological configurations would be required to link up the deeper and older Barossa reservoir unit to the much younger Tiwi Islands aquifer units. Regional mapping does not support this occurrence. • Porosity and permeability preservation across the Malita graben between the Barossa field and the Tiwi Islands is poor due to highly cemented sandstones inhibiting all lateral fluid migration. Drilling fluid used at the Barossa field (sometimes referred to as "drilling mud") will also have no effect on the Tiwi Islands aquifers. Even if the rock surrounding the borehole is permeable and porous the invasion zone of the drilling fluid into the surrounding host rock will only be about 1 meter in diameter. In relation to the shared aquifer, the Tiwi Island aquifers are at least 20 million years older than PNG and Timor-Leste aquifers. Both PNG and Timor-Leste aquifers are hosted within very different geological formations with limited spatial extents, and they do not connect to the ones on the Tiwi Islands.
Pipeline	

How is the Gas Export Pipeline laid?	The Gas Export Pipeline (**GEP**) is approximately 66cm in diameter and will be laid on top of the seabed, using a special vessel that lays the pipe. Onboard the pipelay vessel, single lengths (approximately 12-15m long) of steel pipe (joints) are welded, inspected and coated. As the pipelay vessel moves forward, the pipe gradually curves downward through the water until it reaches the touchdown point on the seabed. The vessel moves slowly, covering approximately 3km per day and will take approximately 3 months to fully install. There is no trenching or dredging required for the GEP installation. The pipeline route was carefully selected to minimise environmental impacts and risks. Independent experts are carrying out further assessment work to identify any cultural heritage places along the pipeline route.
How do you know if the pipeline is damaged, and will you fix it if it is?	To keep the pipeline operating safely, Santos intends to carry out regular remote and on-site inspections and maintenance. Specialist equipment will monitor the pipeline's condition and integrity and provides advanced warning of potential damage. In the unlikely event of damage to the pipeline, Santos would immediately shut-in the wells to prevent any further gas from entering the pipeline and the pipeline would be depressurised. The nature of the damage would then be assessed, and any necessary repairs completed. The pipeline would be restarted following confirmation of a successful repair and once any associated regulatory approvals to restart were secured.
What holds the pipeline down?	The pipeline is not fixed to the seabed. The pipeline will be made from carbon steel, with the thickness and weight of the pipe itself assisting with keeping it stable (holding it down on the seabed). The pipeline also has an external anti-corrosion coating and concrete covering which is designed to provide extra weight and stability (holding it down on the seabed).
What is the pipeline for?	Santos is proposing to extract natural gas from the offshore Barossa field. The gas is intended to be transported via a gas export pipeline to the existing Santos Darwin Liquified Natural Gas (**DLNG**) facility in Darwin, where it will be liquefied and shipped to customers.
Is this pipeline the same as the Bayu-Undan pipeline?	The Bayu-Undan pipeline runs for approximately 502km from the Bayu-Undan gas fields in the Timor Sea to the DLNG plant. At its closest point, the Bayu-Undan pipeline is approximately 20km away from Bathurst Island. The Bayu-Undan pipeline is the same size as the proposed gas export pipeline for the Barossa project, with a diameter of approximately 66cm.

Will the pipeline impact the turtles and dugongs?	The pipeline is not likely to significantly impact turtles and dugongs. Interactions between vessels associated with the Barossa GEP installation activity and marine fauna are considered under the Barossa GEP Installation Environment Plan. The Barossa pipeline installation vessels will be subject to restrictions within designated 'caution zones'. A caution zone is defined as 150m distance from turtles. When operating vessels within a caution zone, vessels are restricted to a vessel speed of less than 6 knots, must have a lookout on the vessel for turtles and must maintain a distance of at least 50m from any turtles. Reduced vessel speeds allow marine life such as turtles to dive and move away from an area where there is vessel activity. All Santos contracted vessels are required to maintain a marine fauna sighting record and record any interactions with marine fauna.
How long will the pipeline installation vessel be located in the vicinity of turtle nesting beaches?	The pipeline installation vessels may be visible from the Tiwi Islands for about one month during pipelay activities. The closest the vessels will be to the Tiwi Islands is approximately 7km (West of Cape Fourcroy). Santos has completed light modelling and impact assessments to better understand the risks to nesting turtles associated with lighting. While light emissions are expected to be visible at turtle nesting beaches, it is unlikely to affect the behaviour of Olive Ridley and Flatback hatchling turtles on the beach.
Have you done checks for underground volcanoes?	As part of our environmental assessment of the pipeline, Santos carried out marine surveys along the entire pipeline route. No underground or subsea volcanoes were detected. Santos has completed a review of records of seismic activity and mapping of geologic fault lines in the region so that the proposed infrastructure locations are away from high-risk areas. The pipeline route was carefully selected to minimise environmental impacts and risks.
How far is the pipeline and Barossa field from the Tiwi islands?	The Barossa field is located approximately 140 km north of Seagull Island. At its closest point, the pipeline will be approximately 7 km from the Tiwi Islands (west of Cape Fourcroy).
How safe are the pipes?	The pipeline to be used for Barossa is designed to international and Australian standards and subject to third party validation. This is a requirement of the Australian Safety Case regulatory regime. It is widely recognised and acknowledged that the regulatory regime that operates in Australia is among the strictest in the world. By designing the pipeline to the required design standard for subsea pipelines the pipeline has a very low probability of failing. For example, death by car crash is approximately 10,000 times more likely an event to occur than a pipeline failing.
Cultural heritage assessment	

How are you protecting our intellectual property rights as part of the cultural heritage assessment process for the Gas Export Pipeline?	Santos has engaged independent experts to undertake an assessment to identify any underwater cultural heritage places along the Barossa pipeline route, also referred to as the Gas Export Pipeline or GEP route, to which people, in accordance with Indigenous tradition, may have spiritual and cultural connections that may be affected by the future activities covered by the GEP Installation Environment Plan. Santos has engaged Dr Brendan Corrigan as an independent anthropologist. Dr Corrigan is leading a team of other independent experts and obtaining information from Tiwi Islanders about any spiritual and cultural connections to any underwater cultural heritage places along the Barossa pipeline, or GEP, route. Santos is confident that, with their expertise, Dr Corrigan and his team will handle all confidential and sensitive information appropriately.
What process are you following for the cultural heritage assessment for the Gas Export Pipeline?	Santos has engaged independent experts to undertake an assessment to identify any underwater cultural heritage places along the Barossa pipeline route, also referred to as the Gas Export Pipeline or GEP route, to which people, in accordance with Indigenous tradition, may have spiritual and cultural connections that may be affected by the future activities covered by the GEP Installation Environment Plan. Dr Brendan Corrigan is the lead independent expert. Dr Corrigan has over 25 years of experience as an anthropologist and has worked on projects identifying and documenting culturally significant places across Australia, including the Northern Territory, Western Queensland, Cape York, Torres Strait and Kimberley regions. Dr Corrigan has an experienced team of independent experts assisting him. As independent experts, they will seek inputs from people who have a spiritual and cultural connection to any underwater cultural heritage place along the Barossa pipeline route which may be affected by the Barossa pipeline (or GEP) installation activities. Santos is confident that the experts will take care that any spiritual and cultural information is collected in a culturally appropriate, respectful and sensitive way. If any information is identified as being confidential, the experts will respect the wishes of the people providing it and keep it confidential. The experts also want to know if there is anyone else in your community who they should be speaking with about cultural and spiritual connections with underwater cultural heritage places along the Barossa pipeline route (or GEP).

We would like you to engage with us before you start laying the pipeline, to map our sacred underwater cultural heritage sites with Traditional Owners so that the impacts can be avoided, especially where you say you want to build the pipeline.	We welcome engagement with you. The pipeline installation has not yet started. We are first causing an assessment to be undertaken to identify any underwater cultural heritage places along the Barossa pipeline route, also referred to as the Gas Export Pipeline or GEP, to which people, in accordance with Indigenous tradition, may have spiritual and cultural connections that may be affected by the future activities covered by the GEP Installation Environment Plan. This is being conducted by independent, appropriately qualified experts. If the process identifies any underwater cultural heritage places along the route that may be affected by future pipeline installation activities, Santos will consider this and will update the Environment Plan as appropriate. That process would involve evaluating impacts and risks to identified underwater cultural heritage places and, if appropriate, updating proposed control measures to reduce any impacts and risks to as low as reasonably practicable and acceptable levels. The pipelay activity will only commence after the assessment is completed and any regulatory obligations are met.
Carbon	
What is CO2?	CO2 is the abbreviation for carbon dioxide, which occurs naturally in most natural gas fields. Carbon dioxide is what we breath out and is naturally present in the atmosphere in small quantities. Barossa gas contains about 18 per cent carbon dioxide. When natural gas is produced or used for industry or to create energy, carbon dioxide is produced as a by-product. It is one of the greenhouse gases and companies like Santos are committed to seeking to reduce SHCO2 emissions through technology such as Carbon Capture and Storage (**CCS**).
How is the Bayu-Undan project supporting the Barossa project?	The Bayu-Undan field in Timor-Leste has a potential future role as a carbon capture and storage facility, following the end of natural gas production from that field. Santos proposes to repurpose the Bayu-Undan pipeline, which connects Darwin LNG to Bayu-Undan, and to transport CO2 from the Barossa project to Bayu-Undan via Darwin LNG. Front-end engineering design (**FEED**) commenced for the project in March 2022.

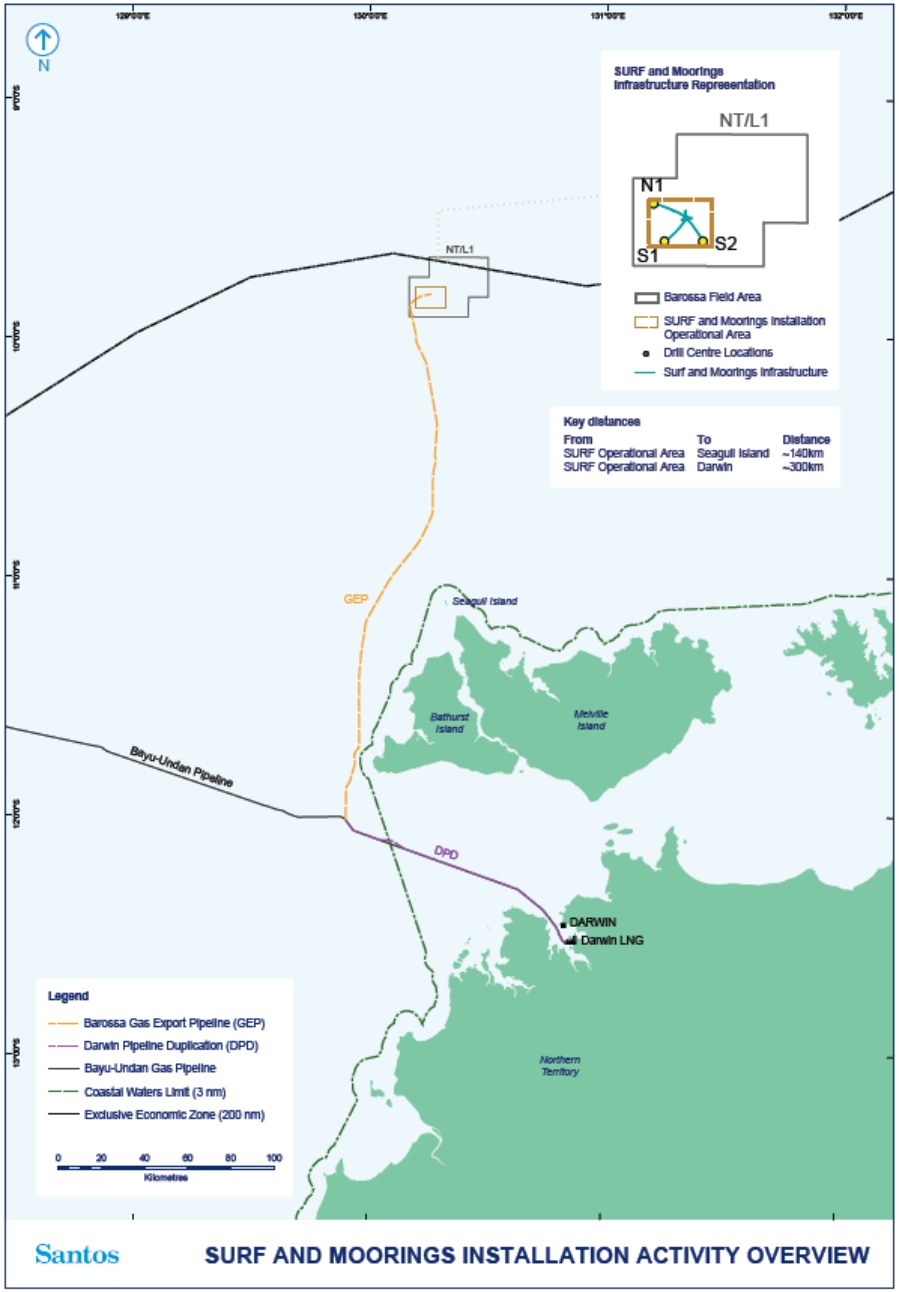
What are you going to do with the carbon from Barossa?	The CO2 from Barossa will be vented to the air via CO2 removal facilities on the FPSO and at DLNG. The CO2 emissions may be offset by Santos through purchasing carbon credits. Santos is also pursuing the Bayu-Undan CCS project so that the CO2 can be safely and permanently stored in depleted reservoirs at Bayu-Undan instead of being vented to the air. The technical work is almost complete, and Santos is working with the governments of Australia and Timor-Leste to progress regulatory frameworks and approvals.
What CCS projects have been done before?	Today, Santos is aware of 30 commercial CCS facilities operating around the world, with a storage capacity of over 42 million tonnes of CO2 per year. CCS is proven technology, and the International Energy Agency's (IEA) Net Zero by 2050 Roadmap envisages Carbon Capture, Utilisation and Storage growing to 7.6 billion tonnes of CO2 per year by 2050. The IEA's Executive Director has said that reaching net zero goals without CCS "will become virtually impossible".
How much CO2 will be captured by the Bayu-Undan CCS project?	The Bayu-Undan CCS project will be designed for initial injection and storage of approximately 2.3 million tonnes of CO2 per annum from Barossa.
How will you comply with the Safeguard Mechanism to ensure that Barossa is net zero emissions on day one of gas production scheduled for 2025?	The Government is still finalising the detailed guidelines for the Safeguard Mechanism. Santos expects to comply with the Safeguard Mechanism by storing the CO2 at the Bayu-Undan CCS project once the approvals are in place and the CCS infrastructure is operational. Before then, Santos will purchase carbon credits to offset reservoir CO2 emissions.
General	
When will the project be completed?	The Barossa project currently remains on target to commence production in the first half 2025. Drilling and Completions activities are planned to be completed approximately 2 years following commencement of drilling. Following planned commencement of production in the first half of 2025, production is expected to continue for 25 years.
Is the NT or Federal Governments part of this project?	The NT Government and Commonwealth Government regulate certain Project activities, with the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) (a Commonwealth government authority) regulating the Project's offshore activities.

<table>
<tr>
<td>Will the Barossa project significantly increase marine vessel traffic around the Tiwi Islands?</td>
<td>Over the construction phase of the project, the number of associated vessels between Darwin Port and the activity area will vary depending on the project activity. This is summarised in the table below.
<table>
<tr><th>Project Activity</th><th>Drilling and Completions</th><th>Subsea Infrastructure Installation</th><th>Darwin Pipeline Duplication</th><th>Gas Export Pipeline</th></tr>
<tr><td>Vessel Movements</td><td>Approx. 2 per week for 24-32 months</td><td>Approx. 5-7 per week for 8 months</td><td>Appro. 3 per week for 12 months</td><td>Approx. 3 per week for 6-12 months</td></tr>
</table>
Once the construction is complete, approximately 2 vessels per week will service the FPSO for the duration of the project life (~25 years).

For context, Darwin Port currently has on average 30 commercial vessel movements per week.</td>
</tr>
<tr>
<td>Legendre gas leak</td>
<td>The gas seepage at Legendre field in the Carnarvon Basin, offshore from Western Australia (not the Barossa Project) is not a risk to human safety, given the small gas volumes and low rates of seepage observed. Santos has also assessed that this small amount of gas seepage is unlikely to have any significant impact on the marine environment as methane, the main constituent of the gas, is not toxic to marine life.

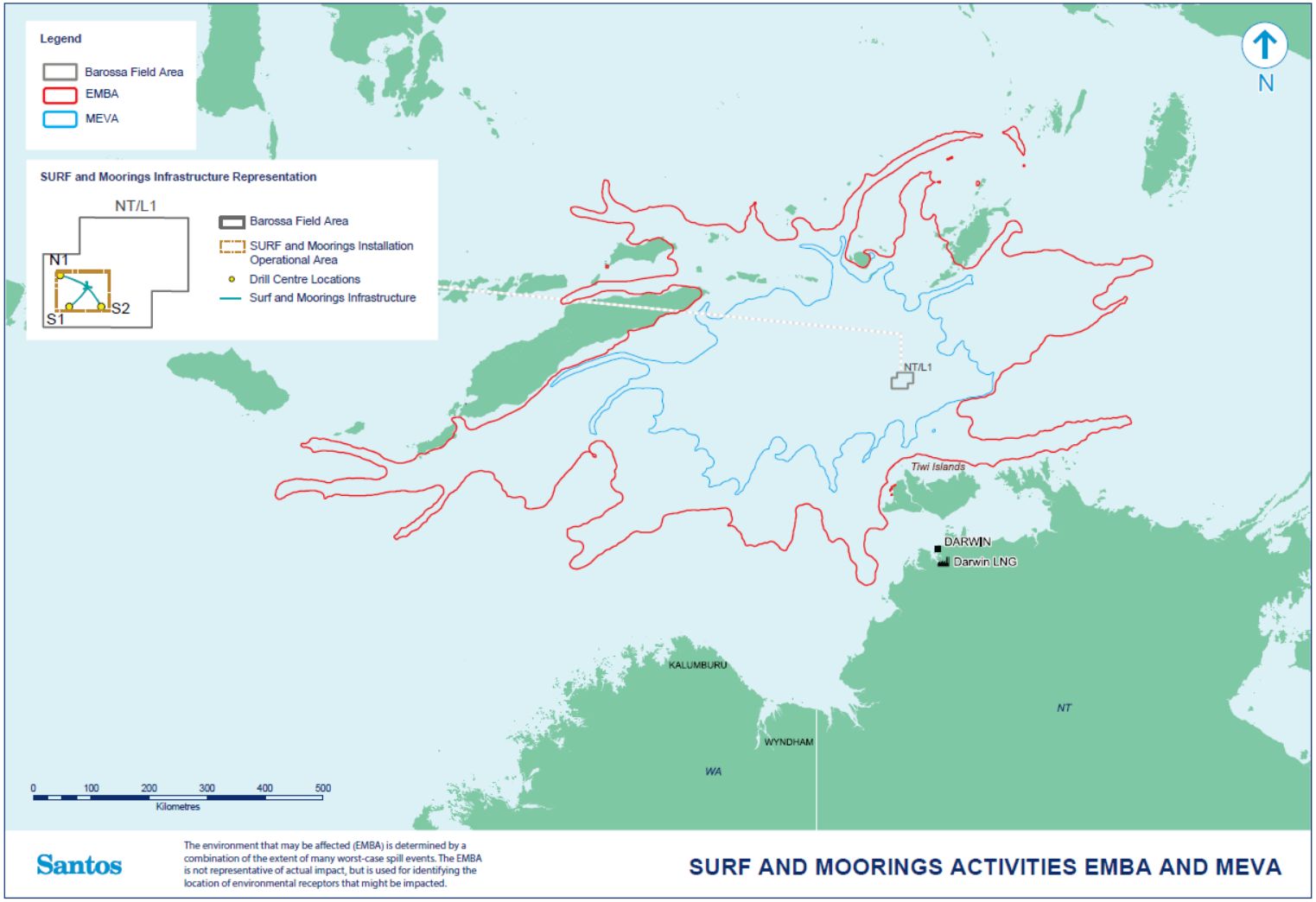
Santos is taking a responsible approach to the ongoing presence of the gas bubble seepage at this site and has proposed a robust environmental management currently under assessment by the offshore regulator NOPSEMA, which includes for a marine monitoring program.</td>
</tr>
</table>

6. Maps and figures



Santos

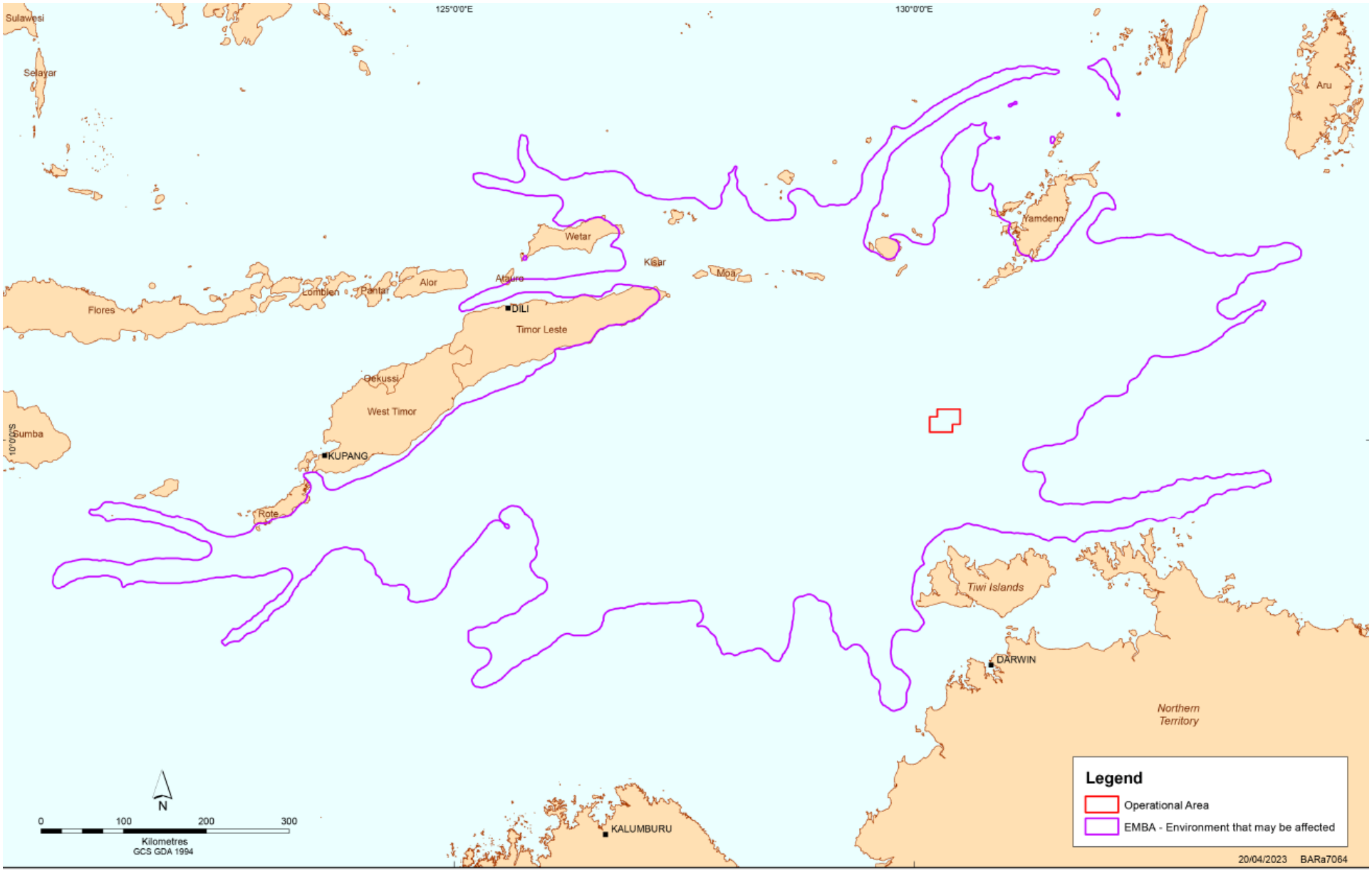
SURF AND MOORINGS INSTALLATION ACTIVITY OVERVIEW



Santos

The environment that may be affected (EMBA) is determined by a combination of the extent of many worst-case spill events. The EMBA is not representative of actual impact, but is used for identifying the location of environmental receptors that might be impacted.

SURF AND MOORINGS ACTIVITIES EMBA AND MEVA



Santos

The environment that may be affected (EMBA) is determined by a combination of the extent of many worst-case spill events. The EMBA is not representative of actual impact, but is used for identifying the location of environmental receptors that might be impacted.

SURF ACTIVITY EMBA

Appendix G Chronology – Tiwi Islands Consultations

No.	Date	Action	Summary of Action
1.	5 December 2022	Meetings with Northern Land Council and Tiwi Land Council	Santos met by video conferencing with Northern Land Council and Tiwi Land Council in relation to the upcoming consultations.
2.	9 December 2022	Tiwi Resources advise of cancellation of proposed engagements	Tiwi Resources advised that meetings between Santos and Tiwi Islands clan members proposed for 12-14 December were cancelled.
3.	13 January 2023	Meeting with Northern Land Council regarding consultations	Santos attended a meeting with the Northern Land Council to discuss the upcoming consultation process on the Tiwi Islands.
4.	10 February 2023	Meeting with Tiwi Enterprises	Santos representatives attended a meeting with the CEO of Tiwi Enterprises at Mantiyupwi Hotel at Wurrumiyanga to discuss the upcoming consultation process on the Tiwi Islands.
5.	17 February 2023	Meeting with Gwalwa Garankiki Association and NT Chief Minister's Office	Santos representatives meet with representatives of the Gwalwa Garankiki Association and the Northern Territory Chief Minister's Office. The representative of the Gwalwa Garankiki Association provided feedback on how community meetings should be arranged, and how Santos can best engage with Tiwi Islands clans in relation to the Barossa Project.
6.	27 February 2023	Tiwi Community Engagement	Santos representatives and representatives from Tiwi Islands consultant Kode Blak attended Wurrumiyanga for engagement with community, to build relationships and answer questions.
7.	7 March 2023	Engagement with Tiwi Resources	A Santos representative met with a Tiwi Resources representative regarding preparations for upcoming boat trips and clan group meetings.
8.	28 March 2023 (live until 24 April 2023)	Social Media Engagement	Santos social media advertisement published on Facebook, Instagram, and Messenger, with target location Tiwi Islands, Darwin and 60km radius. The advertisement advised of upcoming sessions between 24-28 April 2023 on Tiwi Islands, and said that at the sessions attendees would have an opportunity to hear about the project (including SURF activities), and provide feedback, and Santos would also answer their questions.

No.	Date	Action	Summary of Action
9.	28 March 2023 (live until 5 May 2023)	Social Media Engagement	Santos social media advertisement published on Facebook, Instagram, and Messenger, with target location: Tiwi Islands. The advertisement advised of Tiwi Islands April consultation sessions, including in relation to SURF activities.
10.	28 March 2023	Email notice sent to Tiwi Land Council	Santos sent an email to the Tiwi Land Council attaching a “Santos Notice of Consultation” referring to consultation regarding the SURF EP. The Notice of Consultation included a QR code which provided access to further information on the Barossa project.
11.	28 March 2023	Notice posted to Tiwi Noticeboard	A notice regarding Tiwi Islands engagement and consultation sessions to be held in April 2023 was placed on the Tiwi Noticeboard.
12.	29 March 2023	Advertising	A full page advertisement regarding Tiwi Islands engagement and consultation sessions to be held in April 2023 was published in NT News.
13.	1 April 2023	Advertising	A full page advertisement was published in NT News regarding Tiwi Island April consultation sessions.
14.	8 April 2023	Advertising	A full page advertisement was published in NT News regarding Tiwi Island April consultation sessions.
15.	11 April 2023	Contact via hotline phone number	Santos publicised a hotline phone number that could be called regarding the consultations. On 11 April 2023, a member of the Malawu clan called the number wishing to attend the consultation scheduled for 28 April 2023 in Wurrumiyanga.
16.	15 April 2023	Advertising	A full page advertisement was published in NT News regarding Tiwi Islands April 2023 consultation sessions.
17.	17 April 2023	Tiwi Islands consultation planning	Santos was advised of sorry business on the Tiwi Islands including two funerals on 21 and 27 April 2023 with a date to be advised for a third funeral. Santos rescheduled meetings planned for Milikapiti on 24 April 2023 to 4 May 2023.
18.	20 April 2023 (live until 22 May 2023)	Social Media Engagement	Santos social media advertisement published on Facebook, Instagram, and Messenger, with target location Western Australia and Northern Territory. The advertisement sought to identify and consult with persons who consider that they may be a relevant person whose functions, interests or activities may be affected by the proposed SURF EP.
19.	20 April 2023	Email update provided to stakeholders	Quarterly update on Barossa Development, including on consultations for the SURF EP, emailed from the Offshore Consultations Email to the Tiwi Land Council.

No.	Date	Action	Summary of Action
20.	21 April 2023	Upload to Santos website of information on SURF EP	Information regarding the SURF EP was made available on Santos' website, including links to the following materials: • NOPSEMA Environment plan content requirements • NOPSEMA Environment plan consultation requirements • Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 • Barossa Offshore Project Proposal • Barossa Offshore Project proposal appendices • Barossa Gas Project Glossary • Santos Barossa Subsea Infrastructure Installation and Pre-commissioning Activity Information Booklet
21.	21 April 2023	Advertising	A half page advertisement was published in NT News regarding Darwin drop in sessions.
22.	21 April 2023 (live until 5 May 2023)	Social Media Engagement	Santos social media advertisement published on Facebook, Instagram, and Messenger, with target location Tiwi Islands, Darwin and 60km radius. The advertisement advised of upcoming sessions between 24-28 April 2023 on Tiwi Islands, and said that at the sessions attendees would have an opportunity to hear about the project, provide feedback, and that Santos would also answer their questions. The advertisement was updated (including to add consultation sessions in May).
23.	21 April 2023 (live until 3 May 2023)	Social Media Engagement	Santos social media advertisement published on Facebook, Instagram, and Messenger, with target location Tiwi Islands, Darwin and 60km radius. The advertisement advised of upcoming community consultation drop-in sessions.
24.	22 April 2023 (until 22 May 2023)	Advertising	Radio ads broadcasted from 22 April until 22 May (4 x ads per day in Darwin and Perth, with all other national markets running 2x per day)
25.	22 April 2023 (live until 22 May 2023)	Social Media Engagement	Santos social media advertisement published on Facebook, Instagram, and Messenger, with target location Australia. The advertisement sought to identify and consult with persons who consider that they may be a relevant person whose functions, interests or activities may be affected by the proposed SURF EP.

No.	Date	Action	Summary of Action
26.	22 April 2023	Advertising	The following advertisements were published: • a full page advertisement in the NT News regarding Tiwi Islands April consultation sessions; • a full page advertisement in The Australian regarding SURF relevant persons; • a full page advertisement in the Australian Financial Review regarding SURF relevant persons; • a full page advertisement in the National Indigenous Times regarding SURF; and • a full page advertisement in The West Australian regarding SURF relevant persons.
27.	24 April 2023	Santos email consultation	Santos emailed the Tiwi Land Council to advise of opportunities in Darwin on 27 April 2023 and 3 May 2023 to obtain information, provide feedback and ask questions on the Barossa Project, including the activities proposed pursuant to the SURF EP.
28.	24 April 2023	Advertising	The following advertisements were published: • a public notice in The West Australian regarding SURF relevant persons; and • a full page advertisement in the NT News regarding SURF relevant persons.
29.	24 April 2023 (until 21 May 2023)	Advertising	Radio ads broadcasted from 24 April until 21 May 2023 across metro stations in Sydney, Melbourne, Brisbane, Adelaide and Perth regarding the SURF EP.
30.	24 April 2023 and 4 May 2023 (until 21 May 2023)	Advertising	Radio ads broadcasted on 24 April, and from 4 May until 21 May 2023 in Darwin regarding the SURF EP.
31.	25 April 2023	Advertising	A full page advertisement was published in National Indigenous Times regarding the SURF EP.
32.	26 April 2023	Barossa Gas Project FAQs posted on Santos website	Barossa Gas Project FAQs posted to the 'Public Notices' section of Santos' website among other Barossa-related documentation (https://www.santos.com/about-us/corporate-governance/public-notices/). These FAQs contained questions and responses relevant to the SURF EP.
33.	26 April 2023	Advertising	A public notice was published in the Australian Financial Review regarding SURF relevant persons.
34.	26 April 2023 at 10.30am	Consultation Session with Munupi Clan	Tiwi Islands engagement and consultation meeting regarding the SURF EP held with Santos and Munupi Clan at Pirlangimpi. Members from Wulirankuwu, Marrikawuyanga, Yimpinari, Mantiyupwi, Jikilaruwu, Wurankuwu, and Malawu clans also attended. Also in attendance was an expert on turtles (the founder of a leading marine conservation biology and artificial light assessment consultancy).

No.	Date	Action	Summary of Action
			Consultation conducted pursuant to agreed script, prepared by Santos, and directed by PowerPoint presentation, prepared by Santos. Various video explanations played and discussed. A qualified interpreter from the Aboriginal Interpretation Services (AIS) was also present. 107 clan members attended this session, from the following clans: • Wulirankuwu -–1 • Marrikawuyanga – 3 • Yimpinari – 1 • Munupi – 90 • Mantiyupwi – 4 • Jikilaruwu – 3 • Wurankuwu – 3 • Malawu – 2 Documents circulated at consultation included: • Notice of Consultation with Tiwi Island People • Agenda for Tiwi Islands April/May Consultation Sessions • Barossa Gas Project FAQs document • SURF Fact Sheet • SURF Activity Information Booklet • Map of the SURF EMBA • SURF and Moorings Installation Activity Overview
35.	27 April 2023 until 3 May 2023	Advertising	Radio advertisements regarding drop-in consultation sessions broadcasted. Advertising broadcasted on TVM, by way of ARN Defining Audio. The script was as follows: "*Santos is holding Barossa Gas Project consultation drop-in sessions on April 27 and May 3 at the Darwin Convention Centre about proposed activities for the project. Relevant persons can nominate for consultation, give feedback and ask questions. For more information, including who is a relevant person and proposed project activities, visit santos.com slash barossa, phone 1800 267 600, or email offshore.consultation@santos.com*"
36.	27 April 2023	Advertising	A half page advertisement was published in NT News regarding Darwin drop-in sessions.

No.	Date	Action	Summary of Action
37.	27 April 2023	Darwin Community Engagement Session	Santos hosted an open drop in consultation session at the Darwin Convention Centre. Four visitors attended.
38.	27 April 2023	Barossa Gas Project FAQ posted to Tiwi Islands Facebook Noticeboard	Barossa Gas Project FAQs posted to the Tiwi Islands Facebook Noticeboard with the following wording: "*We have received many great questions about the Barossa Gas Project. The answers provided in this document are intended to provide clear, summary responses to the questions we have received. This document will be updated on an ongoing basis during the development and delivery of the project as new questions are asked. We have copies of this document that we will share at the consultation sessions this week and next. You can also contact us at any time to request a copy of this document. We look forward to seeing you and answering more of your questions at the sessions.*"
39.	28 April 2023	Advertising	Half page advertisement was published in NT News regarding Darwin drop-in sessions.
40.	28 April 2023 at 10:30am	Consultation Session with Mantiyupwi Clan	Tiwi Islands engagement and consultation meeting regarding the SURF EP held with Santos and Mantiyupwi Clan at Wurrumiyanga (Nguiu Club). Members from Wulirankuwu, Yimpinari, Jikilaruwu, Wurankuwu, and Munupi clans also attended. In addition, an expert on turtles (the founder of a leading marine conservation biology and artificial light assessment consultancy) also attended. Consultation conducted pursuant to agreed script, prepared by Santos, and directed by PowerPoint presentation, prepared by Santos. Various video explanations played and discussed. 105 clan members attended this session, from the following clans: • Wulirankuwu -–6 • Yimpinari – 1 • Munupi – 5 • Mantiyupwi – 89 • Jikilaruwu – 3 • Wurankuwu – 1 Documents circulated at the consultation included:

No.	Date	Action	Summary of Action
			• Notice of Consultation with Tiwi Island People • Agenda for Tiwi Islands April/May Consultation Sessions • Barossa Gas Project FAQs document • SURF Fact Sheet • SURF Activity Information Booklet • Map of the SURF EMBA • SURF and Moorings Installation Activity Overview
41.	28 April 2023 at 1:00pm	Consultation Session with Jikilaruwu Clan	Tiwi Islands engagement and consultation meeting regarding the SURF EP held with Santos and Jikilaruwu Clan at Wurrumiyanga. Members from the Wulirankuwu, Yimpinari, Mantiyupwi, Wurankuwu, Munupi, and Malawu clans also attended. In addition, an expert on turtles (the founder of a leading marine conservation biology and artificial light assessment consultancy) was also present. Consultation conducted pursuant to agreed script, prepared by Santos, and directed by PowerPoint presentation, prepared by Santos. Various video explanations played and discussed. 98 clan members attended this session, from the following clans: • Wulirankuwu – 1 • Yimpinari – 2 • Munupi – 4 • Mantiyupwi – 2 • Jikilaruwu – 83 • Wurankuwu – 4 • Malawu – 2 Documents circulated at the consultation included: • Notice of Consultation with Tiwi Island People • Agenda for Tiwi Islands April/May Consultation Sessions • Barossa Gas Project FAQs document • SURF Fact Sheet • SURF Activity Information Booklet • Map of the SURF EMBA • SURF and Moorings Installation Activity Overview
42.	29 April 2023	Advertising	The following advertisements were published:

No.	Date	Action	Summary of Action
			• A public notice in The Australian regarding SURF relevant persons; • A public notice in NT News regarding SURF relevant persons; and • A full page advertisement in NT News regarding SURF relevant persons.
43.	1 May 2023	Advertising	The following advertisements were published: • A public notice in The West Australian regarding SURF relevant persons; and • A half page advertisement in NT News regarding Darwin drop-in sessions.
44.	1 May 2023	Noticeboard – re April / May consultation sessions with Tiwi Islanders	Santos Notice of Consultation with respect to the April / May 2023 SURF consultations displayed on the Tiwi Islands Noticeboard, Santos' website and at the Milikapiti shops. The Notice of Consultation included a QR code which provides access to further information on the Barossa project.
45.	1 May 2023 (live until 5 May 2023)	Social Media Engagement	Santos social media advertisement published on Facebook, Instagram, and Messenger, with target location Tiwi Islands, Darwin and 60km radius. The advertisement advised of upcoming sessions on the Tiwi Islands relating to the SURF EP, and said at the sessions attendees will have an opportunity to provide feedback on the project.
46.	3 May 2023	Advertising	A public notice was published in the Australian Financial Review regarding SURF relevant persons.
47.	3 May 2023	Darwin Community Engagement Session	Santos hosted an open drop in consultation session at the Darwin Convention Centre. Four visitors attended.
48.	4 May 2023 at 10:30am	Consultation Session with Marrikawuyanga and Yimpinari Clans	Tiwi Islands engagement and consultation meeting regarding the SURF EP held with Santos and Marrikawuyanga, Yimpinari, Wulirankuwu, Malawi, Munupi, Mantiyupwi and Jikilaruwu clans at Milikapiti (Milikapiti Sport and Recreation Centre). Consultation conducted pursuant to agreed script, prepared by Santos, and directed by PowerPoint presentation, prepared by Santos. Various video explanations played and discussed. A qualified interpreter from AIS was also present. 161 clan members attended this session, from the following clans:

No.	Date	Action	Summary of Action
			• Wulirankuwu – 51 • Marrikawuyanga – 5 • Yimpinari – 49 • Munupi – 32 • Mantiyupwi – 11 • Jikilaruwu – 3 • Malawu - 10 Documents circulated at the consultation included: • Notice of Consultation with Tiwi Island People • Agenda for Tiwi Islands April/May Consultation Sessions • Barossa Gas Project FAQs document • SURF Fact Sheet • SURF Activity Information Booklet • Map of the SURF EMBA • SURF and Moorings Installation Activity Overview
49.	4 May 2023 at 1:00pm	Consultation Session with Wulirankuwu Clan	Tiwi Islands engagement and consultation meeting regarding the SURF EP held with Santos and the Wulirankuwu clan at Milikapiti (Milikapiti Sport and Recreation Centre). Consultation conducted pursuant to agreed script, prepared by Santos, and directed by PowerPoint presentation, prepared by Santos. Various video explanations played and discussed. A qualified interpreter from AIS was also present. 6 members of the Wulirankuwu clan attended this session. Documents circulated at consultation included: • Notice of Consultation with Tiwi Island People • Agenda for Tiwi Islands April/May Consultation Sessions • Barossa Gas Project FAQs document • SURF Fact Sheet • SURF Activity Information Booklet • Map of the SURF EMBA • SURF and Moorings Installation Activity Overview

No.	Date	Action	Summary of Action
50.	4 May 2023	One-on-one discussions	Santos representatives also engaged in one-on-one discussions with attendees at the Marrikawuyanga, Yimpinari, and Wulirankuwu clan consultation sessions, which were separately noted by Santos. Santos has records of two such discussions.
51.	5 May 2023 at 10:30am	Consultation Session with Wurankuwu Clan	Tiwi Islands engagement and consultation meeting regarding the SURF EP held with Santos and the Wurankuwu clan at Wurrumiyanga (Nguiu Club). Yimpinari, Wulirankuwu, Malawu, Munupi, Mantiyupwi and Jikilaruwu clan members attended this session as well. Consultation conducted pursuant to agreed script, prepared by Santos, and directed by PowerPoint presentation, prepared by Santos. Various video explanations played and discussed. 136 clan members attended this session, from the following clans: • Wulirankuwu – 12 • Yimpinari – 9 • Munupi – 5 • Mantiyupwi -6 • Jikalaru – 16 • Wurankuwu – 83 • Malawu – 5 Documents circulated at the consultation included: • Notice of Consultation with Tiwi Island People • Agenda for Tiwi Islands April/May Consultation Sessions • Barossa Gas Project FAQs document • SURF Fact Sheet • SURF Activity Information Booklet • Map of the SURF EMBA • SURF and Moorings Installation Activity Overview
52.	5 May 2023 at 1:00pm	Consultation Session with Malawu Clan	Tiwi Islands engagement and consultation meeting regarding the SURF EP held with the Malawu clan at Wurrumiyanga (Nguiu Club). Marrikawuyanga, Yimpinari, Wulirankuwu, Malawi, Munupi, Mantiyupwi and Jikilaruwu clan members attended this session as well. Consultation conducted pursuant to agreed script, prepared by Santos, and directed by PowerPoint presentation, prepared by Santos. Various video explanations played and discussed. 207 clan members attended this session, from the following clans:

No.	Date	Action	Summary of Action
			• Mulirankuwu – 17 • Marrikawuyanga – 1 • Yimpinari – 1 • Munupi – 12 • Mantiyupwi – 16 • Jikilaruwu – 37 • Malawu – 123 Documents circulated at the consultation included: • Notice of Consultation with Tiwi Island People • Agenda for Tiwi Islands April/May Consultation Sessions • Barossa Gas Project FAQs document • SURF Fact Sheet • SURF Activity Information Booklet • Map of the SURF EMBA • SURF and Moorings Installation Activity Overview
53.	5 May 2023	One-on-one discussions	Santos representatives also engaged in one-on-one discussions and discussions in small groups with attendees at the Malawu and Wurankuwu clan consultation sessions, which were separately noted by Santos. Santos has records of four such discussions.
54.	6 May 2023	Advertising	The following advertisements were published: • a public notice in The Australian regarding SURF relevant persons; • a public notice in NT News regarding SURF relevant persons; and • a full page advertisement in NT News regarding SURF relevant persons.
55.	8 May 2023	Advertising	A public notice was published in The West Australian regarding SURF relevant persons.
56.	10 May 2023	Advertising	A public notice was published in the Australian Financial Review regarding SURF relevant persons.
57.	10 May 2023	Darwin Community Engagement Sessions	Santos hosted a stall at Arts in the Grass in Darwin. At this stall, Santos representatives handed out information booklets and showed content on iPads relating to the SURF activities. Santos representatives answered questions and received feedback.

<table>
<tr><th>No.</th><th>Date</th><th>Action</th><th>Summary of Action</th></tr>
<tr><td>58.</td><td>12 May 2023 (live until 16 June 2023)</td><td>Social Media Engagement</td><td>Santos social media advertisement published on Facebook, Instagram, and Messenger, with target location Tiwi Islands, Darwin and 60km radius.
Advertisement advised of upcoming sessions on 13-16 June 2023 on Tiwi Islands.</td></tr>
<tr><td>59.</td><td>12 May 2023</td><td>Advertising</td><td>A half page advertisement was published in NT News regarding Darwin drop-in consultation sessions published.</td></tr>
<tr><td>60.</td><td>13 May 2023</td><td>Advertising</td><td>The following advertisements were published:
• a public notice in The Australian regarding SURF relevant persons;
• a public notice in NT News regarding SURF relevant persons; and
• a full page advertisement in NT News regarding June Tiwi Islands consultation sessions.</td></tr>
<tr><td>61.</td><td>14 May 2023</td><td>Advertising</td><td>During the week commencing 14 May 2023, a 30-second advertisement publicising the SURF consultation was played on the following stations:
<table>
<tr><th>Station</th><th>Location</th><th>Number of times played</th></tr>
<tr><td>Darwin | HOT100</td><td>Darwin</td><td>16</td></tr>
<tr><td>BONUS HOT100</td><td>Darwin</td><td>3</td></tr>
<tr><td>Darwin | MIX1049</td><td>Darwin</td><td>16</td></tr>
<tr><td>BONUS MIX1049</td><td>Darwin</td><td>3</td></tr>
<tr><td>Tiwi Islands Local Radio | 29 local communities</td><td>Tiwi Islands</td><td>16</td></tr>
<tr><td>Sydney | KISS 1065</td><td>Sydney</td><td>8</td></tr>
<tr><td>BONUS KISS 1066</td><td>Sydney</td><td>4</td></tr>
<tr><td>Melbourne | KISS 101.1</td><td>Melbourne</td><td>8</td></tr>
<tr><td>BONUS KISS 101.1</td><td>Melbourne</td><td>4</td></tr>
<tr><td>Brisbane | 97.3FM</td><td>Brisbane</td><td>8</td></tr>
<tr><td>BONUS 97.3FM</td><td>Brisbane</td><td>4</td></tr>
<tr><td>Adelaide | MIX 102.3</td><td>Adelaide</td><td>8</td></tr>
<tr><td>BONUS MIX 102.3</td><td>Adelaide</td><td>4</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>No.</th><th>Date</th><th>Action</th><th>Summary of Action</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><td>Perth | 96FM</td><td>Perth</td><td>16</td></tr>
<tr><td>BONUS 96FM</td><td>Perth</td><td>8</td></tr>
<tr><td>Sydney | NOVA 96.9</td><td>Sydney</td><td>8</td></tr>
<tr><td>BONUS NOVA 96.9</td><td>Sydney</td><td>3</td></tr>
<tr><td>Melbourne | NOVA 100</td><td>Melbourne</td><td>8</td></tr>
<tr><td>BONUS NOVA 100</td><td>Melbourne</td><td>3</td></tr>
<tr><td>Brisbane | NOVA 106.9</td><td>Brisbane</td><td>8</td></tr>
<tr><td>BONUS NOVA 106.9</td><td>Brisbane</td><td>3</td></tr>
<tr><td>Adelaide | NOVA 91.9</td><td>Adelaide</td><td>8</td></tr>
<tr><td>BONUS NOVA 91.9</td><td>Adelaide</td><td>3</td></tr>
<tr><td>Perth | NOVA 93.7</td><td>Perth</td><td>16</td></tr>
<tr><td>BONUS NOVA 93.7</td><td>Perth</td><td>6</td></tr>
</table>
</td></tr>
<tr><td>62.</td><td>15 May 2023</td><td>Advertising</td><td>The following advertisements were published:
• a public notice in The West Australian regarding SURF relevant persons;
• a half page advertisement in NT News regarding Darwin drop-in sessions; and
• a public notice published in The Australian Financial Review regarding the SURF EP.</td></tr>
<tr><td>63.</td><td>17 May 2023</td><td>Advertising</td><td>The following advertisements were published:
• a half page advertisement in NT News regarding Darwin drop-in sessions; and
• a public notice published in The Australian Financial Review regarding SURF relevant persons.</td></tr>
<tr><td>64.</td><td>17 May 2023 (live until 12 June 2023)</td><td>Social Media Engagement</td><td>Santos social media advertisement published on Facebook, Instagram, and Messenger. Advertisement advised of community consultation drop-in sessions in Darwin in May and June 2023.</td></tr>
<tr><td>65.</td><td>18 May 2023 8:30am – 11:30am</td><td>Darwin Pop Up Stand</td><td>Santos established a pop up stand in Darwin’s Smith Street Mall. 16 people attended, including seven individuals from the Tiwi Islands.</td></tr>
</table>

<table>
<tr><th>No.</th><th>Date</th><th>Action</th><th>Summary of Action</th></tr>
<tr><td>66.</td><td>19 May 2023</td><td>Santos email consultation</td><td>Santos emailed Tiwi Land Council providing a link to NOPSEMA's website document: Consultation in the course of an Environmental Plan.</td></tr>
<tr><td>67.</td><td>20 May 2023</td><td>Advertising</td><td>The following advertisements were published:
a full page advertisement in NT News regarding Tiwi Islands June consultation sessions;
a public notice in The Australian regarding SURF relevant persons; and
a public notice in NT News regarding SURF relevant persons.</td></tr>
<tr><td>68.</td><td>21 May 2023</td><td>Advertising</td><td>During the week commencing 22 May 2023, a 30-second advertisement publicising the consultation was played on the following stations:
<table>
<tr><th>Station</th><th>Location</th><th>Number of times played</th></tr>
<tr><td>Darwin | HOT100</td><td>Darwin</td><td>33</td></tr>
<tr><td>Darwin | MIX1049</td><td>Darwin</td><td>33</td></tr>
<tr><td>Tiwi Islands Local Radio | 29 local communities</td><td>Tiwi Islands</td><td>28</td></tr>
<tr><td>Sydney | KISS 1065</td><td>Sydney</td><td>21</td></tr>
<tr><td>Melbourne | KISS 101.1</td><td>Melbourne</td><td>21</td></tr>
<tr><td>Brisbane | 97.3FM</td><td>Brisbane</td><td>21</td></tr>
<tr><td>Adelaide | MIX 102.3</td><td>Adelaide</td><td>21</td></tr>
<tr><td>Perth | 96FM</td><td>Perth</td><td>42</td></tr>
<tr><td>Sydney | NOVA 96.9</td><td>Sydney</td><td>20</td></tr>
<tr><td>Melbourne | NOVA 100</td><td>Melbourne</td><td>20</td></tr>
<tr><td>Brisbane | NOVA 106.9</td><td>Brisbane</td><td>20</td></tr>
<tr><td>Adelaide | NOVA 91.9</td><td>Adelaide</td><td>20</td></tr>
<tr><td>Perth | NOVA 93.7</td><td>Perth</td><td>37</td></tr>
</table></td></tr>
<tr><td>69.</td><td>22 May 2023</td><td>Advertising</td><td>A half page advertisement was published in NT News regarding Darwin drop-in sessions.</td></tr>
</table>

<table>
<tr><th>No.</th><th>Date</th><th>Action</th><th>Summary of Action</th></tr>
<tr><td>70.</td><td>22 May 2023</td><td>Darwin Community Engagement Session</td><td>Santos hosted an open drop in consultation session at the Darwin Convention Centre. Two people attended.</td></tr>
<tr><td>71.</td><td>22 May 2023 (until 7 June 2023)</td><td>Advertising</td><td>Radio ads broadcasted from 22 May until 7 June 2023 in Darwin regarding Darwin drop-in sessions including in relation to the SURF EP.</td></tr>
<tr><td>72.</td><td>24 May 2023</td><td>Advertising</td><td>A half page advertisement was published in NT News regarding Darwin drop-in sessions.</td></tr>
<tr><td>73.</td><td>27 May 2023</td><td>Advertising</td><td>A full page advertisement was published in NT News regarding Tiwi Islands June consultation sessions.</td></tr>
<tr><td>74.</td><td>28 May 2023</td><td>Advertising</td><td>During the week commencing 29 May 2023, a 30-second advertisement publicising the consultation was played on the following stations:
<table>
<tr><th>Station</th><th>Location</th><th>Number of times played</th></tr>
<tr><td>Darwin | HOT100</td><td>Darwin</td><td>33</td></tr>
<tr><td>BONUS HOT100</td><td>Darwin</td><td></td></tr>
<tr><td>Darwin | MIX1049</td><td>Darwin</td><td>33</td></tr>
<tr><td>Tiwi Islands Local Radio | 29 local communities</td><td>Tiwi Islands</td><td>28</td></tr>
<tr><td>Sydney | KISS 1065</td><td>Sydney</td><td>21</td></tr>
<tr><td>Melbourne | KISS 101.1</td><td>Melbourne</td><td>21</td></tr>
<tr><td>Brisbane | 97.3FM</td><td>Brisbane</td><td>21</td></tr>
<tr><td>Adelaide | MIX 102.3</td><td>Adelaide</td><td>21</td></tr>
<tr><td>Perth | 96FM</td><td>Perth</td><td>42</td></tr>
<tr><td>Sydney | NOVA 96.9</td><td>Sydney</td><td>20</td></tr>
<tr><td>Melbourne | NOVA 100</td><td>Melbourne</td><td>20</td></tr>
<tr><td>Brisbane | NOVA 106.9</td><td>Brisbane</td><td>20</td></tr>
<tr><td>Adelaide | NOVA 91.9</td><td>Adelaide</td><td>20</td></tr>
<tr><td>Perth | NOVA 93.7</td><td>Perth</td><td>37</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>No.</th><th>Date</th><th>Action</th><th>Summary of Action</th></tr>
<tr><td>75.</td><td>29 May 2023</td><td>Advertising</td><td>A half page advertisement was published in NT News regarding Darwin drop-in sessions.</td></tr>
<tr><td>76.</td><td>29 May 2023</td><td>Santos email consultation</td><td>Santos emailed Tiwi Land Council a project fact sheet which included information relating to SURF.</td></tr>
<tr><td>77.</td><td>31 May 2023</td><td>Darwin Community Engagement Session</td><td>Santos hosted pop-up stall at Arts in the Grass, Darwin. Approximately 30 people attended. Eight people engaged in one on one conversations.</td></tr>
<tr><td>78.</td><td>31 May 2023</td><td>Advertising</td><td>A half page advertisement was published in NT News regarding Darwin drop-in sessions.</td></tr>
<tr><td>79.</td><td>4 June 2023</td><td>Advertising</td><td>During the week commencing 5 June 2023, a 30-second advertisement publicising the consultation was played on the following stations:
<table>
<tr><th>Station</th><th>Location</th><th>Number of times played</th></tr>
<tr><td>Darwin | HOT100</td><td>Darwin</td><td>33</td></tr>
<tr><td>Darwin | MIX1049</td><td>Darwin</td><td>33</td></tr>
<tr><td>Tiwi Islands Local Radio | 29 local communities</td><td>Tiwi Islands</td><td>28</td></tr>
<tr><td>Sydney | KISS 1065</td><td>Sydney</td><td>21</td></tr>
<tr><td>Melbourne | KISS 101.1</td><td>Melbourne</td><td>21</td></tr>
<tr><td>Brisbane | 97.3FM</td><td>Brisbane</td><td>21</td></tr>
<tr><td>Adelaide | MIX 102.3</td><td>Adelaide</td><td>21</td></tr>
<tr><td>Perth | 96FM</td><td>Perth</td><td>42</td></tr>
<tr><td>Sydney | NOVA 96.9</td><td>Sydney</td><td>20</td></tr>
<tr><td>Melbourne | NOVA 100</td><td>Melbourne</td><td>20</td></tr>
<tr><td>Brisbane | NOVA 106.9</td><td>Brisbane</td><td>20</td></tr>
<tr><td>Adelaide | NOVA 91.9</td><td>Adelaide</td><td>20</td></tr>
<tr><td>Perth | NOVA 93.7</td><td>Perth</td><td>37</td></tr>
</table></td></tr>
<tr><td>80.</td><td>5 June 2023</td><td>Advertising</td><td>A half page advertisement was published in NT News regarding Darwin drop-in sessions.</td></tr>
</table>

<table>
<tr><th>No.</th><th>Date</th><th>Action</th><th>Summary of Action</th></tr>
<tr><td>81.</td><td>7 June 2023</td><td>Advertising</td><td>A half page advertisement was published in NT News regarding Darwin drop-in sessions.</td></tr>
<tr><td>82.</td><td>8 June 2023</td><td>Darwin Community Engagement Session</td><td>Santos hosted an open drop in consultation session at the Darwin Convention Centre. Six people attended.</td></tr>
<tr><td>83.</td><td>9 June 2023</td><td>Darwin Community Engagement Session</td><td>Santos hosted a pop-up stand at Darwin Mall. Five people attended.</td></tr>
<tr><td>84.</td><td>10 June 2023</td><td>Advertising</td><td>A full page advertisement published in NT News regarding June consultations.</td></tr>
<tr><td>85.</td><td>12 June 2023</td><td>Advertising</td><td>During the week commencing 12 June 2023, a 30-second advertisement publicising the consultation was played on the following stations:
<table>
<tr><th>Station</th><th>Location</th><th>Number of times played</th></tr>
<tr><td>Darwin | HOT100</td><td>Darwin</td><td>24</td></tr>
<tr><td>Darwin | MIX1049</td><td>Darwin</td><td>24</td></tr>
<tr><td>Tiwi Islands Local Radio | 29 local communities</td><td>Tiwi Islands</td><td>28</td></tr>
<tr><td>Sydney | KISS 1065</td><td>Sydney</td><td>15</td></tr>
<tr><td>Melbourne | KISS 101.1</td><td>Melbourne</td><td>15</td></tr>
<tr><td>Brisbane | 97.3FM</td><td>Brisbane</td><td>15</td></tr>
<tr><td>Adelaide | MIX 102.3</td><td>Adelaide</td><td>15</td></tr>
<tr><td>Perth | 96FM</td><td>Perth</td><td>30</td></tr>
<tr><td>Sydney | NOVA 96.9</td><td>Sydney</td><td>14</td></tr>
<tr><td>Melbourne | NOVA 100</td><td>Melbourne</td><td>14</td></tr>
<tr><td>Brisbane | NOVA 106.9</td><td>Brisbane</td><td>14</td></tr>
<tr><td>Adelaide | NOVA 91.9</td><td>Adelaide</td><td>14</td></tr>
<tr><td>Perth | NOVA 93.7</td><td>Perth</td><td>26</td></tr>
</table></td></tr>
</table>

No.	Date	Action	Summary of Action
86.	12 June 2023	Advertising	A half page advertisement was published in The West Australian regarding consultation relating to the SURF EP.
87.	13 June 2023 at 10.30am	Consultation session with Marrikawuyanga and Yimpinari clans	Tiwi Islands Engagement and Consultation regarding the SURF EP with Wulirankuwu, Marrikawuyanga, Yimpinari, Munupi, Mantiyupwi, Jikilaruwu, Malawu clans at Milikapiti (Milikapiti Sport and Recreation Centre) (Melville Island). Consultation conducted pursuant to agreed script, prepared by Santos, and directed by PowerPoint presentation, prepared by Santos. Various video explanations played and discussed. A qualified interpreter from the AIS was present. 193 clan members attended this session, from the following clans: • Wulirankuwu – 51 • Mirrikawuyanga – 6 • Yimpinari – 53 • Munupi – 36 • Mantiyupwi – 25 • Jikilaruwu – 8 • Malawu - 14 Documents circulated at the consultation included: • Notice of Consultation with Tiwi Island People • Agenda for Tiwi Islands June Consultation Sessions • NOPSEMA Consultation on Offshore Petroleum Environment Plans: Information for the Community • Barossa Gas Project FAQs document • SURF Fact Sheet • SURF Activity Information Booklet • Map of the SURF EMBA • SURF and Moorings Installation Activity Overview
88.	13 June 2023 at 1.00pm	Consultation session with Wulirankuwu clan	Tiwi Islands Engagement and Consultation regarding the SURF EP with Wulirankuwu, Marrikawuyanga, Yimpinari, Wurankuwu, Malawu clans at Milikapiti (Milikapiti Sport and Recreation Centre) (Melville Island). Consultation conducted pursuant to agreed script, prepared by Santos, and directed by PowerPoint presentation, prepared by Santos. Various video explanations played and discussed. A qualified interpreter from the AIS was present.

No.	Date	Action	Summary of Action
			17 clan members attended this session, from the following clans: • Wulirankuwu – 10 • Mirrikawuyanga – 2 • Yimpinari – 1 • Wurankuwu – 1 • Malawu - 3 Documents circulated at the consultation included: • Notice of Consultation with Tiwi Island People • Agenda for Tiwi Islands June Consultation Sessions • NOPSEMA Consultation on Offshore Petroleum Environment Plans: Information for the Community • Barossa Gas Project FAQs document • SURF Fact Sheet • SURF Activity Information Booklet • Map of the SURF EMBA • SURF and Moorings Installation Activity Overview
89.	13 June 2023	One-on-one discussions	Santos representatives also engaged in one-on-one discussions and discussions in small groups with attendees at the Wulirankuwu clan consultation session, which were separately noted by Santos. Santos has records of three such discussions.
90.	13 June 2023	Advertising	A full page advertisement was published in The Australian regarding the SURF EP.
91.	14 June 2023 at 10.30am	Consultation session with Mantiyupwi clan	Tiwi Islands Engagement and Consultation regarding the SURF EP with Wulirankuwu, Yimpinari, Munupi, Mantiyupwi, Jikilaruwu, Wurankuwu, Malawu clans at Wurrumiyanga (Mantiyupwi Motel) (Bathurst Island). Consultation conducted pursuant to agreed script, prepared by Santos, and directed by PowerPoint presentation, prepared by Santos. Various video explanations played and discussed. A qualified interpreter from the AIS was present. 42 clan members attended this session, from the following clans:

No.	Date	Action	Summary of Action
			• Wulirankuwu – 2 • Yimpinari –6 • Munupi – 4 • Mantiyupwi – 20 • Jikilaruwu – 2 • Wurankuwu – 2 • Malawu – 6 Documents circulated at the consultation included: • Notice of Consultation with Tiwi Island People • Agenda for Tiwi Islands June Consultation Sessions • NOPSEMA Consultation on Offshore Petroleum Environment Plans: Information for the Community • Barossa Gas Project FAQs document • SURF Fact Sheet • SURF Activity Information Booklet • Map of the SURF EMBA • SURF and Moorings Installation Activity Overview
92.	14 June 2023 at 1.00pm	Consultation session with Jikilaruwu clan	Tiwi Islands Engagement and Consultation regarding the SURF EP with Wulirankuwu, Yimpinari, Munupi, Mantiyupwi, Jikilaruwu, Wurankuwu, Malawu clans at Wurrumiyanga (Mantiyupwi Motel) (Bathurst Island). Consultation conducted pursuant to agreed script, prepared by Santos, and directed by PowerPoint presentation, prepared by Santos. Various video explanations played and discussed. A qualified interpreter from the AIS was present. 126 clan members attended this session, from the following clans: • Wulirankuwu – 8 • Yimpinari – 5 • Manupi – 6 • Mantiyupwi – 7 • Jikilaruwu – 80 • Wurankuwu – 3 • Malawu – 17 Documents circulated at the consultation included:

No.	Date	Action	Summary of Action
			• Notice of Consultation with Tiwi Island People • Agenda for Tiwi Islands June Consultation Sessions • NOPSEMA Consultation on Offshore Petroleum Environment Plans: Information for the Community • Barossa Gas Project FAQs document • SURF Fact Sheet • SURF Activity Information Booklet • Map of the SURF EMBA • SURF and Moorings Installation Activity Overview
93.	14 June 2023	Advertising	The following advertisements were published: • a half page advertisement in the Australian Financial Review regarding the SURF EP; and • a half page advertisement in the NT News regarding the SURF EP.
94.	15 June 2023 at 10.30am	Consultation session with Wurankuwu clan	Tiwi Islands Engagement and Consultation regarding the SURF EP with Wulirankuwu, Marrikawuyanga, Yimpinari, Munupi, Mantiyupwi, Jikilaruwu, Wurankuwu, Malawu clans at Wurrumiyanga (Mantiyupwi Motel) (Bathurst Island). Consultation conducted pursuant to agreed script, prepared by Santos, and directed by PowerPoint presentation, prepared by Santos. Various video explanations played and discussed. A qualified interpreter from the AIS was present. 77 clan members attended this session, from the following clans: • Wulirankuwu – 3 • Marrikawuyanga – 1 • Yimpinari – 4 • Manupi – 3 • Mantiyupwi – 2 • Jikilaruwu – 11 • Wurankuwu – 22 • Malawu – 31 Documents circulated at the consultation included:

No.	Date	Action	Summary of Action
			• Notice of Consultation with Tiwi Island People • Agenda for Tiwi Islands June Consultation Sessions • NOPSEMA Consultation on Offshore Petroleum Environment Plans: Information for the Community • Barossa Gas Project FAQs document • SURF Fact Sheet • SURF Activity Information Booklet • Map of the SURF EMBA • SURF and Moorings Installation Activity Overview
95.	15 June 2023 at 1.00pm	Consultation session with Malawu clan	Tiwi Islands Engagement and Consultation regarding the SURF EP with Wulirankuwu, Munupi, Jikilaruwu, Wurankuwu, Malawu clans at Wurrumiyanga (Mantiyupwi Motel) (Bathurst Island). Consultation conducted pursuant to agreed script, prepared by Santos, and directed by PowerPoint presentation, prepared by Santos. Various video explanations played and discussed. A qualified interpreter from AIS was present. 84 clan members attended this session, from the following clans: • Wulirankuwu – 5 • Manupi – 4 • Jikilaruwu – 6 • Wurankuwu – 11 • Malawu – 58 Documents circulated at the consultation included: • Notice of Consultation with Tiwi Island People • Agenda for Tiwi Islands June Consultation Sessions • NOPSEMA Consultation on Offshore Petroleum Environment Plans: Information for the Community • Barossa Gas Project FAQs document • SURF Fact Sheet • SURF Activity Information Booklet • Map of the SURF EMBA • SURF and Moorings Installation Activity Overview

No.	Date	Action	Summary of Action
96.	15 June 2023	One-on-one discussions	Santos representatives also engaged in one-on-one discussions and discussions in small groups with attendees at the Wurankuwu and Malawu clan consultation sessions, which were separately noted by Santos. Santos has records of two such discussions.
97.	16 June 2023 at 11.00am	Consultation session with Munupi clan	Tiwi Islands Engagement and Consultation regarding the SURF EP with Wulirankuwu, Yimpinari, Munupi, Mantiyupwi, Jikilaruwu, Wurankuwu, Malawu at Pirlangimpi (Pirlangimpi Sports and Social Club) (Melville Island). Consultation conducted pursuant to agreed script, prepared by Santos, and directed by PowerPoint presentation, prepared by Santos. Various video explanations played and discussed. A qualified interpreter from the AIS was present. 140 clan members attended this session, from the following clans: • Wulirankuwu – 4 • Yimpinari – 3 • Manupi – 110 • Mantiyupwi – 6 • Jikilaruwu – 2 • Wurankuwu – 6 • Malawu – 9 Documents circulated at the consultation included: • Notice of Consultation with Tiwi Island People • Agenda for Tiwi Islands June Consultation Sessions • NOPSEMA Consultation on Offshore Petroleum Environment Plans: Information for the Community • Barossa Gas Project FAQs document • SURF Fact Sheet • SURF Activity Information Booklet • Map of the SURF EMBA • SURF and Moorings Installation Activity Overview
98.	16 June 2023	One-on-one discussions	A Santos representative also engaged in one-on-one discussions and discussions in small groups with attendees at the Munupi clan consultation session, which is separately noted by Santos.

No.	Date	Action	Summary of Action
99.	16 June 2023 (until 14 July 2023)	Advertising	Radio ads were broadcasted from 16 June until 14 July 2023 regarding the SURF EP on metro stations in Sydney, Melbourne, Brisbane, Adelaide, Darwin and Perth as well as by the Top End Aboriginal Bush Broadcasting Association.
100.	17 June 2023	Advertising	The following advertisements were published: • a half page advertisement in The West Australian regarding the SURF EP; and • a half page advertisement in The Australian regarding the SURF EP.
101.	19 June 2023 (every weekday through to 14 July 2023)	Advertising	National radio advertisements regarding SURF relevant persons broadcasted.
102.	19 June 2023	Advertising	A half page advertisement was published in the Australian Financial Review regarding the SURF EP.
103.	20 June 2023 (live until 14 July 2023)	Social Media Engagement	Santos social media advertisement published on Facebook, Instagram, and Messenger, with target location Western Australia and Northern Territory. The advertisement asked that recipients who consider they may be a relevant person in relation to the SURF EP to contact Santos by 14 July 2023 and provides contact information.
104.	21 June 2023	Advertising	A half page advertisement was published in NT News regarding the SURF EP.
105.	22 June 2023	Advertising	A full page advertisement was published in NT News regarding Tiwi Islands July consultation sessions.
106.	23 June 2023	Santos email consultation	Santos sent an email to the Tiwi Land Council containing the SURF Fact Sheet and SURF Activity Information Booklet.
107.	24 June 2023	Advertising	The following advertisements were published: • a half page advertisement in The West Australian regarding the SURF EP; and • a half page advertisement in The Australian regarding the SURF EP.
108.	26 June 2023	Advertising	A half page advertisement in the Australian Financial Review regarding the SURF EP.
109.	28 June 2023	Advertising	A half page advertisement was published in NT News regarding the SURF EP.
110.	1 July 2023	Advertising	The following advertisements were published: • a half page advertisement in The West Australian regarding the SURF EP; and • a half page advertisement in The Australian regarding the SURF EP.

No.	Date	Action	Summary of Action
111.	1 July 2023	Advertising	A full page advertisement was published in NT News regarding Tiwi Islands July consultation sessions.
112.	3 July 2023	Advertising	A half page advertisement was published in the Australian Financial Review regarding the SURF EP.
113.	5 July 2023	Advertising	A half page advertisement was published in NT News regarding the SURF EP.
114.	6 July 2023	Advertising	A half page advertisement was published in NT News regarding Darwin drop-in sessions.
115.	7 July 2023 (until 17 July 2023)	Advertising	Radio ads broadcasted from 7 July until 17 July 2023 in Darwin regarding Darwin drop-in sessions.
116.	8 July 2023	Advertising	The following advertisements were published: a half page advertisement in The West Australian regarding the SURF EP; and a half page advertisement in The Australian regarding the SURF EP.
117.	8 July 2023	Advertising	A full page advertisement was published in NT News regarding Tiwi Islands July consultation sessions.
118.	10 July 2023	Advertising	A half page advertisement was published in the Australian Financial Review regarding the SURF EP.
119.	10 July 2023	Advertising	A half page advertisement was published in NT News regarding Darwin drop-in sessions.
120.	10 July 2023 (live until 17 July 2023)	Social Media Engagement	Santos social media advertisement published on Facebook, Instagram, and Messenger, with target location Darwin. The advertisement advised of Darwin drop-in sessions.
121.	12 July 2023	Advertising	A half page advertisement was published in NT News regarding the SURF EP.
122.	13 July 2023	Advertising	A half page advertisement was published in NT News regarding Darwin drop-in sessions.
123.	17 July 2023	Darwin Drop-in Session	Santos hosted an open drop in consultation session at the Darwin Convention Centre. 7 people attended.
124.	17 July 2023	Advertising	A half page advertisement was published in NT News regarding Darwin drop-in sessions.
125.	17 July 2023 (live until 8 August 2023)	Social Media Engagement	Santos social media advertisement published on Facebook, Instagram, and Messenger, with target location Tiwi Islands. The advertisement advised of Tiwi Islands July consultation sessions.
126.	18 July 2023	Advertising	A full page advertisement was published in NT News regarding Tiwi Islands July consultation sessions.

No.	Date	Action	Summary of Action
127.	18 July 2023 (live until 4 August 2023)	Social Media Engagement	Santos social media advertisement published on Facebook, Instagram, and Messenger, with target location Australia. The advertisement concerned the SURF EP.
128.	19 July 2023	Advertising	A half page advertisement was published in NT News regarding the SURF EP.
129.	19 July 2023 (until 4 August 2023)	Advertising	Radio ads were broadcasted from 19 July until 4 August 2023 regarding the SURF EP on metro stations in Sydney, Melbourne, Brisbane, Adelaide, Darwin and Perth as well as by the Top End Aboriginal Bush Broadcasting Association.
130.	21 July 2023	Advertising	A half page advertisement was published in the Australian Financial Review regarding the SURF EP.
131.	22 July 2023	Advertising	The following advertisements were published: • a half page advertisement in The West Australian regarding the SURF EP; and • a half page advertisement in The Australian regarding the SURF EP.
132.	22 July 2023	Advertising	A full page advertisement was published in NT News regarding Tiwi Islands July consultation sessions.
133.	24 July 2023	Advertising	A half page advertisement was published in the Australian Financial Review regarding the SURF EP.
134.	25 July 2023	Advertising	A half page advertisement was published in National Indigenous Times regarding the SURF EP.
135.	26 July 2023	Advertising	A half page advertisement was published in NT News regarding the SURF EP.
136.	27 – 29 July 2023	NT Community Engagement Sessions	Santos hosted a stall at Royal Show Circuit in Darwin. Santos representatives provided materials related to the SURF activities to attendees.
137.	29 July 2023	Advertising	The following advertisements were published: • a half page advertisement in The West Australian regarding the SURF EP; and • a half page advertisement in The Australian regarding the SURF EP.
138.	31 July 2023	Advertising	A half page advertisement was published in the Australian Financial Review regarding the SURF EP.
139.	2 August 2023	Engagement with Tiwi Resources re Tiwi Islands consultation	Santos contacted Tiwi Resources to query whether, in light of the voluntary combining of clans, certain clans would consent to being consulted with in combined sessions, with specific clan combinations proposed as below:

No.	Date	Action	Summary of Action
			• Marrikawuyanga & Yimpinari Clans (8 August 2023) • Mantiyupwi & Jikilaruwu Clans (9 August 2023) • Wurankuwu & Malawu Clans (9 August 2023) It was proposed that the Wulirankuwu and Munupi clans would be consulted in separate sessions, one for each held on 8 August and 10 August, respectively.
140.	2 August 2023	Advertising	A half page advertisement was published in NT News regarding the SURF EP.
141.	3 August 2023	Engagement with Tiwi Resources re Tiwi Islands consultation	Tiwi Resources confirmed that the clans were "happy to have joint meetings" in relation to the consultation sessions held by Santos concerning the SURF EP.
142.	3 August	Engagement with Tiwi Resources re Tiwi Islands consultation	Tiwi Resources contacted Santos to advised that the Trustee for the Munupi clan had asked for the proposed consultation with than clan on 10 August 2023 not proceed because of a recent death in the community.
143.	3 August 2023	Consultation Notification	A Notice of Consultation with the Tiwi Islands People was issued on 3 August. This notice contained details of consultations planned with Tiwi Islands clans on 8-9 August 2023. The notice also contained the following language with respect to consultation with the Munupi clan: "*The Munupi Clan meeting remains on hold due to Sorry Business and alternative arrangement will be made at an appropriate time. In the meantime, outstanding feedback for the SURF Environment Plan can continue to be provided via offshore.consultation@santos.com or 1800 267 600.*".
144.	5 August 2023	Advertising	A full page advertisement was published in NT News regarding Tiwi Islands July consultation sessions.
145.	7 August 2023	Advertising	A full page advertisement was published in NT News regarding Tiwi Islands July consultation sessions.
146.	8 August	Consultation session with the Marrikawauyanga and Yimpinari Clans	Tiwi Islands Engagement and Consultation regarding the SURF EP with Marrikawauyanga and Yimpinari Clans at the Milikapiti Sports and Recreation Centre, Milikapiti. The session was scheduled for 10:30am and commenced around this time. Consultation conducted pursuant to agreed script, prepared by Santos, and directed by PowerPoint presentation, prepared by Santos. Various video explanations played and discussed. A qualified interpreter from the AIS was present.

No.	Date	Action	Summary of Action
			90 clan members attended this session, from the following clans: • Wulirankuwu – 20 • Yimpinari – 35 • Munupi – 12 • Mantiyupwi – 9 • Jikilaruwu – 1 • Malawu – 11 • Mirrakawayanga – 2 Documents circulated at the consultation included: • Notice of Consultation with Tiwi Island People • Agenda for Tiwi Islands August Consultation Sessions • NOPSEMA Consultation on Offshore Petroleum Environment Plans: Information for the Community • Barossa Gas Project FAQs document • SURF Fact Sheet • SURF Activity Information Booklet • Map of the SURF EMBA • SURF and Moorings Installation Activity Overview • SURF consultations feedback document
147.	8 August 2023	Consultation session with the Wulirankuwu and Malawu	Tiwi Islands Engagement and Consultation regarding the SURF EP with the Wulirankuwu and Malawu at the Milikapiti Sports and Recreation Centre, Milikapiti. The session was scheduled for 1pm and commenced around this time. Consultation conducted pursuant to agreed script, prepared by Santos, and directed by PowerPoint presentation, prepared by Santos. Various video explanations played and discussed. A qualified interpreter from the AIS was present. 86 clan members attended this session, from the following clans:

No.	Date	Action	Summary of Action
			• Wulirankuwu – 20 • Yimpinari – 21 • Munupi – 27 • Mantiyupwi – 9 • Jikilaruwu – 1 • Malawu – 6 • Mirrakawayanga – 2 Documents circulated at the consultation included: • Notice of Consultation with Tiwi Island People • Agenda for Tiwi Islands August Consultation Sessions • NOPSEMA Consultation on Offshore Petroleum Environment Plans: Information for the Community • Barossa Gas Project FAQs document • SURF Fact Sheet • SURF Activity Information Booklet • Map of the SURF EMBA • SURF and Moorings Installation Activity Overview • SURF consultations feedback document
148.	9 August 2023	Consultation session with the Mantiyupwi and Jikilaruwu Clans	Tiwi Islands Engagement and Consultation regarding the SURF EP with the Mantiyupwi and Jikilaruwu Clans at the Mantiyupwi Motel, Wurrumiyanga. The session was scheduled for 10:30am and commenced around this time. Consultation conducted pursuant to agreed script, prepared by Santos, and directed by PowerPoint presentation, prepared by Santos. Various video explanations played and discussed. A qualified interpreter from the AIS was present. 133 clan members attended this session, from the following clans:

No.	Date	Action	Summary of Action
			• Wulirankuwu – 13 • Yimpinari – 5 • Manupi – 9 • Mantiyupwi – 24 • Jikilaruwu – 67 • Wurankuwu – 2 • Malawu – 13 Documents circulated at the consultation included: • Notice of Consultation with Tiwi Island People • Agenda for Tiwi Islands August Consultation Sessions • NOPSEMA Consultation on Offshore Petroleum Environment Plans: Information for the Community • Barossa Gas Project FAQs document • SURF Fact Sheet • SURF Activity Information Booklet • Map of the SURF EMBA • SURF and Moorings Installation Activity Overview • SURF consultations feedback document
149.	9 August 2023	Consultation session with the Wurankuwu and Malawu Clans	Tiwi Islands Engagement and Consultation regarding the SURF EP with the Wurankuwu and Malawu Clans at the Mantiyupwi Motel, Wurrumiyanga. The session was scheduled for 1pm and commenced around this time. Consultation conducted pursuant to agreed script, prepared by Santos, and directed by PowerPoint presentation, prepared by Santos. Various video explanations played and discussed. A qualified interpreter from the AIS was present. 219 clan members attended this session, from the following clans:

No.	Date	Action	Summary of Action
			• Wulirankuwu – 11 • Yimpinari – 6 • Manupi – 2 • Mantiyupwi – 15 • Jikilaruwu – 26 • Wurankuwu – 57 • Malawu – 102 Documents circulated at the consultation included: • Notice of Consultation with Tiwi Island People • Agenda for Tiwi Islands August Consultation Sessions • NOPSEMA Consultation on Offshore Petroleum Environment Plans: Information for the Community • Barossa Gas Project FAQs document • SURF Fact Sheet • SURF Activity Information Booklet • Map of the SURF EMBA • SURF and Moorings Installation Activity Overview • SURF consultations feedback document
150.	9 August 2023	Darwin Community Engagement Session	Santos hosted pop-up stall at Arts in the Grass, Darwin. Approximately 15 people attended.
151.	24 August 2023	Consultation with the Munupi Clan	Santos (via Tiwi Resources) posted a flyer on the Pirlangimpi community notice board requesting final feedback from members of the Munupi clan on SURF activities by 31 August 2023. Also posted alongside the flyer was the SURF EP consultations feedback document (as presented during SURF consultations with other clans).

Appendix H Maritime archaeology heritage assessment

COSMOS ARCHAEOLOGY

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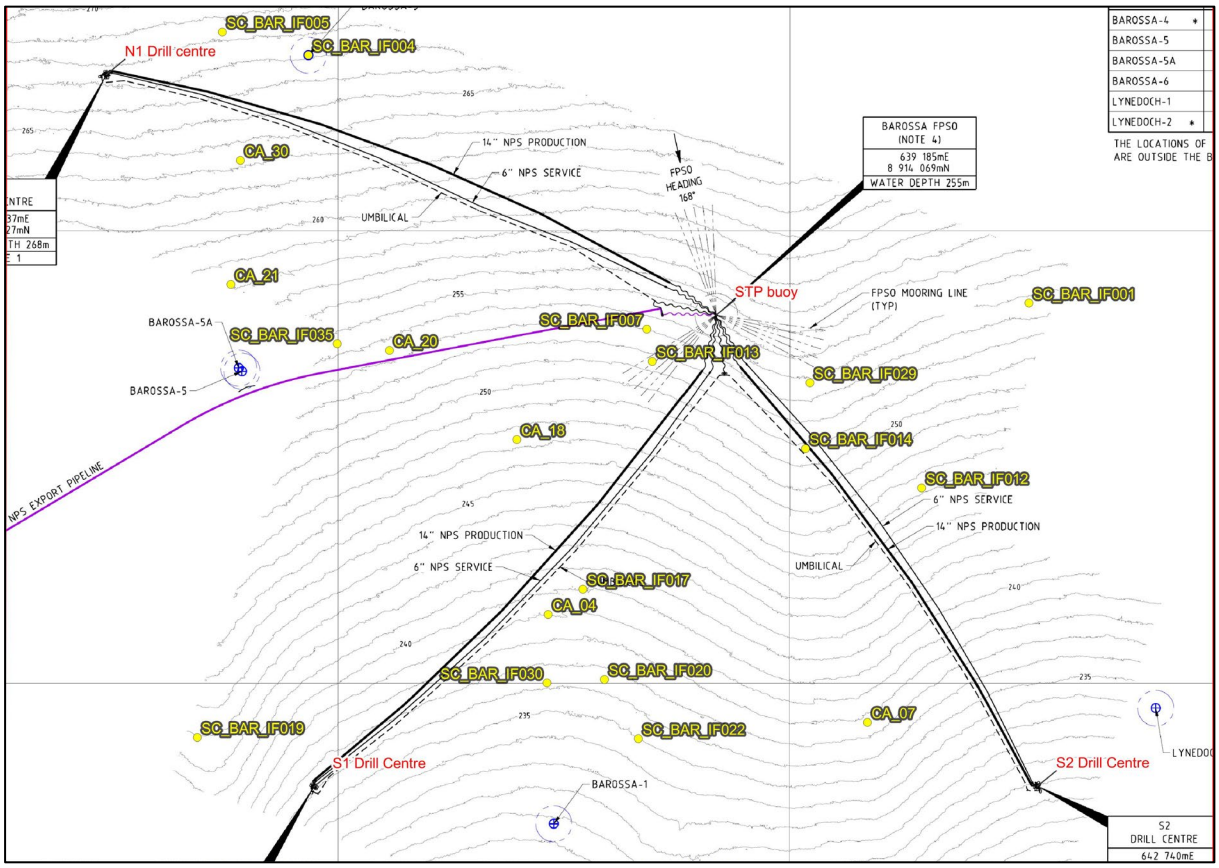
A.B.N. 83 082 211 498

Santos (Barossa)
Offshore Development

Infield Infrastructure



Maritime Heritage Assessment

Timor Sea
Northern Territory

BAS-210 0058

January 2023

Santos (Barossa) Offshore Development

Infield Infrastructure

Maritime Heritage Assessment

Prepared for:
Santos Ltd

By:
Connor McBrian
Caroline Wilby

January 2023

Cosmos Archaeology Job Number J21/22d

Cover image: **Geophysical survey anomalies and proposed subsea infrastructure.**

Revision	Description	Date	Originator	Reviewer	Approver
V0	Draft Report	19/10/2022	CM	CC	CC
V0.1	Inclusion of detailed proposed works	01/11/2022	CM	CC	CC
V0.2	Only relevant works assessed	03/11/2022	CM	CC	CC
V1	Client comments addressed	07/12/2022	CM	CC	CC
V2	Final draft	31/01/2023	CM	CC	CC

EXECUTIVE SUMMARY

Santos Pty Ltd is proposing to install a gas export pipeline (GEP) off the northwest coast of the Northern Territory (NT). The proposed GEP begins at the Barossa gas field, north of the Tiwi Islands, and extends south to feed the Darwin LNG, located in Middle Arm, Darwin Harbour. The first proposed route is a GEP from the Barossa gas field to a pipeline end termination (PLET) close to the existing Bayu-Undan to Darwin pipeline southwest of Bathurst Island. The second proposal is to extend the GEP from the PLET to the Darwin LNG. This maritime archaeological heritage assessment (MAHA) examines the installation of extraction infrastructure in the infield area. Separate reports have been prepared for the two GEP proposals.

A review of historical sources, databases and marine geophysical information has found that the waters within the study area may have been visited over the past four hundred years by Dutch explorers and traders, Macassan trepang traders, British explorers and attempted settlers, and Japanese pearling fleets. The waters of the Timor Sea, in the general vicinity of the study area, saw significant military action during World War II, which including the sinking of numerous ships and aircraft within the Timor Sea.

There are no located shipwrecks, aircraft wrecks, dump sites, maritime infrastructure, or UXO within the study area. The closest shipwreck, the SS *Florence D*, is located approximately 148 km south from the study area. There is one unlocated shipwreck recorded to have wrecked within the vicinity of the study area, a modern Indonesian fishing vessel sunk in 1997. There are ten unlocated aircraft wrecks in the Timor Sea that could potentially occur within the study area based on historical accounts of the wreck event and general wreck location. All ten aircraft wrecks are associated with Japanese and Australian air forces during WWII.

The remains of these aircraft, along with their contents and fittings, if located in the study area, would be automatically protected under the Cwlth *Underwater Cultural Heritage Act 2018*. The modern Indonesian wreck would not be automatically protected under State or Commonwealth legislation.

Side scan sonar data and MBES data from marine geophysical surveys conducted in 2018 were reviewed and no clear evidence of the presence of a shipwreck or aircraft wreck within the study area was identified. Nineteen sonar contacts or anomalies were identified by CA as being potentially cultural. These anomalies could be natural features, debris fields or isolated instances of debris and/or discard. A visual survey would be the best means to determine their nature.

Two anomalies are located within 50 m of proposed infrastructure locations: target SC_BAR_IF013, located 15 m from the FPSO mooring line, and target SC_BAR_IF014, located 39 m from the S2 production line between KP 4 and 5. Both targets appear to potentially be isolated debris, and are designated Category B. Therefore, infrastructure installation is not believed to be likely to impact any of the targeted geophysical survey anomalies.

The marine geophysical data provided by Santos was obtained by Multibeam Echo Sounder and Side Scan Sonar, used to identify features on the seabed. Magnetometer data, used to detect the presence of ferrous objects on the seabed, was not collected and provided for this assessment. The high quality and coverage of these datasets were sufficient for the purposes of identifying potential cultural heritage targets, however, the lack of magnetometer data is a limitation to this assessment. Because of this limitation a conservative approach was taken in defining the potential heritage significance of identified anomalies.

In the unlikely event of maritime archaeological remains being discovered within the infrastructure installation area during the construction phase an Unexpected Maritime Archaeological Finds Protocol to responsibly manage such finds has been prepared in addition to this report.

Based on the findings above the recommendations made in this report are as follows:

Recommendation 1 ***Review of this report should the design placement of proposed infrastructure change.***

Recommendation 2 ***If additional remote sensing data is collected for the proposed subsea infrastructure, it should be reviewed by a qualified maritime archaeologist***

Recommendation 3 ***Vessels anchoring as part of the proposed works should avoid placing anchors where they may impact any unverified geophysical survey anomalies.***

Recommendation 4 ***Prepare and implement an Unexpected Maritime Archaeological Finds Protocol.***

TABLE OF CONTENTS

Abbreviations

AHS SD	Australian Hydrographic Service Sea Dumping Database
AUCHD	Australasian Underwater Cultural Heritage Database
CA	Cosmos Archaeology Pty Ltd
DLNG	Darwin Liquified Natural Gas plant (Wickham Point)
DPD	Direct pipeline
FLET	flowline end termination
FPSO	Floating, production, storage and offloading (vessel)
GEP	gas export pipeline
GPS	global positioning system
IJNAF	Imperial Japanese Navy Air Force
IJN	Imperial Japanese Navy
.kmz	keyhole markup file
MHA	maritime heritage assessment
MBES	multi-beam echosounder
NT	Northern Territory
PLET	Pipeline end termination
RAAF	Royal Australian Air Force
ROV	remotely operated underwater vehicle
SMCA	USA *Sunken Military Craft Act 2004*
SSS	side scan sonar
STP	Submerged turret production (buoy)
UCH	underwater cultural heritage
UCHA	Cwth *Underwater Cultural Heritage Act 2018*
USAAF	United States Army Air Force
USN	United States Navy
UTA	Umbilical termination assembly
UXO	unexploded ordnance
WWII	World War II

1 INTRODUCTION

1.1 Background

Cosmos Archaeology (CA) has been commissioned by Santos Pty Ltd to undertake a maritime heritage assessment (MHA) for the proposed installation of subsea infrastructure and moorings for a floating, production, storage, and offloading (FPSO) vessel within the Barossa Development.

The Barossa Development is an offshore natural gas development located approximately 300 km northwest of Darwin and will backfill gas supply to the existing Darwin LNG facility at Wickham Point (Figure 1). The initial development involves producing natural gas and condensate from the Barossa Field through subsea wells and a network of subsea flowlines and marine risers to a FPSO vessel. Gas will be transported from the FPSO to the DLNG facility via a new 262 km Barossa Gas Export Pipeline (GEP) and directly to the DLNG through a direct pipeline (DPD) through Beagle Gulf and Darwin Harbour.

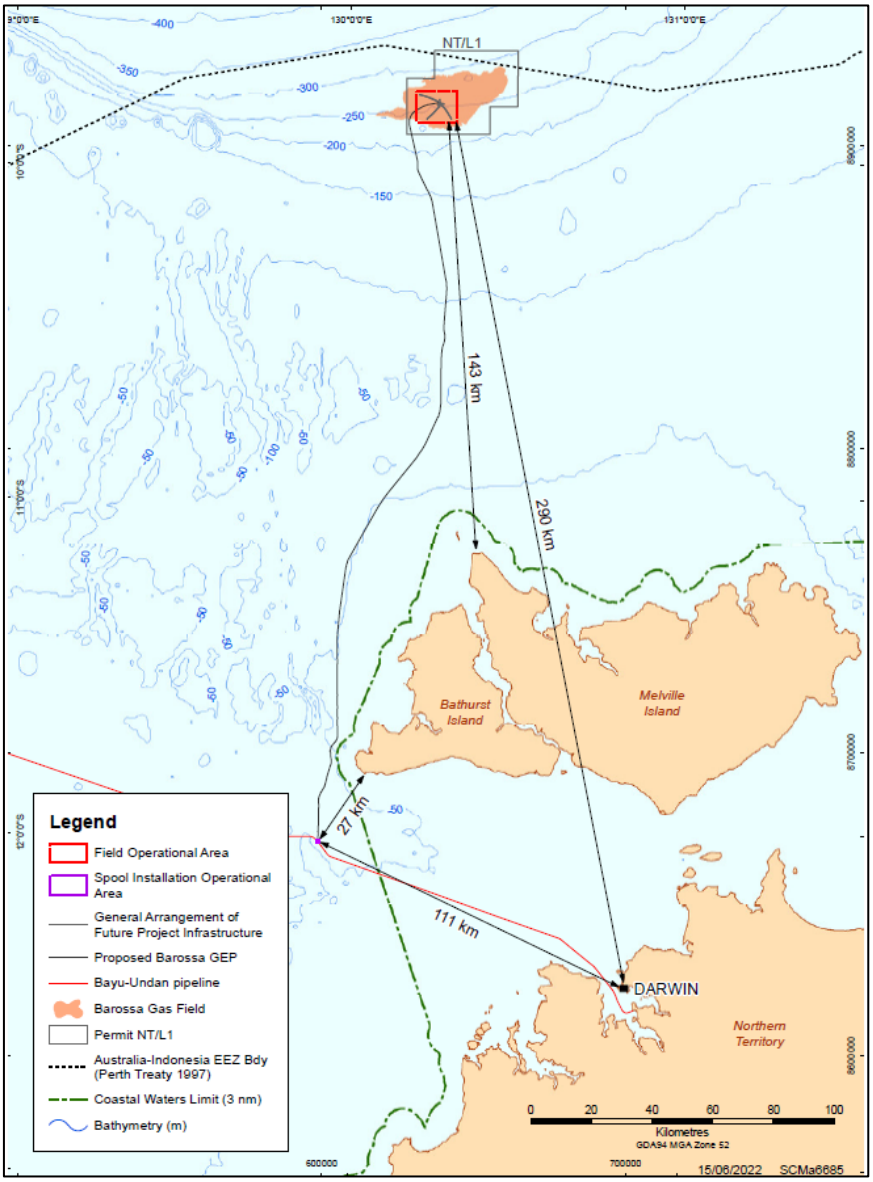


Figure 1: Barossa Development location, in relation to Darwin and the existing Bayu-Undan GEP.

The field operational area for this project is defined as a zone of approximately 134 km² within which all activities within the Barossa Field will take place (Figure 2). Infrastructure for installation will include (Figure 3):

1. Fifteen suction anchors with mooring chains, sheathed wires and mooring line buoyancy elements for floating FPSO mooring;
2. STP buoy for securement of the FPSO mooring lines and connection of the risers;
3. Three 14” and three 6” corrosion resistant alloy rigid flowlines with a nominal length of 19 km;
4. Flowline end terminations (FLETs) at the end of each flowline;
5. Displacement initiator structures along the flowline routes to control lateral bucking in operation;
6. Four manifolds;
7. 6” and 12” risers and riser tether base structures;
8. Umbilicals with UTA;
9. Spools and well jumpers;
10. Steel tube, optical and electrical flying leads;
11. Subsea support structures (flowline walking mitigation, support mattresses, scour protection, stabilisation, foundations).

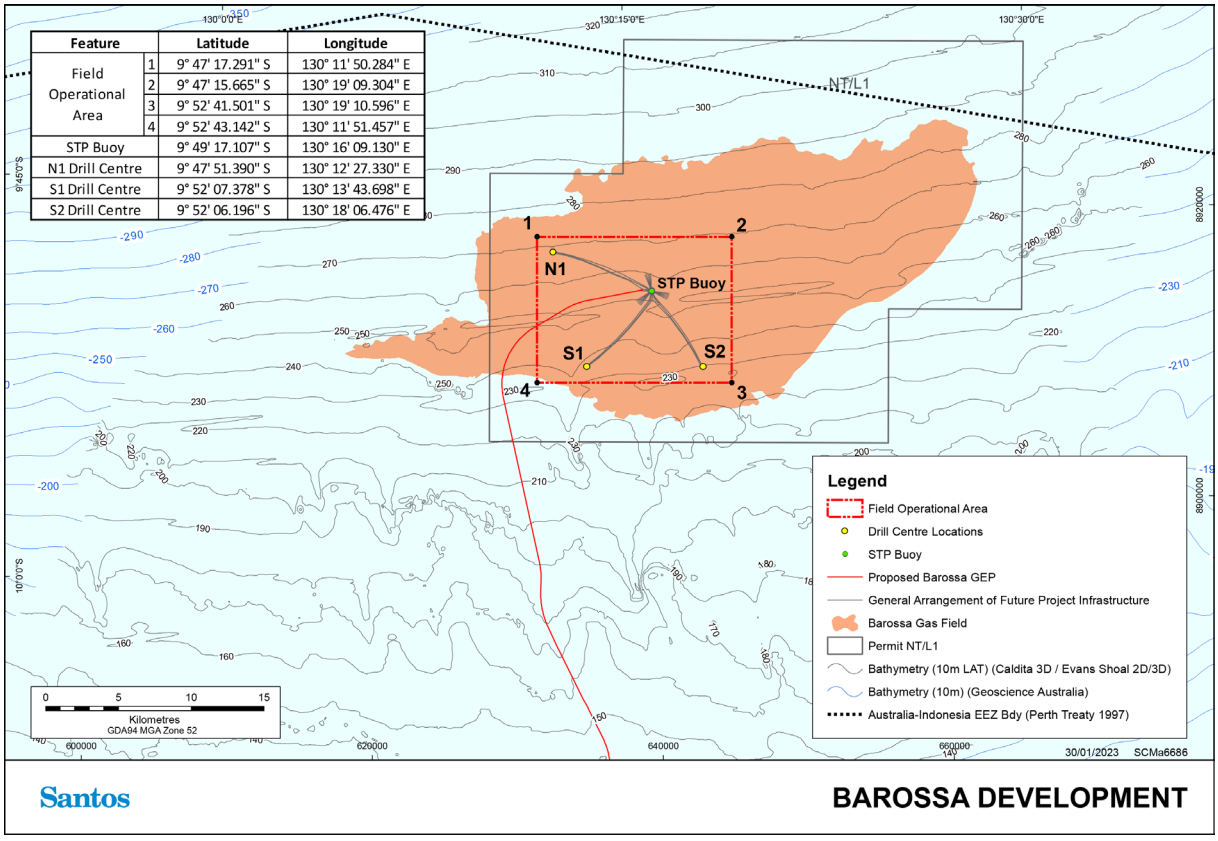


Figure 2: Location detail of the field operational area and spool operational area, including location of infrastructure installation and general arrangement of future project infrastructure.

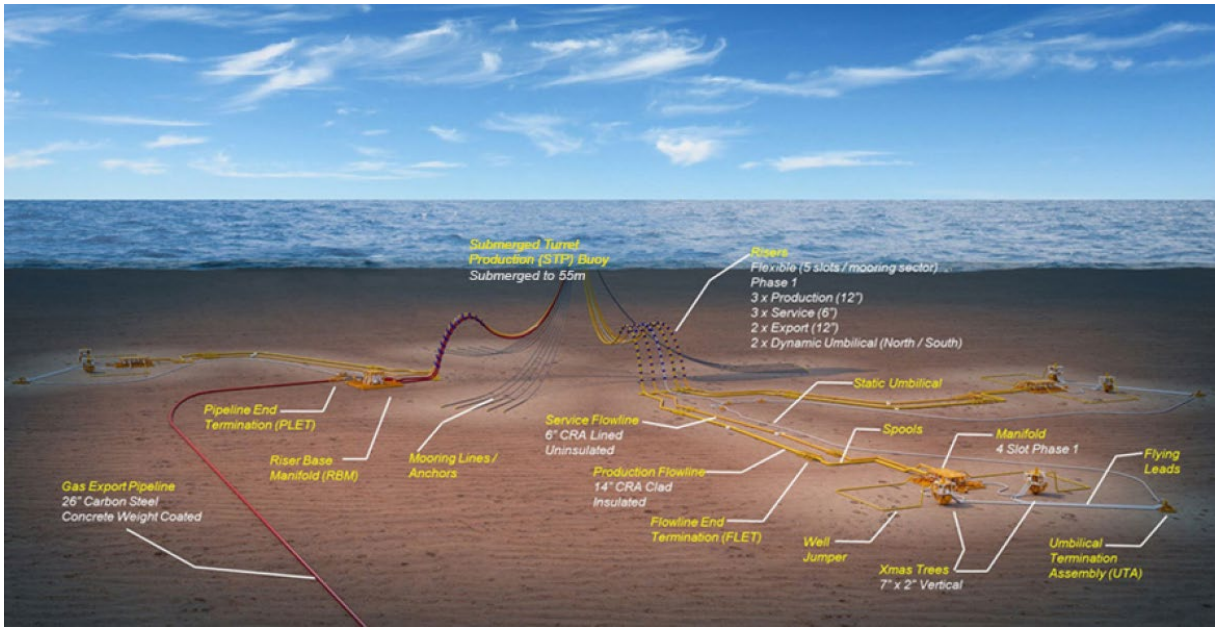


Figure 3: Indicative layout for subsea infrastructure and FPSO moorings installation.

This MHA assesses only the proposed subsea infrastructure within the Barossa Development area. CA has prepared separate MHAs for both GEP proposals as well.[1]

1.2 The Maritime Archaeological Study Area

A project survey area has been provided by Santos Pty Ltd. This area has been subject to a geophysical survey, which will be discussed further in Section 6. The survey area consists of a buffer of variable width covering the locations of the proposed drill centre locations and STP buoy mooring, as well as the future project infrastructure. The maritime archaeological study area defined by CA for this report is larger than the project survey area and encompasses a 1000 m buffer around the field operational area (Figure 4). This is because the exact positions of many of the documented shipwrecks and aircraft wrecks in the Timor Sea are not known, and some could potentially be located within a wider area. Historical or estimated positions for some wrecks could have a margin of error of a few kilometres.

The coordinates for the survey area were provided by Santos in the geophysical survey report for the Barossa Project infield area.[2] Locations for the proposed subsea infrastructure, FPSO moorings installation, and the field operational area were provided by Santos in a separate document.[3] Geophysical survey and bathymetry data was collected by DOF Subsea in 2018 and was provided as geotiff and shapefiles.

[1] **Cosmos Archaeology, 2022a,** *Santos (Barossa) Gas Export Pipeline, Original Barossa GEP Stage (Timor Sea and Tiwi Islands): Maritime Heritage Assessment,* report prepared for Santos Pty Ltd; **Cosmos Archaeology, 2022b,** *Santos (Barossa) Gas Export Pipeline, Additional and Nearshore Barossa GEP Stage (Beagle Gulf and Darwin Harbour): Maritime Heritage Assessment,* report prepared for Santos Pty Ltd.
[2] **DOF Subsea, 2018,** Barossa Project: Geophysical Survey Report – Infield Area, report provided for Santos Pty Ltd.
[3] **Santos, 2022,** *Stakeholder Consultation, Barossa Development: Subsea Infrastructure and FPSO Moorings Installation and Pre-Commissioning Environment Plan.*

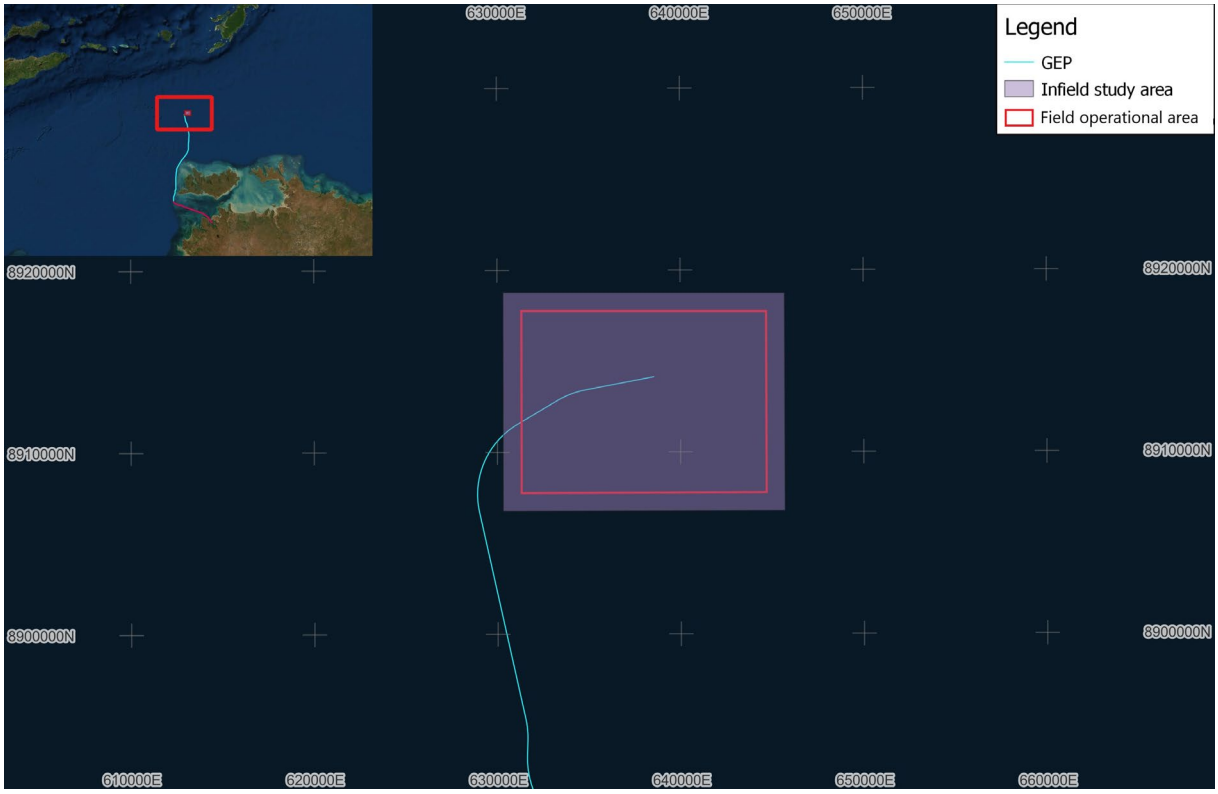


Figure 4: Location of study area, field operational area, and proposed GEP route.

1.3 Scope of the Study

This study addresses the *Archaeological Scope of Works for the GEP Barossa Gas Field to Middle Arm, Darwin Harbour*, prepared by the NT Heritage Branch in November 2021 and includes the following:

- Provide a list of located and potential maritime archaeological sites (including shipwrecks, aircraft wrecks and dump sites) known to be, or possibly located, within the study area
- Provide an outline of potential impacts from the subsea infrastructure installation.
- Provide a description of the different types of potential maritime archaeological sites on the seabed.
- Provide an expert analysis of geophysical survey data in regards to anomalies indicating potential maritime archaeological remains.
- Review of relevant legislative requirements.
- Provide mitigation measures for potential impacts on maritime archaeological remains.

This study examines maritime archaeological sites which are defined as wrecks (ship or aircraft) and associated material, dumped material, maritime infrastructure, and associated deposits on or under the seabed below the highest astronomical tide. This report addresses only the potential cultural heritage aspects of dumped and spent munitions and should not be considered a UXO assessment.

Assessment of archaeological potential for Aboriginal cultural heritage and submerged terrestrial sites is not addressed within the scope of this report.

2 METHODOLOGY

2.1 Sources consulted

This desktop study has used various sources to prepare a list of known and potential shipwrecks, as well as other maritime archaeological sites in the study area (Table 1). Research is confined to what is available online and in the consultant's extensive library. Additionally, the NT Heritage Branch has been directly consulted for the location of sites which may not be publicly available.

Table 1: Historic resources consulted in this report.

Source	Description
Australasian Underwater Cultural Heritage Database (AUCHD)	The Australasian Underwater Cultural Heritage Database, maintained by the Commonwealth Department of Agriculture, Water and the Environment, is an online database of known and potential shipwrecks, aircraft wrecks and other maritime heritage sites and objects in Australian and Commonwealth waters.
Australian Government Department of Defence and Australia Hydrographic Service – Sea Dumping in Australia (AHS SD)	This database of sea dumping sites is managed by the Australian Government Department of Defence with information supplied by the Australian Hydrographic Service. http://www.hydro.gov.au/n2m/dumping/dumping.htm
NT Heritage Branch	Direct consultation with the NT Heritage Branch to determine the location of located heritage sites within the study area. *Email received from Heritage Branch on 28/3/2022 with recommendations for potential heritage items that might be located within study area.
Archival sources and heritage reports	A review of a wide range of primary and secondary historical sources held by NT Library and Archives, the National Library of Australia, the National Archives of Australia, and various published and unpublished heritage reports and articles was undertaken.
Previous reports completed by Cosmos Archaeology	A review of reports on projects Cosmos Archaeology has conducted within the NT in Darwin Harbour and surrounds.

In addition to the heritage inventories, databases, historical resources, and previous reports, a detailed review of available geophysical survey data was also conducted. Section 7 details the results of the geophysical survey review and includes a table of targets identified to be potentially cultural in origin.

2.2 General statements on site locations

Few of the known and potential maritime archaeological sites presented in this study have accurate positions. This is because most of the shipwrecks and aircraft wrecks potentially situated in the study area have not been located and are known only from historical sources or heritage databases. Therefore, only broad areas within which they can be expected to be found can be presented with any confidence. As for the wrecks which have been located, designating accurate positions was not always possible as, in most cases, it is not known how their positions were recorded, such as with global positioning systems (GPS) or a compass/sextant. Furthermore, positions of known wrecks may have been taken off the charts and, therefore, reductions in precision due to plotting and scaling could be expected. Coordinates provided in some databases could also have been inferred from vague historical accounts which in fact could place the site within a relatively large area. This issue is proportionately compounded for sites that are lost at increasingly greater distances from the coast of Australia.

GPS coordinates have become increasingly reliable, but it must be noted that positions recorded with GPS in the 1980s to 1990s had accuracies of 100-300 metres. Those sites found and recorded by GPS closer to shore are likely to have had their location updated over time, but sites further from the coast and/or less accessible may still be listed with old and inaccurate coordinates. There are also different geodetic datums used by GPS units, but if datum is not recorded with the coordinates this can lead to errors when using the same coordinates with a different datum. User error can also occur when a recorder, or someone copying the location records, interprets the coordinates in the wrong style; such as reading coordinates in degrees, minutes, seconds rather than degrees and decimal minutes for example. Based on these scenarios, it is safe to assume that there is always a degree of inaccuracy with the provision of site coordinates.

Australasian Underwater Cultural Heritage Database (AUCHD) [4]

Information presented in the AUCHD is compiled from each of the State and Territory historic shipwreck agencies or supplied by collecting institutions holding historic shipwreck objects. The integrity or source of the information held by these agencies is unknown. The size of the area in which an individual wreck could be found varies depending on the historical information available. Some wrecks which have been found have a latitude and longitude position, but the accuracy of that position could not be determined as the method used in obtaining the position is not known.

Department of Defence and Australian Hydrographic Service – Sea Dumping in Australia (AHS SD) [5]

The locations of sea dumped materials are provided by the Department of Defence Australian Hydrographic Service. Dumped materials of heritage value can include abandoned vessels and historic munitions, such as WWII-era aircraft components and Lend-Lease material.[6] It is unclear where the Australian Hydrographic Service obtained the positions of the dumped materials. It is important to note that these locations are where the materials were designated to be dumped, but it has been found that those dumping the materials may not have been particular about the final location. An example of this was identified in a previous CA study that found the Narrabeen Dumping Ground, Sydney (a ships graveyard), despite having a high concentration of wrecks within its boundary, also had a dense concentration of sites between four to five kilometres to the east, outside of the designated dumping area.[7]

[4] **Department of Agriculture, Water and the Environment, 2020**, *Australasian Underwater Cultural Heritage Database*, available at https://www.environment.gov.au/heritage/underwater-heritage/auchd
[5] **Department of Defence and Australian Hydrographic Service, 2020**, *Sea Dumping in Australia*, available at http://www.hydro.gov.au/n2m/dumping/dumping.htm
[6] **Cosmos Archaeology, 2014,** INPEX Ichthys LNG Project : Nearshore Development – Dredging. East Arm, Darwin Harbour, Northern Territory. Relocation of Heritage Objects and Removal of debris. Prepared for Tek Ventures Pty Ltd
[7] **Cosmos Archaeology, 2007b,** Submarine Cable System, Landfall Option – Collaroy: Underwater Heritage Impact Assessment Baseline Review, report prepared for Patterson Britton and Partners.

3 LEGISLATION

The proposed subsea infrastructure is located Australian territorial waters and is subject to the Commonwealth *Underwater Cultural Heritage Act 2018*, administered by the Australian Government Department of Agriculture, Water and the Environment (DAWE).

3.1 Commonwealth *Underwater Cultural Heritage Act 2018*

The Commonwealth *Underwater Cultural Heritage* (UCH) *Act 2018* (replacing the *Historic Shipwrecks Act 1976*) provides for the protection, conservation, and management of Australia's historic shipwrecks, sunken aircraft, and other types of underwater cultural heritage. The Act is also designed to enable the cooperative implementation of national and international maritime heritage responsibilities, and to promote public awareness, understanding, appreciation, and appropriate use of Australia's underwater cultural heritage.

Under Part 1, Division 2 of the *UCH Act 2018*, underwater cultural heritage is defined as "any trace of human existence that has a cultural, historical or archaeological character; and is located under water." Traces of human existence are considered to be located under water whether they are located partially or totally under water, and whether they are under water periodically or continuously. A "trace of human existence" is further defined to include:

(a) sites, structures, buildings, artefacts and human and animal remains, together with their archaeological and natural context; and
(b) vessels, aircraft and other vehicles or any part thereof, together with their archaeological and natural context; and
(c) articles associated with vessels, aircraft or other vehicles, together with their archaeological and natural context.

Seabed pipelines and cables, and other installations that are placed on the seabed and are still in use, are not considered to be underwater cultural heritage under the Act.

Different articles of underwater cultural heritage are, or can be, protected under the *UCH Act 2018*, depending on the kinds of articles, their heritage significance, and their location. Part 2, Division 1 of the Act provides that certain articles of underwater cultural heritage are automatically protected, including:

(a) all remains of vessels that have been in Australian waters for at least 75 years;
(b) every article that is associated with a vessel, or the remains of a vessel, and that has been in Australian waters for at least 75 years;
(c) all remains of aircraft that have been in Commonwealth waters for at least 75 years;
(d) every article that is associated with an aircraft, or the remains of an aircraft, and that has been in Commonwealth waters for at least 75 years.

These articles of underwater cultural heritage are automatically protected whether or not the existence or location of the article is known, and even if the article is or has been removed from Australian or Commonwealth waters – after the passage of 75 years.

The term "associated with" is defined under Part 1, Division 2 of the Act whereby an article is considered to be associated with a vessel, aircraft, or other vehicle if the article:

(a) appears to have formed part of the vessel, aircraft or other vehicle; or
(b) appears to have been installed or carried on the vessel, aircraft or other vehicle; or
(c) is remains of humans or animals that appear to have been on board the vessel, aircraft or other vehicle; or
(d) appears to have been constructed or used by a person associated with a vessel.

"Australian waters" and "Commonwealth waters" have different meanings under the *UCH Act 2018* (Part 1, Division 2), whereby "Australian waters" extend from the seaward limits of a State to the outer limit of Australia's continental shelf, and "Commonwealth waters" extend from waters 3 nautical miles seaward of the Territorial Sea Baseline adjacent to the States

and the NT – i.e. beyond State or Territory coastal waters – to the outer limit of Australia's continental shelf. Specifically, under Part 1, Division 2 of the Act:

"Australian waters" means:

(a) any waters on the landward side of the territorial sea of Australia that are not within the limits of a State; and
(b) the territorial sea of Australia; and
(c) the sea above the continental shelf of Australia; and
(d) the seabed and subsoil beneath any such sea or waters.

"Commonwealth waters" means:

(a) the territorial sea of Australia, other than coastal waters of a State or the Northern Territory; and
(b) the sea above the continental shelf of Australia; and
(c) the seabed and subsoil beneath any such sea or waters.

The Territorial Sea Baseline generally corresponds with the low water line along the coast, measured to the level of Lowest Astronomical Tide. However, in some cases, straight baselines have been established in areas where the coastline is deeply indented and cut into, or where there is a fringe of islands along the coast in its immediate vicinity.

The Territorial Sea Baseline in the region of the current study area incorporates straight baselines that connect the mainland to the Tiwi Islands. As such, the Beagle Gulf forms part of the coastal waters of the NT – see Figure 5. Waters beyond this boundary of NT coastal waters to the outer limit of Australia's continental shelf are "Commonwealth waters" under the *UCH Act 2018.*

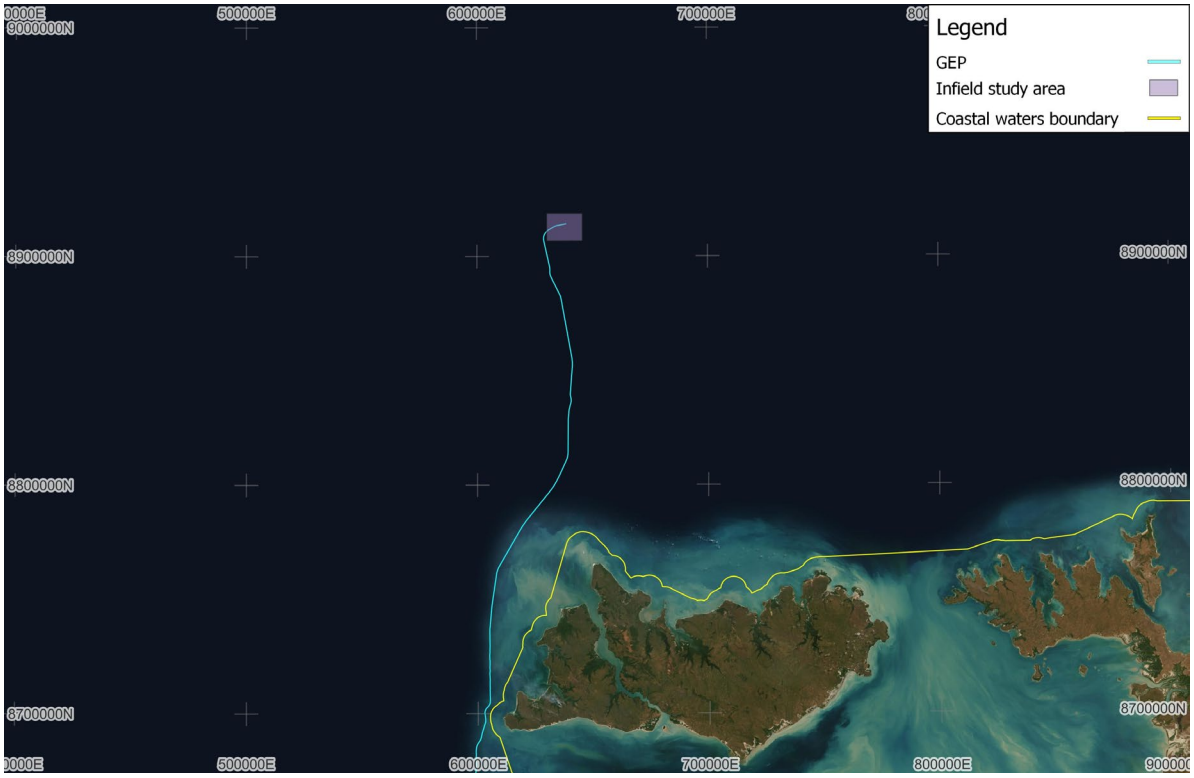


Figure 5: Boundary of NT coastal waters around Timor Sea and Tiwi Islands.[8]

[8] **Australian Government Geoscience Australia**. 2022. *Coastal Waters (State / Territory Powers) Act 1980.* Australian Marine Spatial Information System (AMSIS).

These definitions of Australian and Commonwealth waters in the *UCH Act 2018* have been carried over from the *Historic Shipwrecks Act 1976.* In its original form, the *Historic Shipwrecks Act 1976* applied to waters adjacent to a State's coasts upon Commonwealth proclamation and applied automatically to waters adjacent to a Territory's coast. In 1980, the Act was amended to apply to waters adjacent to a State only with the consent of the State, however, the automatic application to waters adjacent to a Territory's coast remained.

As such, NT waters – including coastal waters, bays, rivers, and bodies of water within the jaws of the land and inland waters, below the low water mark – i.e. all waters on the landward side of the NT coastal water boundary shown above in Figure 5 – fell within the definition of "Australian waters" under the *Historic Shipwrecks Act 1976.* This application continues under the current *Underwater Cultural Heritage Act 2018.*

Part 3, Division 2 of the *Underwater Cultural Heritage Act 2018* provides for the regulation of activities relating to protected underwater cultural heritage. Specifically, any conduct that has or is likely to have an adverse impact on protected underwater cultural heritage is prohibited unless carried out in accordance with a permit granted under the Act. Conduct is considered to have an adverse impact on protected cultural heritage if it:

(a) directly or indirectly physically disturbs or otherwise damages the protected underwater cultural heritage; or

(b) causes the removal of the protected underwater cultural heritage from waters or from its archaeological context.

The study area is situated within Commonwealth waters and as such ship and aircraft wrecks over 75 years old are automatically protected and other forms of underwater cultural heritage can be declared protected.

3.2 UNESCO 2001 *Convention on the Protection of Underwater Cultural Heritage*

The United Nations Educational, Scientific and Cultural Organization (UNESCO) 2001 *Convention on the Protection of the Underwater Cultural Heritage* is an international treaty that was developed to provide a common framework for States Parties on how to better identify, research, and protect underwater heritage whilst ensuring its preservation and sustainability. The UNESCO 2001 *Convention* consists of a main text that sets out basic principles for the protection of underwater cultural heritage and provides a detailed State cooperation system, and an Annex that outlines widely recognised practical rules for the treatment and research of underwater cultural heritage. The UNESCO 2001 *Convention* entered into force in 2009.

The Commonwealth of Australia supported the principles and drafting of the UNESCO 2001 *Convention* and is currently considering ratification of the Convention in accordance with requirements under Australia's *Treaty Making Guidelines.* The *Underwater Cultural Heritage Act 2018* was also developed specifically to align with the UNESCO 2001 Convention.

In 2010, the Commonwealth, States, and the NT signed the *Australian Underwater Cultural Heritage Intergovernmental Agreement* that would enable the Australian Government to ratify the UNESCO Convention 2001, should it so choose. The Agreement establishes the roles and responsibilities of Commonwealth, State and NT governments for the identification, protection, management, conservation, and interpretation of Australia's underwater cultural heritage. One of the key aims of the Agreement is for all parties to meet internationally recognised best practice management of Australia's underwater cultural heritage as outlined in the Rules in the Annex to the UNESCO 2001 *Convention*.

The main principles of the UNESCO 2001 Convention are as follows:

- Obligation to Preserve Underwater Cultural Heritage – States Parties should preserve underwater cultural heritage and take action accordingly. This does not mean that States would necessarily have to undertake archaeological excavations; they only have to take measures according to their capabilities. The Convention encourages scientific research and public access.
- *In Situ* Preservation as first option – The *in situ* preservation of underwater cultural heritage (i.e. in its original location on the seafloor) should be considered as the first option before allowing or engaging in any further activities. The recovery of objects may, however, be authorized for the purpose of making a significant contribution to the protection or knowledge of underwater cultural heritage.
- No Commercial Exploitation – The 2001 Convention stipulates that underwater cultural heritage should not be commercially exploited for trade or speculation, and that it should not be irretrievably dispersed. This regulation is in conformity with the moral principles that already apply to cultural heritage on land. It is not to be understood as preventing archaeological research or tourist access.
- Training and Information Sharing – States Parties shall cooperate and exchange information, promote training in underwater archaeology and promote public awareness regarding the value and importance of underwater cultural heritage.

The general principles concerning activities directed at underwater cultural heritage as contained in the Annex of the UNESCO 2001 *Convention* are

Rule 1. The protection of underwater cultural heritage through in situ preservation shall be considered as the first option. Accordingly, activities directed at underwater cultural heritage shall be authorized in a manner consistent with the protection of that heritage, and subject to that requirement may be authorized for the purpose of making a significant contribution to protection or knowledge or enhancement of underwater cultural heritage.

Rule 2. The commercial exploitation of underwater cultural heritage for trade or speculation or its irretrievable dispersal is fundamentally incompatible with the protection and proper management of underwater cultural heritage. Underwater cultural heritage shall not be traded, sold, bought or bartered as commercial goods.

Rule 3. Activities directed at underwater cultural heritage shall not adversely affect the underwater cultural heritage more than is necessary for the objectives of the project.

Rule 4. Activities directed at underwater cultural heritage must use non-destructive techniques and survey methods in preference to recovery of objects. If excavation or recovery is necessary for the purpose of scientific studies or for the ultimate protection of the underwater cultural heritage, the methods and techniques used must be as non-destructive as possible and contribute to the preservation of the remains.

Rule 5. Activities directed at underwater cultural heritage shall avoid the unnecessary disturbance of human remains or venerated sites.

Rule 6. Activities directed at underwater cultural heritage shall be strictly regulated to ensure proper recording of cultural, historical and archaeological information.

Rule 7. Public access to *in situ* underwater cultural heritage shall be promoted, except where such access is incompatible with protection and management.

Rule 8. International cooperation in the conduct of activities directed at underwater cultural heritage shall be encouraged in order to further the effective exchange or use of archaeologists and other relevant professionals.

4 KNOWN AND POTENTIAL MARITIME ARCHAEOLOGY

4.1 Environment and Morphology

The Barossa Field is located offshore in the Timor Sea, approximately 300 km north-northwest of Darwin in the Bonaparte Basin. Water depths in the portions of the gas field surveyed for this project range from a minimum depth of 217 m in the southeast to 275 m in the northwest.[9] The seabed is typically smooth and featureless with only a micro-topography, such as 0.5 m high mounds associated with previous drilling exploration, being visible.

Seabed features have only been interpreted from MBES, SSS, and SBP data, as no sampling has been undertaken. The sediments of the outer shelf of northern Australia typically comprise sand and silt, forming a flat and featureless seabed (Figure 6). Small portions of the seabed do contain noticeable features. These features have been ascribed to disturbed ground from exploratory drilling or as locations where older, and possibly more cohesive, sediments are exposed on the seabed.[10] In addition to these features, multiple types of seabed scars were noted during geophysical surveys and have been ascribed to both bottom trawling and anchor drags (Figure 7).

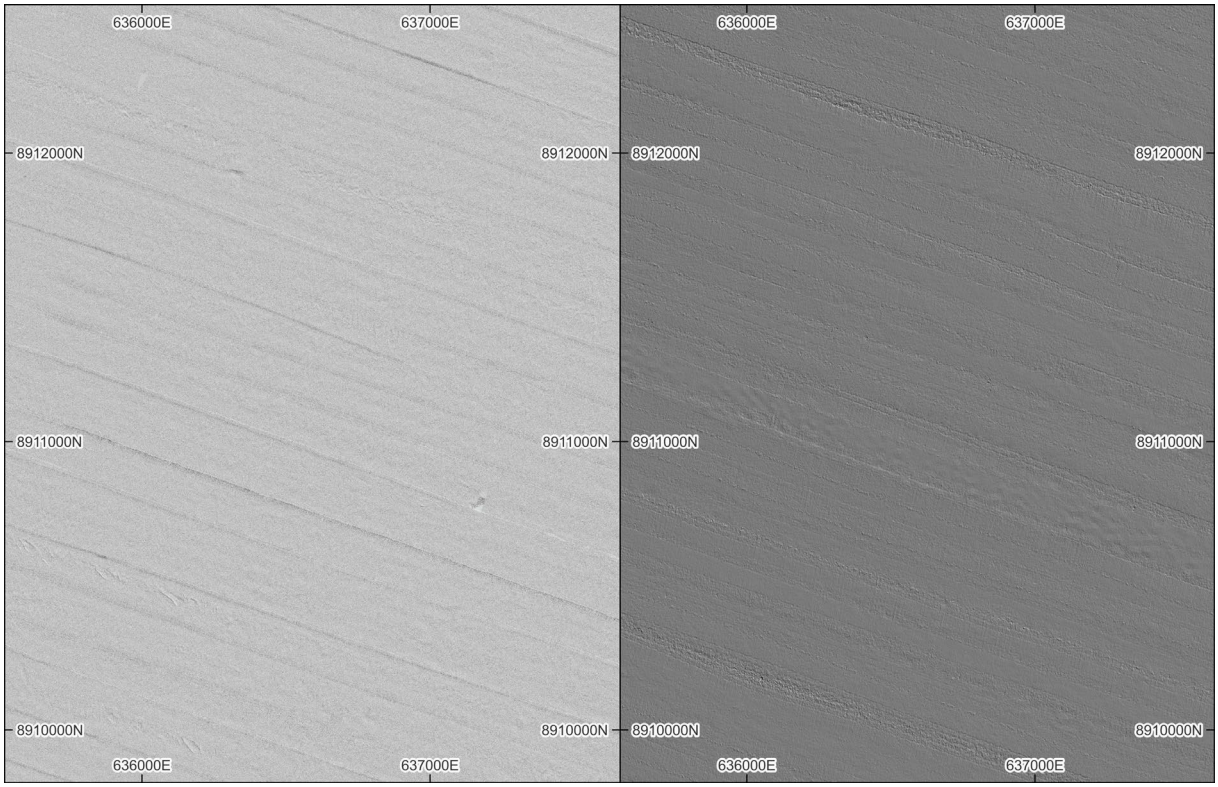


Figure 6: SSS (left) and MBES (right) imagery of study area, showing typical flat featureless surface.

[9] **Dof Subsea, 2018,** *Geophysical Survey Report – Infield Area,* report prepared for Santos (document ID: BAS-103 0034).
[10] Op. Cit., **Dof Subsea, 2018.**

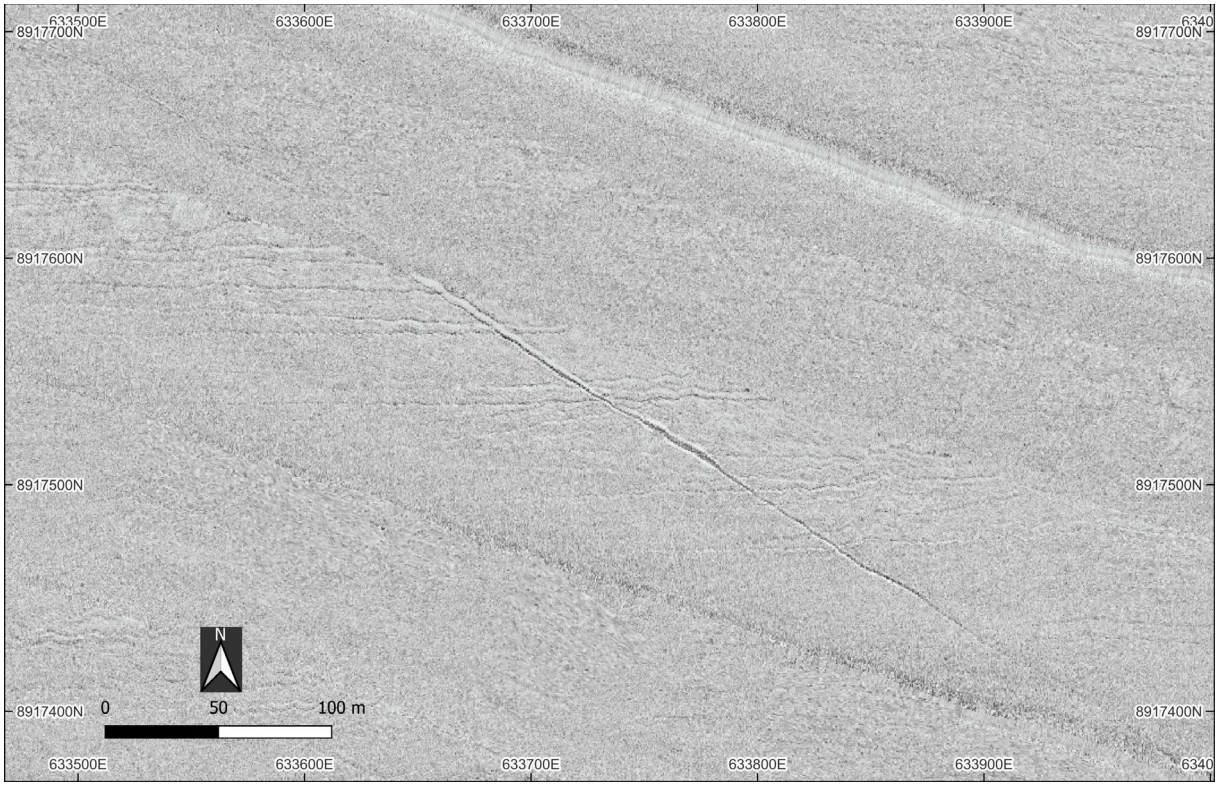


Figure 7: SSS image showing distinctive anchor drag across several trawl scars.

4.2 Cultural activities in the Timor Sea

4.2.1 *Dutch exploration*

The earliest recorded European voyages through the Timor Sea occurred in the early to mid 1600s. In 1636, Dutch merchant and explorer, Pieter Pieterszoon, led an expedition south from New Guinea and sailed west along part of the northern coast of Bathurst and Melville Islands and across the Timor Sea. In 1644, Dutch explorer Abel Tasman, in the service of the spice trade United Dutch East India Company (Verenigde Oostindische Compagnie—VOC) also sailed along the northern coasts of Bathurst and Melville Islands, and into the Van Diemen Gulf. The first recorded contact between Europeans and the Tiwi occurred in 1705 when a VOC expedition under the command of Maarten van Delft spent almost two months exploring the west and north coasts of Bathurst and Melville Islands.[11] Figure 8 below shows the sailing routes of Pieterszoon, Tasman, and Delft and the northern coastline of the Tiwi Islands as charted during the three voyages.

[11] **Forrest, P. 1995**. *The Tiwi Meet the Dutch: The First European Contacts.* Report for The Tiwi Land Council, NT.; **Van Duivenvoorde, W., D. Wesley, M. Litster, F. Wonu Veys, W. Nayati, M. Polzer, J. McCarthy & L. Jansen. 2019**. "Van Delft Before Cook: The Earliest Record of Substantial Cultural Contact Between Indigenous Australians and the Dutch East India Company Prior to 1770." *Australasian Journal of Maritime Archaeology.* Vol. 43, pp. 27-49.

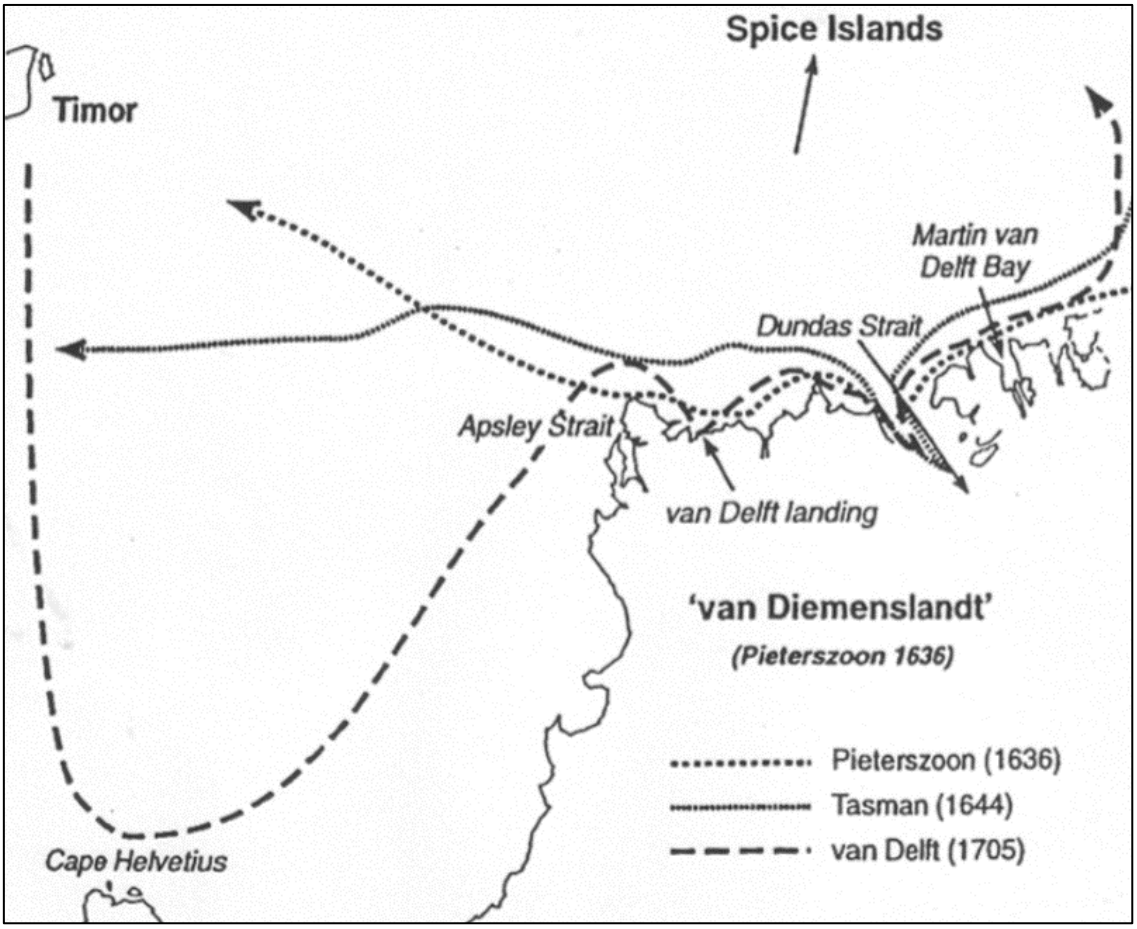


Figure 8: Map showing the sailing routes of Pieterszoon, Tasman, and Delft and the northern coastline of the Tiwi Islands as charted during the three voyages.[12]

4.2.2 *Macassan traders*

In the early to mid 1700s, Indonesian traders began visiting parts of the northern coast of Australia to fish for trepang – sea cucumber or *bêche-de-me*r – prized for its culinary and medicinal values in Chinese markets. The term "Macassan" – originally denoting people from Macassar, the major fishing port in south-west Sulawesi, is generally used to apply to all the trepangers who came to Australia, even though some were from other islands in the Indonesian Archipelago, including Timor, Rote, and Aru.

Throughout the latter 1700s to early 1900s, fleets of Macassan *perahus* or *praus*, timber multi-hulled sailing vessels, travelled to the north Australian coast with the north-westerly winds during the tropical wet season, and departed with the south-easterly winds of the dry season. A single fleet could be composed of thirty or more vessels, and in some periods up to 200 *perahus,* amounting to over 2,000 men, were estimated to be fishing the coastline from Coburg Peninsula to south-eastern Arnhem land. The sea route between the Indonesian archipelago and Australia took the Macassans through the Timor Sea and along the north coast of Melville Island – see Figure 9. Historical documents record the loss of at least five Macassan perahu on the north coasts of Bathurst and Melville Islands during the late 1800s to early 1900s.[13]

[12] Op cit. **Forrest, P. 1995.**
[13] **Clark, M. & S. K. May (eds). 2013** *Macassan History and Heritage – Journeys, Encounters and Influences* .Australian National University Press, ACT.; **Coroneos, C. 1996.** "The shipwreck universe of the Northern Territory." *Bulletin of the Australian Institute for Maritime Archaeology*. Vol. 20; pp. 11-22.; **Jung, S. 1992.** *Annotated Bibliography of Macassan Perahu Wrecks & Sightings.* Maritime Archaeology & History, Northern Territory Museum of Arts and Sciences, Darwin, NT.

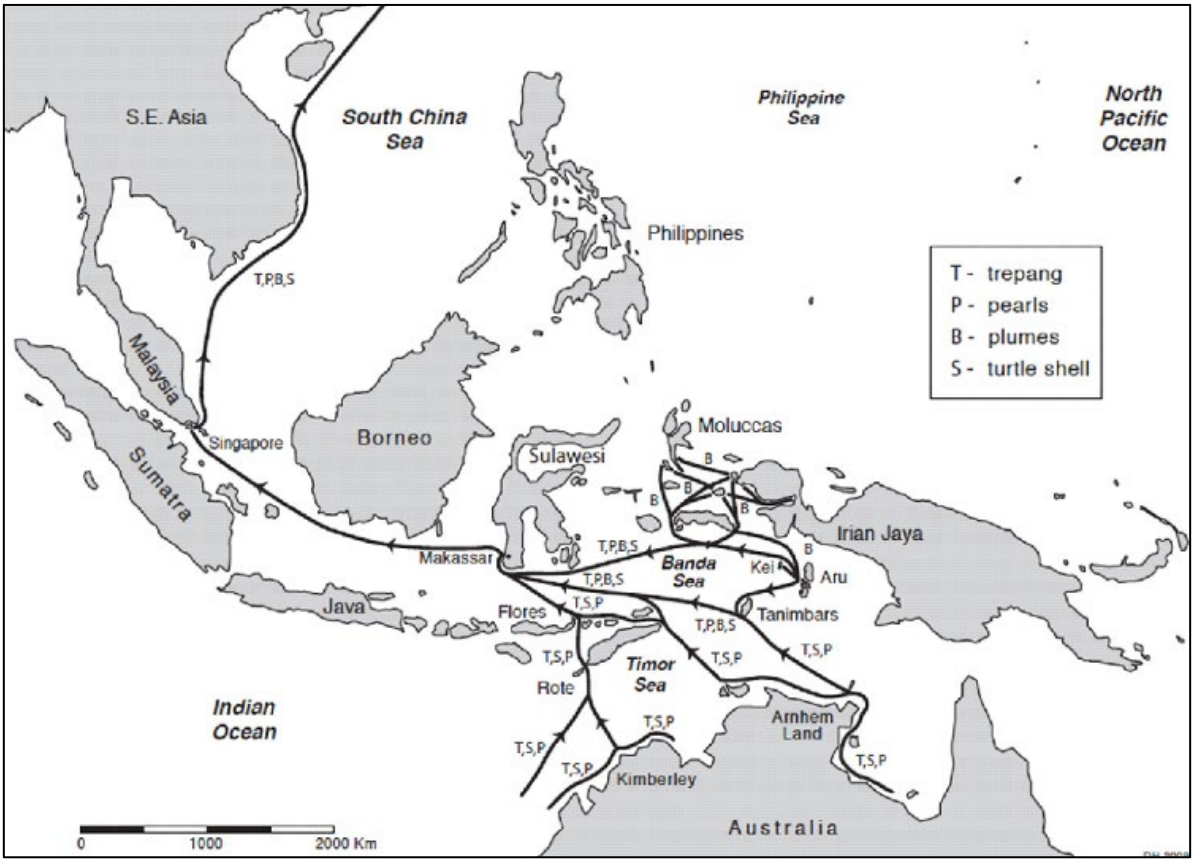


Figure 9: Map of the Indonesian archipelago showing maritime trade routes throughout the 1700-1900s.[14]

4.2.3 *Early British settlement of the Northern Territory and associated shipping*

In 1818, under instruction from the British Admiralty, Royal Navy Rear Admiral Phillip Parker King led an exploratory voyage from Sydney around the southern, western, and northern Australian coasts as far as Van Diemen Gulf. The expedition included a survey of the Tiwi Islands, providing the British and New South Wales governments with the first thorough knowledge of the area. Within a few years, the expansion of Dutch commercial and military interests in the East Indian Archipelago, together with a desire for a share of the maritime trade throughout the region, the British Government decided to claim and occupy the Tiwi Islands. In 1824, Royal Navy Captain Gordon Bremer was appointed to establish an outpost settlement and military garrison on the west coast of Melville Island, facing Apsley Strait – see Figure 10. The settlement turned out to be a short-lived disaster, and in 1829 – due largely to continuous conflict with Tiwi people – Fort Dundas was abandoned.[15]

MacKnight, C. C. 1976. *The Voyage to Marege; Macassan Trepangers in Northern Australia.* Melbourne University Press, VIC.

[14] **Clark, P. 2011.** "Monsoon traders lost on the Northern Australian coast – historical evidence for their existence."

[15] **Morris, J. 2001.** "The Tiwi and the British: an ill-fated outpost." *Aboriginal History.* Vol. 25; **Crosby, E. 1978.** *Survey and excavation at Fort Dundas, Melville Island, Northern Territory, 1975.* The Australian Society for Historical Archaeology, Sydney, NSW.

Figure 10: 1883 British navigation chart of Timor Sea and Tiwi Islands, showing location of Fort Dundas.[16]

In the late 1850s, the beginnings of a network of telegraph lines linking capital cities across Australia was being established, and speculation soon arose regarding a possible international connection between Australia and the new telegraph line from Europe to the East Indies. Competition between the Australian colonies over the route was fierce, with both the Victorian and South Australian governments organising expeditions to cross the continent from south to north and identify potential overland telegraph routes. During the 1860s, SA Government surveyors were sent to the north coast of the NT to select a potential landing site for the telegraph and establish a supporting settlement. The first site, selected in 1864 by Surveyor Boyle Travers Finniss at Escape Cliffs near the mouth of the Adelaide River, was abandoned in 1867. After examination of several other suggested areas, a settlement was finally laid out by Surveyor-General George Goyder at Fort Point near Port Darwin in 1869.

The final telegraph contract was secured in 1870 when the SA Government proposed to extend the line from Port Augusta to Palmerston and the British-Australian Telegraph Company agreed to lay the undersea cable from Java to Port Darwin. Palmerston began to develop from a constructor's camp to a small township, and Port Darwin became the focus of trade and transport to supply the new settlement. Development was further spurred by the discovery of gold near Pine Creek in 1871 during the construction of the overland telegraph, sparking a gold rush in surrounding areas that attracted thousands of prospectors and pioneers to the NT.

[16] **Great Britain. Hydrographic Department. 1883.** *Australia-north coast, Melville Island with Dundas and Clarence Straits. From Surveys made by Commanders King, Wickham and Stokes and F. Howard, Master, R.N., between the years 1818 and 1864.* Published at the Admiralty 14th April 1883 under the Superintendence of Captain Sir Frederick J. Evans, R.N. K.C.B. F.R.S. Hydrographer, London, UK. National Library of Australia, MAP RM 3355.

The township of Palmerston continued to develop throughout the late 1800s to early 1900s, largely facilitated by the construction of a railway line between Palmerston and the goldfields at Pine Creek and a corresponding expansion of Darwin port facilities during the 1880s. The residential and industrial population expanded, and Port Darwin advanced as a trade and transport shipping hub and commercial centre of various coastal pearling industries being established along the coast, attracting fleets from Japan, Timor, Malaysia, and the Philippines. Shipping throughout the Timor Sea increased as trade and transport routes saw vessels travelling along the western side of the Tiwi Islands to and from the entrance of Beagle Gulf and the approaches to Port Darwin.[17]

4.2.4 *Japanese pearling*

The earliest references to pearling in the Northern Territory date to 1874 when the Melbourne owned schooner *Northern Light* came from the Gulf of Carpentaria with a crew of divers to prospect for pearl shell in Darwin Harbour.[18] In 1884, interest in pearling off Darwin began in earnest, with at least 23 boats acquiring licenses to pearl in the Northern Territory. 1884 also saw the first use of Japanese divers hired on Australian pearling luggers. By the 1890s, pearl beds in Darwin Harbour and close to shore had been exhausted, and pearling efforts were moved to beds located off the Tiwi Islands.[19] A government report from 1897 reported 39 boats operating off Melville Island, of which 18 were wrecked in a hurricane whilst sheltering in Darwin Harbour.[20]

Japanese divers, along with Malays and Filipinos, were frequently employed on either Australian or foreign owned pearling vessels. Anti-Asian sentiment led to a restriction on foreign Asian vessels allowed to operate within Australian waters by 1901. A lack of labour to work the 46 licensed pearling boats led to a relaxation on the restriction of “Asiatic” labourers in 1907. Despite this, overexploitation of known pearl beds led to a rapid decline in the pearling industry of the Northern Territory by 1921.

Japanese pearling vessels returned *en masse* to the waters of the Arafura and Timor Seas in the mid-1930s when Japanese pearlers operating from extra-territorial bases in Timor and the Aru Islands began to locate and exploit new shell beds. By 1932, it was estimated that at least ten Japanese luggers were pearling in grounds 45 miles to the northwest of Bathurst Island, and lifted 200 tons of shell from the seafloor.[21] By 1937, Japanese pearlers accounted for 53% of the shell lifted from Australian waters, including those off the Northern Territory, Western Australia, and the Torres Strait.[22] In 1936, a representative of Mitsui Bassan Kaisha Ltd, a Japanese company based in Kobe, stated that there were already 60 Japanese luggers operating off Bathurst Island, with the number rising to over 120 by the end of 1937.[23] In 1938, the Japanese pearling fleet was reorganized and consolidated under Japanese government control and based in Palau, which sent a fleet of 165 pearling vessels to Northern Australian waters in April of that year. Pearling by Japanese luggers ceased in 1941 following the outbreak of WWII, with the majority of Japanese boats either confiscated or scuttled.

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[17] **Clune, F. 1955.** *Overland telegraph: the story of a great Australian achievement and the link between Adelaide and Port Darwin.* Angus and Robertson, Sydney, NSW.; **Cross, J. 2011.** *Great Central State – The Foundation of the Northern Territory*. Wakefield Press, South Australia. **Reece, R. 1989.** “Palmerston (Darwin); Four Expeditions in Search of a Capital.” Statham, P. (ed.) *The Origins of Australia’s Capital Cities.* Cambridge University Press, Cambridge, UK.; **Anon 5 July 1872** “The Northern Territory, Palmerston.” *South Australian Register.*; **Anon 13 October 1883** “Port Darwin.” *The South Australian Register.*

[18] **Bach, J.P.S., 1955,** *The Pearling Industry of Australia: An Account of its Social and Economic Development,* report prepared for The Department of Commerce and Agriculture, p.20.

[19] Op. Cit., **Bach, 1955,** p.40.

[20] Op. Cit., **Bach, 1955,** p.41.

[21] Op. Cit., **Bach, 1955,** p.221.

[22] Op. Cit., **Bach, 1955,** p.219.

[23] Op. Cit., **Bach, 1955,** p.232.

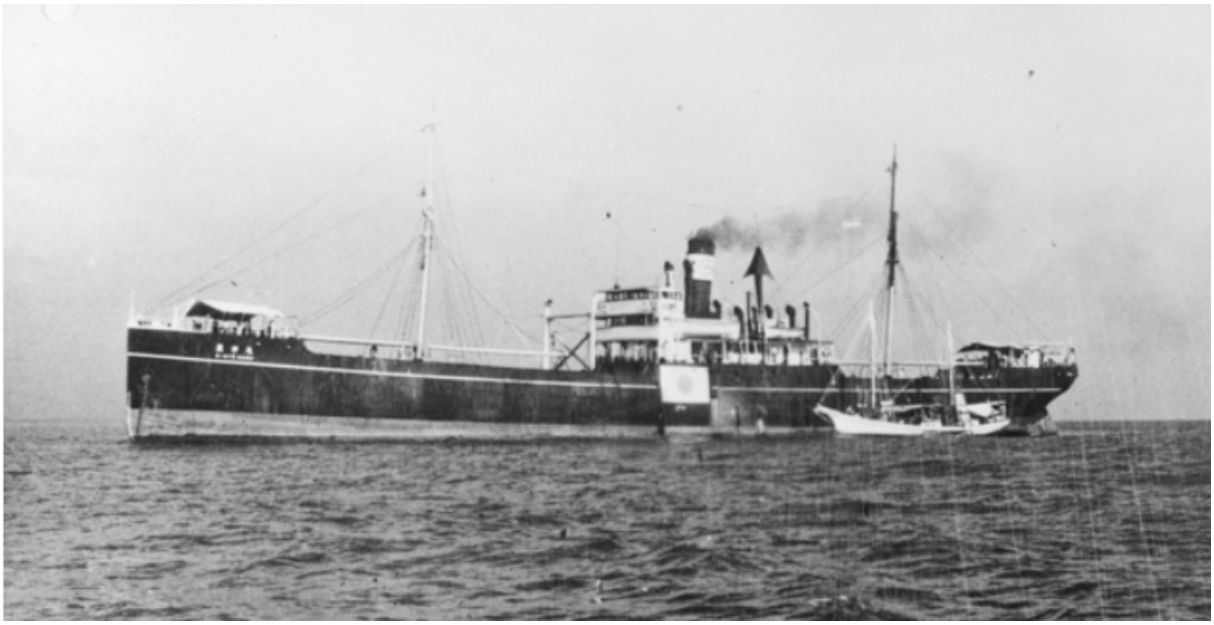


***Figure 11: Japanese pearling mothership* Sinyo Maru *with a lugger alongside. Northern Territory, 1940.*[24]**

4.2.5 *World War II*

In the 1920s to 1930s, British defence planning based on growing concerns of potential aggression from the Empire of Japan led to the development of Port Darwin as a strategic naval refuelling and military support base. Naval fuel tanks were constructed at Stokes Hill, and coastal defence facilities and military garrisons were established at East Point and Emery Point. By the mid 1930s, a worsening international situation, particularly in Europe and Japan, led to further increases in Port Darwin's defences and the establishment of a Royal Australian Air Force (RAAF) base, an Australian Army barracks, and Royal Australian Navy (RAN) depot. Naval infrastructure within Darwin Harbour was further expanded, including the establishment of additional shipping, mooring and maintenance facilities, and the design of anti-submarine defence systems.

In September 1940, Japan entered the World War II "Axis" military alliance with Germany and Italy, and in late 1941, launched direct attacks on British holdings in Malaya, Singapore and Hong Kong and the United States military base at Pearl Harbour, Hawaii. These actions led Britain, America, and Australia to formally declare war on Japan, initiating the Asia-Pacific War. Thousands of Australian and Allied forces were stationed to defend Australia's northern coastline and Port Darwin became an important staging point for Allied naval shipping and aircraft engaged in battles throughout Southeast Asia and Netherlands East-Indies.

On 19 February 1942, Japan launched the first direct attack on the Australian mainland, involving a strike force of 188 aircraft launched from a carrier fleet stationed approximately 350 km north-west of Darwin in the Timor Sea. The aircraft approached Darwin over the Tiwi Islands and attacked port facilities and shipping in Darwin Harbour, Darwin township, military installations, and aerodromes. This raid was the first of many; during the course of WWII, Darwin and surrounds endured a total of sixty-four airborne Japanese attacks and several attempted submarine attacks.

The Timor Sea saw increased traffic throughout the Pacific War; as part of the main shipping route for Allied forces operating between Port Darwin and the Netherlands East-Indies, and along the air route for incoming Japanese attack forces, Allied defence forces, and Allied air

[24] *1940-07-14. Port side view of the Japanese Pearling Mother Vessel Sinyo Maru with a lugger alongside.* Naval Historical Collection, Australian War Memorial, https://www.awm.gov.au/collection/C250703, accessed 28 March 2022.

patrols and attack missions staging out of Darwin. The Timor Sea was also the scene of several air to air and air to sea battles between the Japanese and Allied forces during WWII.

4.2.6 *Summary of cultural activities within the study area*

From the review of the known history of the Timor Sea in the vicinity of the study area, the following activities can be identified:

- Dutch exploration and trade during the 17th and early 18th centuries;
- Macassan trepang fishing and trade throughout the 18th to early 20th centuries;
- Early British settlement of the northern coast of the NT and associated shipping in the early to mid 19th century;
- Pearling, especially by Japanese vessels up until WWII. Not expected to be included in these activities are anchorages due to the relatively deep and exposed waters of the study area;
- Increased Australian and international shipping associated with the development of Port Darwin in the late 19th through 20th century;
- Air and sea travel and combat between Allied and Japanese forces during the Pacific Theatre of WWII.

4.3 Known Maritime Archaeological Sites in the Study Area

4.3.1 *Shipwrecks*

There are no known shipwrecks within the study area. The closest known shipwreck is the SS *Florence* D, a US military-chartered supply vessel sunk by Japanese aircraft in 1942 – located at 619103.29 m E and 8759695.41 m S; approximately 148 km south of the study area.

4.3.2 *Aircraft wrecks*

There are no known aircraft wrecks within the study area.

4.3.3 *Maritime infrastructure*

There is no known historical maritime infrastructure within the study area.

4.3.4 *Sea dumping*

There are no known episodes of sea dumping within the study area. The closest sea dumping site is located at 609617.49 m E and 8899950.38 m S, with a 2.5 nm buffer (4630 m) around it.[25] This location is over 20 km from the nearest boundary of the infield operational area.

4.3.5 *Unexploded ordnance*

There are no known occurrences of unexploded ordnance (UXO) within the study area.

[25] Op. Cit., **AHS SD.**

4.4 Potential Maritime Archaeological Sites in the Study Area

4.4.1 *Shipwrecks*

There is one known but unlocated shipwreck in the Timor Sea that could potentially occur within the study area based on historical accounts of the wreck event – seeTable 2.

There is also potential for shipwrecks not documented in the historical record to be located within the study area, including Aboriginal, Macassan, and early colonial watercraft. Also, Japanese pearling vessels lost offshore would unlikely be noted in Australian records.

Any shipwreck within the study area that was wrecked prior to 1947 – whether located or not – is automatically protected under the *UCH Act 2018*.

Table 2: Potential shipwrecks within the study area. [26]

Name	Type	Year lost	Wreck event	General location
Timor Sea - Indonesian fishing boat	Motor vessel	1997	Foundered	North / north-west of Tiwi Islands, Timor Sea

4.4.2 *Aircraft wrecks*

There are ten known, but unlocated, aircraft wrecks potentially in the Timor Sea that could possibly occur within the study area based on historical accounts of the wreck event and general wreck location – see Table 3.

All of these wrecks are military combat aircraft wrecked during WWII, including five Royal Australian Air Force (RAAF) aircraft and five Imperial Japanese Navy (IJN) and Navy Air Force (IJNAF) aircraft.

Any of the WWII aircraft wrecks that are situated within Commonwealth waters are automatically protected under the *UCH Act 2018* and USA military vessels and aircraft wrecks are protected under the US *Sunken Military Craft Act 2004.*

Table 3: Potential aircraft wrecks within the study area. [27]

Aircraft type / number	Operator	Wreck event	Year Lost	General location
Consolidated PBY5A Catalina A24-49 (ex BuNo.8285) (military seaplane bomber)	Royal Australian Air Force (RAAF) - No. 11 Squadron	Disappeared on a mission from Groote Eylandt, NT to Manokwari, Indonesia.	1944	Possibly in Timor Sea or Arafura Sea
Consolidated PBY5 Catalina A24-50 (ex BuNo.8264) (military seaplane bomber)	RAAF - No. 11 Squadron	Disappeared on a mission from Groote Eylandt, NT to Aru Islands, Dutch New Guinea.	1943	Possibly in Timor Sea or Arafura Sea
Lockheed Hudson A16-137 (ex 41-23207) (military bomber)	RAAF - No. 13 Squadron	Disappeared after departing Darwin for an attack mission on Kupang, Indonesia.	1942	Possibly Beagle Gulf - Timor Sea
Lockheed Hudson A16-170 (ex 41-23607) (military bomber)	RAAF - No. 13 Squadron	Disappeared after departing Darwin for an attack mission on Kupang, Indonesia.	1942	Possibly Beagle Gulf - Timor Sea
Mitsubishi G4M1 "Betty" (military bomber); pilot Kato	Imperial Japanese Navy Air Force (IJNAF) - Takao Ku, 23rd Koku Sentai	Shot down by USAAF 49th Pursuit Group.	1942	North-west of Darwin; Beagle Gulf - Timor Sea

[26] All data obtained from the Australian Underwater Cultural Heritage Database (AUCHD)
[27] All data obtained from the Australian Underwater Cultural Heritage Database (AUCHD)

Aircraft type / number	Operator	Wreck event	Year Lost	General location
Mitsubishi G4M1 "Betty" (military bomber); pilot Kirino	IJNAF - Takao Ku, 23rd Koku Sentai	Shot down by USAAF 49th Pursuit Group.	1942	North-west of Darwin; Beagle Gulf - Timor Sea
Mitsubishi G4M1 'Betty" (military bomber); pilot Ozaki	IJNAF - Takao Ku, 23rd Koku Sentai	Shot down by USAAF 49th Pursuit Group.	1942	North-west of Darwin; Beagle Gulf - Timor Sea
Mitsubishi G4M1 "Betty" (military bomber); pilot Tomohara	IJNAF - Takao Ku, 23rd Koku Sentai	Shot down by USAAF 49th Pursuit Group.	1942	North-west of Darwin; Beagle Gulf - Timor Sea
Mitsubishi G4M1 "Betty" (military bomber); pilot Unohara	IJNAF - Takao Ku, 23rd Koku Sentai	Shot down by USAAF 49th Pursuit Group.	1942	North-west of Darwin; Beagle Gulf - Timor Sea
Supermarine Spitfire A58-89 (ex-BS225) (military fighter)	RAAF - No. 452 Squadron	Damaged during dogfight with incoming IJNAF attack, forcing pilot to bail out and aircraft to crash into sea.	1943	North-west of Darwin, Beagle Gulf - Timor Sea

4.4.3 *Maritime infrastructure*

No potential elements of maritime infrastructure within the study area have been identified in the historical record.

4.4.4 *Sea dumping*

No potential episodes of historical sea dumping within the study area have been identified in the historical record.

4.4.5 *UXO*

*** This section looks at UXO only from a heritage perspective. It is not intended to provide UXO specialist advice or to constitute a detailed UXO risk assessment.*

There is a potential for various types of UXO – namely WWII era UXO – to occur within the study area, including:

- Crashed Allied and Japanese military aircraft ordnance payloads;
- Japanese and Allied air-delivered munitions, and;
- Japanese and Allied sea-delivered munitions.

The Department of Defence maintains a record of sites confirmed as, or reasonably suspected of, being affected by UXO.[28] These records show that various areas of the Timor Sea have historically been used for military training. A desktop UXO study was also provided to Santos by GTek Australia Pty Ltd on 3 September 2020.[29] Both these sources identify that the closest known former air to air weapons range with potential risk for UXO is Darwin AWR (Central) R228, located approximately 37 km south of the current study area.

[28] **Australian Government Department of Defence. 2022.** Defence UXO Mapping Application. whereisuxo.org.au
[29] Op. Cit., **GTek, 2020**, p.12

5 PREDICTED CONDITION OF MARITIME ARCHAEOLOGICAL SITES

5.1 Introduction

The condition of any maritime archaeological resource is affected by environmental and cultural factors as well as the nature of the seabed.

With regards to the study area, the following factors will have the greatest impact on site formation processes:

- Type of event leading to presence on seabed;
- Type of seabed;
- Mechanical damage caused by waves;
- Salvage;
- Anchor and trawl drags;
- Chemical and biological degradation.

5.2 Site Environment

As discussed in Section 4.1, the seabed is primarily sandy and featureless with only small, isolated features showing recent disturbance or older, more cohesive substrates.

5.3 Shipwrecks

The wrecking event is the first factor that influences site formation. Depending on the reasons or forces behind wrecking, the ship may be mostly complete or extensively broken up. A vessel rarely falls or sinks as a result of little or no damage; it is more likely that a vessel would run aground, cause damage to the hull, and then sink with part of the vessel intact and part damaged. Often the force of initial impact is sufficient to break the vessel and cause considerable damage. The vessel would then sink in large pieces, depending on the damage, or remain stuck until it is broken up by physical or human forces. Another reason for a wrecking event is fire which, depending on the extent, can cause a considerable amount of breaking up and scrambling of the ship material before it reaches the seabed.

It is reasonable to assume that a large majority of potential shipwrecks within the study area foundered. In this scenario, the vessel's structural remains would remain highly intact.

The seabed upon which a shipwreck lies has the greatest effect on site formation processes, in particular with wooden hulled vessels, with other factors also having contributory effects.

With regards to vessels coming to rest on a sandy seabed, the archaeological site will usually be formed in the following manner:

- Vessel comes to rest on the seabed.
- The wreck will settle into the seabed up to a certain depth, dependent on the resistance of the sediments and the weight of the vessel. It is a general rule, especially with iron hulled vessels, that wrecks sink into softer sediments up to their waterline.
- Parts of the vessel which protrude above the water may be salvaged for re-use. Non-perishable, accessible and high value parts of the vessel situated underwater may also be removed. It is a general rule that the deeper the

water in which a vessel sinks and the more remote the location, the less likelihood of it being salvaged at the time of loss. Rapidly changing technology in recent times, however, has allowed salvage at greater depths.

- Biological processes will commence immediately on a timber wreck, attacking the exposed timbers and other organic elements of the wreck. This will lead to a weakening of the hull's integrity and eventually organic elements above the seabed will disappear.
- If it is in shallow water, wind generated waves would act upon the broader surfaces of a wreck thereby breaking down exposed components into sections. These sections will orientate themselves to prove the least resistance to the direction from which the waves are more commonly generated.
- Large waves will raise sediments into suspension, thereby resulting in cultural objects, including the hull of the wreck, sinking further into the marine sediments. The older the wreck the deeper it would be buried, unless a hard-alluvial substrate is present close to the surface of the seabed against which the wreck will rest.
- Cultural behaviour will have the effect of scrambling wreck sites and masking their presence. Dragging anchors, scallop dredgers and trawling will spread wreck material and may also result in the 'ploughing up' of buried cultural material.
- Salvaging will have a destructive effect on the hull and organic elements that have survived below the seabed, as well as by removing artefacts and creating a scatter of remaining material around the wreck site.

A wreck coming to rest on a rocky bottom would eventually collapse under its own weight as it would not be able to sink into the seabed. With such a collapse the integrity or coherence of the wreck begins to dissipate. Pockets of surviving structure and other artefacts can remain well preserved amongst boulders, gullies and depressions.

Assessing the condition or, more precisely, the structural integrity of the shipwrecks is of relevance because this can provide an indication of the nature and scale of the obstacle that could affect the pipeline installation process. Shipwreck condition also relates to its 'detectability'. A number of factors influence the condition of shipwrecks, the primary ones being the materials used in the construction of the vessel, the bottom type upon which the wreck rests, the depth of the wreck and its age.

With regards to detecting wreck sites, the two most common remote sensing techniques that are applied would be magnetometer and side scan sonar surveys. The side scan sonar would be more useful in detecting high and low profile wreck sites while the magnetometer is best employed in searching for sites with a high ferrous content which are partially buried or resting on a rocky bottom.

Generally speaking, the 'younger' the wreck is, and the deeper it sank in the water column, the better preserved it would be. Also, a wreck resting on a sandy bottom would be better preserved than if it was resting on a rocky bottom. In conjunction with these factors, the method and type of construction of the vessel is the most important variable when it comes to assessing the condition of a wreck.

Iron/Steel Hulled Wrecks

If resting on a sandy bottom it could be expected that the hull integrity of the wreck would be relatively intact. The hull along midships may have collapsed but the stern and bow sections may still be upright or heeled to one side. The engine components, if any, would be largely intact and *in situ*. Such vessels on a rocky bottom would be relatively disarticulated, though the components of the vessel would still be present. Iron/steel wrecks on either bottom type

can be detected using a magnetometer. Locating such a wreck site on a rocky bottom with side scan sonar would be difficult but the opposite is true with such wrecks on a sandy seabed.

Wooden Hulled Wrecks with Engines

In most cases the hulls of such wrecks would have disappeared. In situations, however, where the wreck rests on a sandy bottom, sections of the hull may have been preserved under the sand. The engine components of such wrecks would be visible. A magnetometer can detect such wrecks on either bottom type. Such wrecks on a rocky bottom would be difficult to detect with side scan sonar but the opposite can be true with such wrecks on a sandy seabed. However, engine components can be partially or completely covered by sediments and would appear as scattered dumped debris or a linear mound.

Large Tonnage (> 100 ton) Wooden Hulled Wrecks (Sail)

In most cases the hulls of such wrecks would have disappeared. In situations, however, where the wreck rests on a sandy bottom, significant sections of the hull may have been preserved under the sand. There would be enough ferrous material present, such as anchors, chain and winches, for such wreck sites to be detected using a magnetometer. The identification of such wreck sites using side scan sonar would be difficult as it could appear as scattered dumped debris, unless the cargo was non-perishable, in which case a linear mound may be visible.

Small Tonnage (< 100 ton) Wooden Hulled Wrecks (Sail)

The same as for large tonnage vessels except that the size of the target and the amount of ferrous material present would be considerably less. It would be difficult to detect using a magnetometer and may be mistaken for dumped material debris from side scan sonar imaging.

5.4 Aircraft Wrecks

There are significant differences between the site formation of underwater aircraft wrecks and shipwrecks due to the vastly different construction, in terms of both shape and material used, as well as the depositional process, i.e., the wrecking event. These are two key determining factors that will influence site formation.[30] The wrecking event for aircraft is the first factor affecting site formation, and can take many forms, from deliberate scuttling on the water's surface and dumping of material to high impact crashes and slower, more controlled ditching events. Aircraft dumping was considered 'fairly commonplace' following WWII, and significant dump sites exist near Sydney and Greencape in NSW, along with sites near Brisbane in QLD, and Rottnest Island in WA.[31] Aircraft wrecked as a result of military combat may have sustained significant damage before crashing into the water. Aircraft sitting on the surface of the water may have also been attacked and sunk through military action.[32] The initial integrity of the aircraft hull depends largely on the wrecking incident, and is influenced by numerous factors, such as the speed and angle of impact upon entry.

Upon entering the water, the shape of the aircraft and the depth of the water column will determine how the aircraft comes to rest on the seafloor. Aircraft hulls and wings are typically made of lightweight material, such as aluminium or even wood and fabric, while machinery and components such as engines will weigh significantly more and contain more ferrous

[30] **Burgess, A., 2013**, Underwater Aviation Archaeology: What is its Place and Value Within Archaeology, and in Particular Maritime Archaeology?, Masters thesis, Faculty of Humanities, University of Southampton, United Kingdom.
[31] **Smith, T., 2004,** Plane Sailing: The archaeology of aircraft losses over water in NSW, Australia. Bulletin of the Australasian Institute for Maritime Archaeology. Vol. 28:113-124.
[32] **Wilkinson, D., 2012,** Underwater aircraft sites in Australia: a summary of what has been learnt so far. Bulletin of the Australasian Institute for Maritime Archaeology. Vol. 36:31-35.

elements. This disparity in weight will cause some aircraft to invert on descent, coming to a rest on their back. Other aircraft, such as single engine WWII fighter planes built with engines at the front, will sink to the bottom nose first. As the aircraft sinks in the water column, it may break up further, with the loss of wings or tail sections being sometimes noted.[33] Once on the seafloor, the combination of increased weight and galvanic corrosion due to differing metals means that larger components, such as engines, may detach and fall away from the rest of the structure. The depth of the wreck has a significant role in its deterioration, as aircraft sunk in shallower waters are more at risk from wave surge and corrosion due to warmer water temperature and increased oxygen levels.[34]

The seafloor composition will determine the burial environment for a sunken aircraft which in turn will have a large impact on the survival and condition of the aircraft. Aircraft are generally lighter than ships and are therefore less likely to penetrate the seabed, and less of the hull may be buried. As with shipwrecks, it is assumed that aircraft that are quickly buried in an anaerobic, stable environment, deep underwater will be better preserved than those in shallow inshore environments, particularly those with hard seabed and heavy surf.[35]

The composition of alloys used in aircraft construction can have a significant impact on the rate of deterioration once an aircraft has sunk. Aluminium, the primary material used in aircraft construction, is highly reactive. When alloyed with metals like copper, its corrosion rate is accelerated. This leads to a phenomenon known as 'pitting,' where perforations appear as the aluminium corrodes.[36] Water with a higher acidity will cause more rapid deterioration.

Direct cultural impacts can also play a role in site formation, especially on sites located in areas of high boat traffic. Fishing nets have frequently become entangled with aircraft wrecks, resulting in damage and fragmentation.[37] Impacts and damage by anchors was frequently noted on PBY Catalina wrecks in Darwin Harbour, including some anchors that remained embedded in the aircraft.[38] Further damage can occur from propeller jet turbulence in shallow water. Due to the lightweight construction of aircraft, these anchor and fishing net collisions can easily move pieces of a sunken aircraft from one location to another, resulting in highly fragmented wreck sites.[39] Aircraft parts can be light enough that even recreational fishing line has been known to snag and disturb sites. Seafloor dredging has also been shown to have a significant negative impact on aircraft crash sites.[40] Other cultural impacts include salvaging, which can include initial salvaging efforts shortly after the wrecking event, as well as looting, illicit salvage, and souvenir taking. Sunken aircraft may become popular with recreational divers and can be damaged by careless visitors.

Although the site formation processes for sunken aircraft display large variation between sites, a general flow of deposition can be summarized:

- An aircraft enters the water, either through a violent and high-impact uncontrolled crash, slower deliberate bailout, or through dumping/scuttling on the surface. Aircraft may have sustained damage prior to entering water, such as those suffering mid-air explosions and aircraft shot down in combat.
- As the aircraft sinks, its orientation and hull integrity will change depending on its construction. Wings and tail may separate, and heavier components may invert an aircraft.

[33] **Wessex Archaeology, 2008,** *Aircraft Crash Sites at Sea: A Scoping Study,* Prepared for English Heritage.
[34] Op. Cit., **Smith, 2004.**
[35] Op. Cit., **Wessex Archaeology, 2008**.
[36] Op. Cit., **Burgess, 2013**.
[37] Op. Cit., **Smith, 2004.**
[38] **Cosmos Archaeology, 2016,** *INPEX Ichthys Project, Catalina Flying-Boat Monitoring 2012 to 2015,* Prepared for Tek Ventures Pty Ltd.
[39] Op. Cit., **Cosmos Archaeology, 2016**.
[40] Op. Cit., **Wessex Archaeology, 2008**.

    - It has been noted on Catalina wrecks that the tails and wings are very rarely found with the rest of the fuselage, indicating that they have potentially broken off and drifted away as the aircraft sunk.[41]
- The aircraft will settle on the sea bottom. Aircraft deposited on hard substrate may not be buried, while those settling on sandy, muddy, or silty bottoms may partially sink into the seafloor.
- In certain cases, salvaging operations may take place immediately, including the removal of high value components. In other cases, illicit salvaging, looting, treasure hunting, and souvenir taking can damage wrecks.
- Aircraft materials will begin to deteriorate over time, due to corrosion as well as natural and cultural external factors.
    - Corrosion will cause deterioration of metals, particularly aluminium, and may cause heavier ferrous components to detach.
    - Surf and surge can further disarticulate aircraft and spread material around a larger area.
    - Human activities such as dredging, fishing and recreational boating can further disperse sites by dragging fishing nets and anchors across sunken aircraft.

5.5 General loss and discard

Losses and discards from vessels may include personal items, fishing equipment, ship equipment, anchors, mooring gear, pearling equipment and other miscellaneous items. If lost accidentally, these items may have been in use and were functional at the time of the incident, but if discarded then these items may be damaged or broken pieces for disposal. Again, these items may be ferrous or metallic in composition but may also be of organic material, polypropylenes, ceramic and glass. They are mostly single, isolated objects but can occur in scatters created in one event or in multiple events. It can be expected that higher concentrations of this material would be closer to shore.

5.6 Unexploded Ordnance

Unexploded ordnance coming to rest on sandy environments can become quickly buried and retain their integrity for much longer than if resting on a rocky bottom in a high energy environment. In the sandy sediment of the study area, it is likely that any UXO will be slightly or completely buried and retain most of their original elements. UXO will likely appear as low relief and highly reflective isolated objects rather than as a scatter. Because they are ferrous, they can be detected with a magnetometer and a gradiometer (two magnetometers towed at a fixed distance from each other) could provide a good indication as to the size of the object and its burial depth.

[41] Op. Cit., Cosmos Archaeology, 2016.

6 REVIEW OF GEOPHYSICAL SURVEY DATA

6.1 Introduction

The marine geophysical survey for the project was undertaken by DOF Subsea on behalf of Santos. The survey was undertaken in 2018, and included multi-beam echosounder bathymetry (MBES), sub-bottom profilers (SBP), and side scan sonar (SSS).

Of relevance to this assessment in particular was the SSS. Additionally, MBES data was used as a second data source to support the selection of targets from SSS. SSS data was provided as geo-tiffs at 1m resolution which were imported into QGIS software and laid over basemaps. This provided highly accurate coordinates of seabed anomalies as well as their dimensions, within the nearest 1 metre due to resolution. The 1m resolution only allowed for relatively larger anomalies to be identified. Due to the offshore location of the study area, and the lack of significant mooring or harbour facilities, this was deemed acceptable to locate larger anomalies (such as shipwrecks and debris scatters), as there was less likelihood for the presence of small single artefacts. MBES data was provided as .xyz data files, which were likewise uploaded into QGIS and rasterised to visualise the data. MBES data was provided at a 2 m resolution.

The sandy featureless seafloor, present across the survey area, is an excellent medium for the identification of cultural material through the use of SSS. This is because cultural objects are generally highly reflective which contrasts with the low reflectivity of sand. Ships with wooden hulls may not necessarily have a high reflection as these sites tend to be flattened or covered by sediment (refer to site formation processes in Section 5.3). Raw SSS images cast shadows as white which signifies an absence of data adjacent to the object. The length of a shadow associated with a high relief object is dictated by the location of the SSS transducer, and how it was positioned relative to the object at the time the data was collected. If this is known, it is then possible to measure the height of the object.

6.2 Data source

6.2.1 *Side Scan Sonar survey*

SSS data was provided as high-resolution black and white geotiffs at a 1m scale from the 2018 DOF Subsea survey (Figure 12). Additionally, 36 targets identified by DOF Subsea during geophysical survey reporting were provided. These were compared against the available SSS and MBES data to assess their potential historical significance and cultural origin (see Table 4).

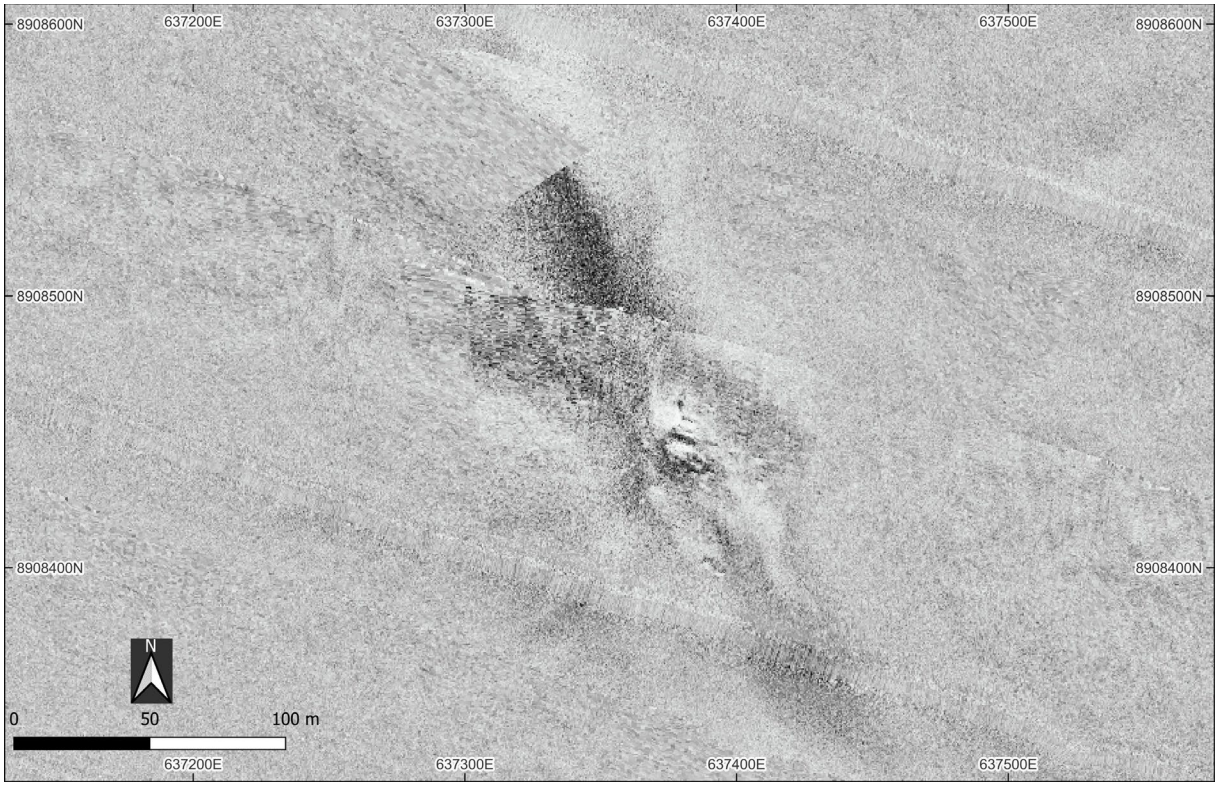


Figure 12: Example of SSS data collected by DOF Subsea in 2018 survey. Note, image on SSS is believed to be location of exploratory well drilling, therefore it is not a listed target.

Table 4: SSS targets identified by DOF Subsea.

Sonar Contact No.	Easting (m)	Northing (m)	Depth (m – LAT)	Description	Length (m)	Width (m)	Height (m)
SC_Bar_IF001	642644.87	8914200.70	-253.72	Unidentified Debris	2.9	1.6	0.3
SC_Bar_IF002	642147.04	8914375.27	-254.89	Unidentified Debris	2.5	2.4	0.3
SC_Bar_IF003	642142.90	8914348.28	-254.85	Unidentified Debris	3.4	1.0	0.2
SC_Bar_IF004	634671.81	8916941.14	-266.37	Unidentified Debris	16.7	6.2	3.0
SC_Bar_IF005	633719.50	8917196.70	-268.43	Unidentified Debris	0.0	0.0	0.0
SC_Bar_IF006	642114.66	8914441.03	-255.31	Unidentified Debris	1.2	0.3	0.0
SC_Bar_IF007	638416.67	8913911.80	-253.08	Unidentified Debris	2.6	1.6	1.2
SC_Bar_IF008	631969.62	8918086.57	-272.33	Unidentified Debris	4.7	0.6	0.4
SC_Bar_IF009	640974.89	8914046.39	-255.29	Unidentified Debris	4.4	0.5	0.0
SC_Bar_IF010	638581.54	8914435.45	-255.81	Unidentified Debris	4.6	0.8	0.0
SC_Bar_IF011	636625.23	8914783.43	-257.40	Unidentified Debris	2.9	0.4	0.0
SC_Bar_IF012	641457.43	8912156.18	-246.36	Unidentified Debris	8.1	2.6	0.0
SC_Bar_IF013	638477.06	8913554.52	-251.56	Unidentified Debris	0.8	0.0	0.0
SC_Bar_IF014	640172.51	8912591.02	-250.73	Unidentified Debris	2.3	0.9	0.0
SC_Bar_IF015	640711.28	8912123.17	-248.16	Unidentified Debris	1.1	0.2	0.0

Sonar Contact No.	Easting (m)	Northing (m)	Depth (m – LAT)	Description	Length (m)	Width (m)	Height (m)
SC_Bar_IF016	638161.80	8911827.64	-243.49	Unidentified Debris	0.3	0.0	0.0
SC_Bar_IF017	637709.44	8911036.83	-240.09	Unidentified Debris	13	5	0.1
SC_Bar_IF018	642623.35	8909215.04	-231.53	Unidentified Debris	2.4	0.7	0.0
SC_Bar_IF019	633442.82	8909398.16	-243.03	Unidentified Debris	3.0	0.8	0.0
SC_Bar_IF020	637947.86	8910038.54	-236.66	Unidentified Debris	5.9	0.7	0.0
SC_Bar_IF021	640687.63	8909081.66	-235.79	Unidentified Debris	2.3	0.3	0.0
SC_Bar_IF022	638322.86	8909384.32	-235.06	Unidentified Debris	6.6	0.7	0.1
SC_Bar_IF023	638255.71	8909348.39	-234.70	Unidentified Debris	2.4	0.7	0.0
SC_Bar_IF024	636379.32	8910080.84	-237.90	Unidentified Debris	2.7	0.3	0.1
SC_Bar_IF025	636745.27	8909386.45	-234.50	Unidentified Debris	3.6	1.0	0.0
SC_Bar_IF026	633934.88	8909264.20	-241.71	Unidentified Debris	2.0	0.3	0.0
SC_Bar_IF027	637307.23	8908009.62	-229.15	Unidentified Debris	2.3	1.0	0.0
SC_Bar_IF028	636757.44	8910966.09	-240.63	Unidentified Debris	2.2	1.9	0.0
SC_Bar_IF029	640221.44	8913318.38	-253.80	Unidentified Debris	4.4	6.5	0.0
SC_Bar_IF030	637311.90	8910001.46	-236.37	Unidentified Debris	0.0	0.0	0.0
SC_Bar_IF031	637578.66	8908742.46	-231.83	Unidentified Debris	3.5	0.7	0.1
SC_Bar_IF032	635688.55	8908478.26	-232.40	Unidentified Debris	2.3	0.3	0.0
SC_Bar_IF033	635026.92	8913722.06	-254.41	Unidentified Debris	2.3	0.6	0.0
SC_Bar_IF034	635014.31	8913718.95	-254.39	Unidentified Debris	2.4	0.5	0.0
SC_Bar_IF035	634990.65	8913750.42	-254.76	Unidentified Debris	2.2	0.9	0.0
SC_Bar_IF036	638022.73	8912174.37	-244.97	Unidentified Debris	4.6	0.3	0.0

6.2.2 *Multi-beam sonar*

MBES bathymetry data was provided in .xyz file format, which was then uploaded to QGIS and rasterised to create geotiff images (Figure 13). MBES data was provided at 2 m resolution.

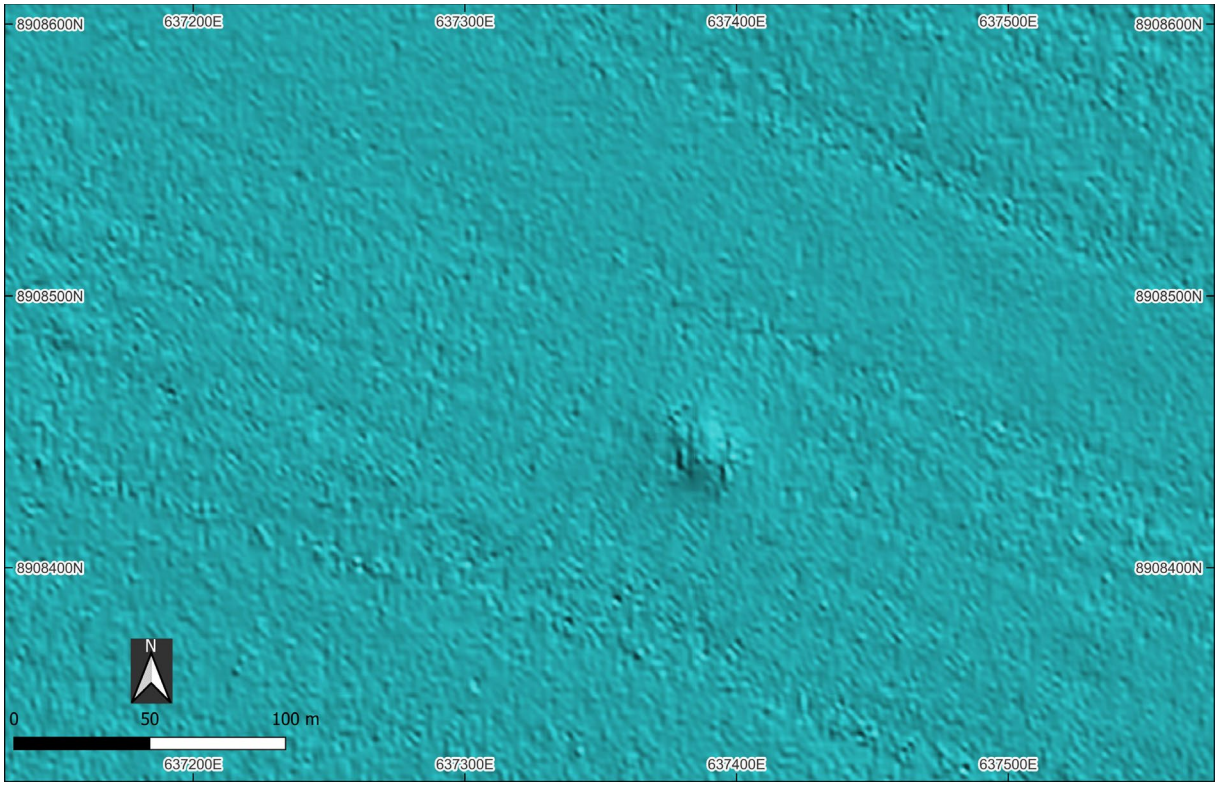


Figure 13: Example of MBES data collected by DOF Subsea in 2018 survey, showing location of exploratory well.

6.3 Limitations

The primary limitation was the lack of magnetometer data. As no magnetometer data was provided for the Barossa Infield proposed works, a more conservative approach to selecting targets was adapted. Targets that might otherwise have been dismissed as cultural were included because of this, as the lack magnetometer data meant that the ferrous content of potential targets could not be identified. The lack of magnetometer data also meant that any ferrous objects that were buried, or were low relief against the seabed, were unlikely to be identified.

6.4 Anomaly Identification

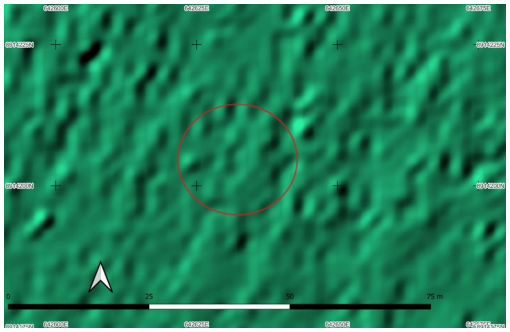
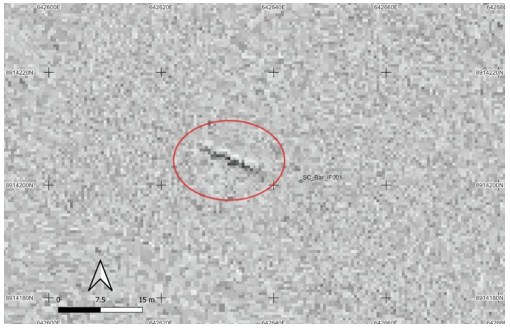
Targets were given arbitrary ID numbers based on the order in which they were identified. Targets identified from the DOF Subsea geophysical report (see Section 6.2.1 and Table 4) use the ID from that report for consistency. Although many targets were initially selected, these were then pared down only to those likely to be cultural. This explains why the numbering reaches 30 although there are only 20 targets listed below.

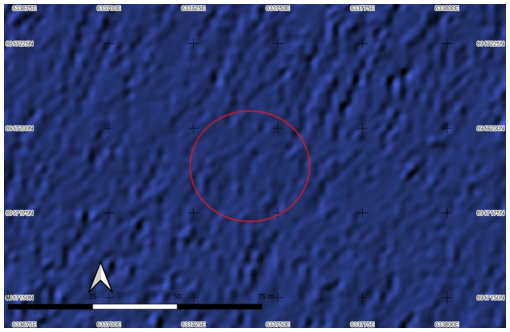
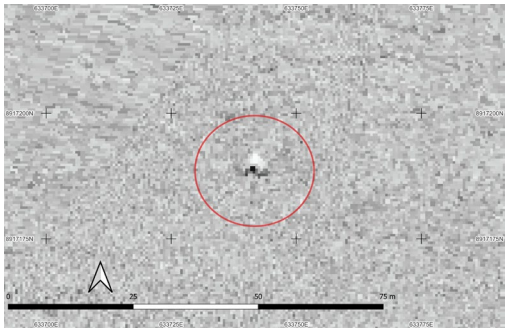
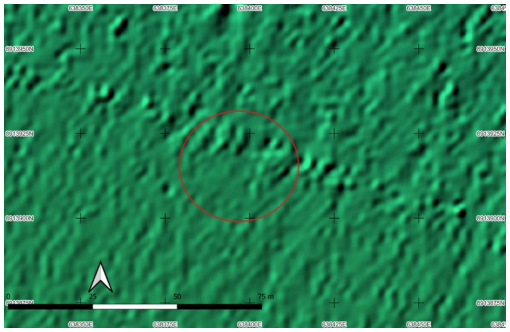
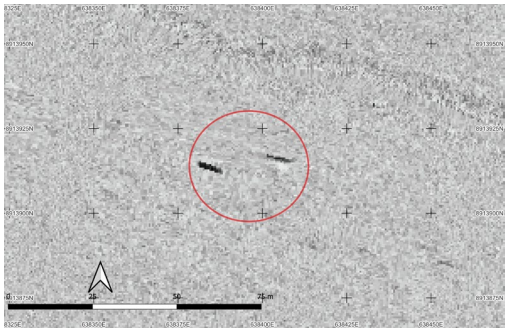
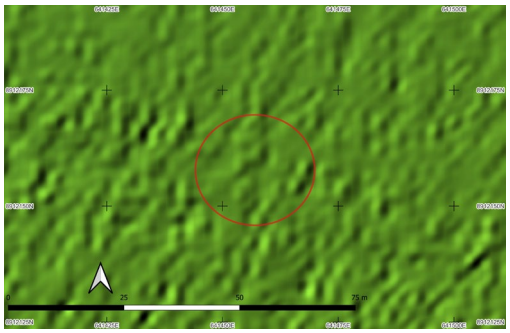
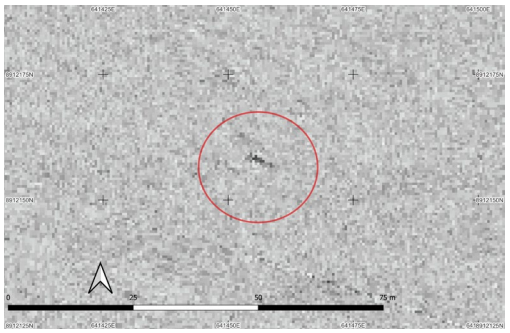
The following table shows the identified geophysical targets, arranged in their priority level for dive survey. The priority level is defined as:

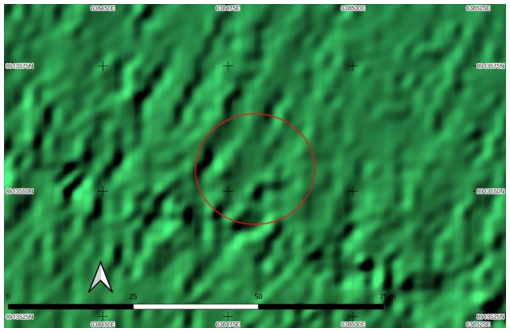
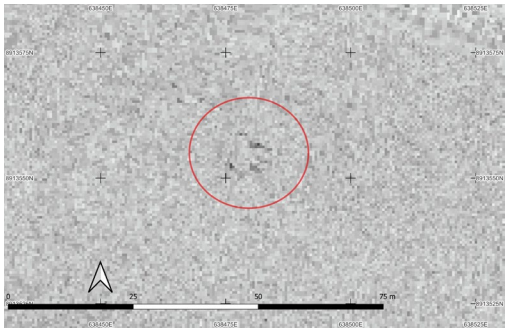
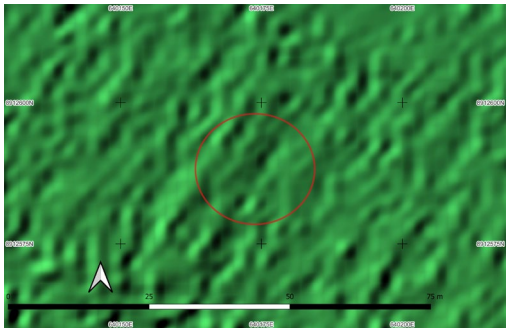
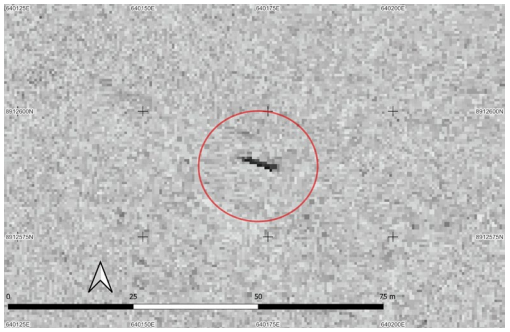
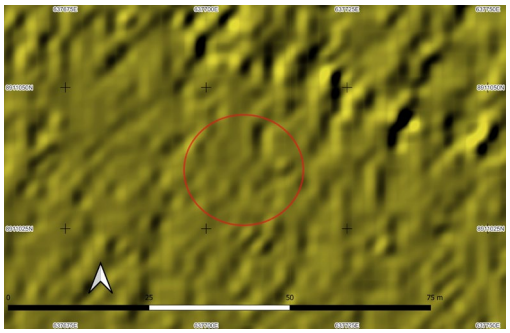
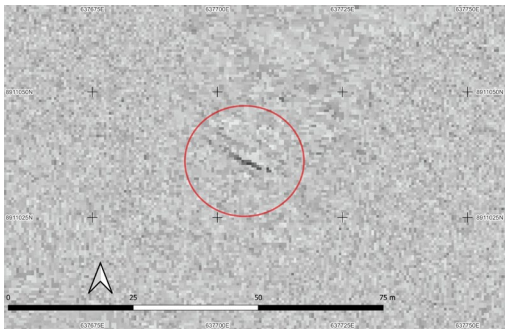
A = Primary – Identified as most likely cultural, as opposed to natural; its significance would need to be determined by visual inspection by remotely operated underwater vehicle (ROV)

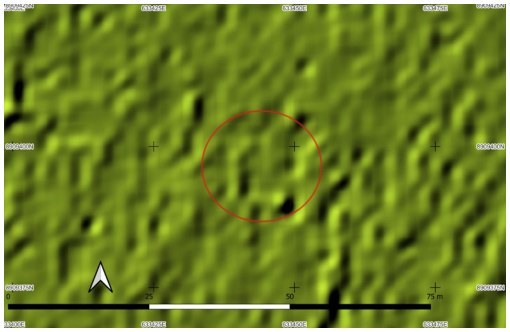
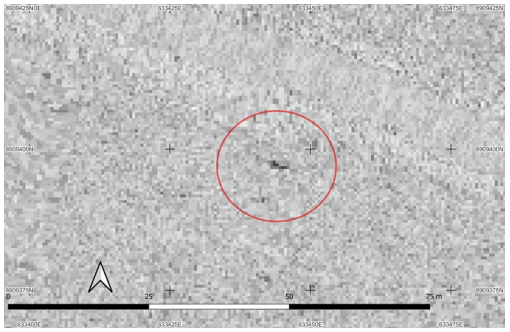
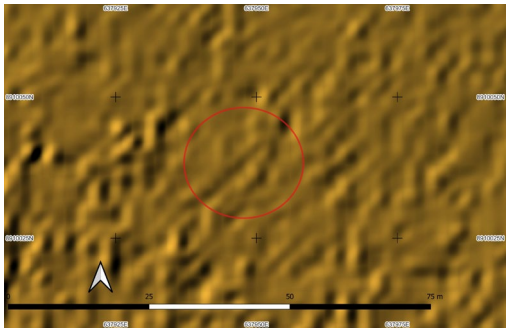
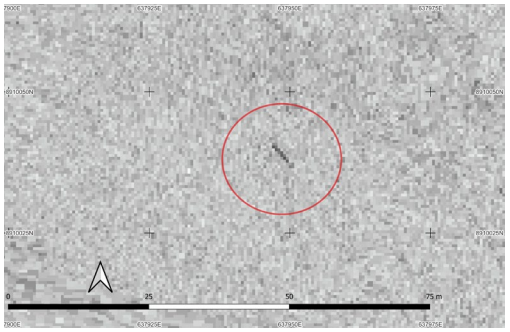
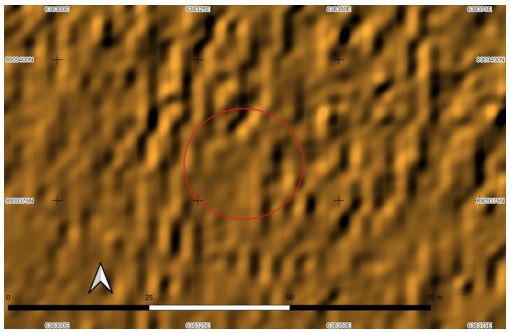
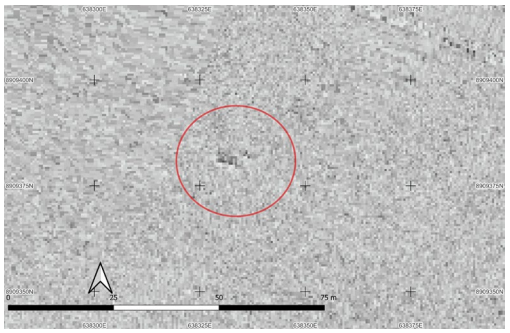
B = Secondary – Possibly cultural, as opposed to natural, or small cultural object such as a single event discard; its significance would need to be determined by ROV

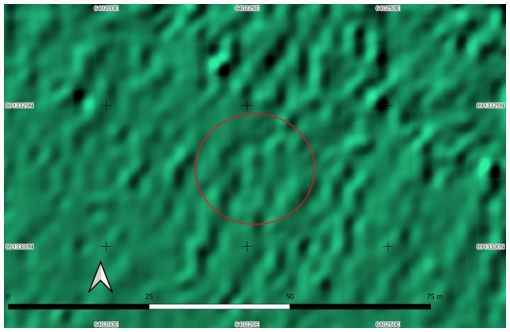
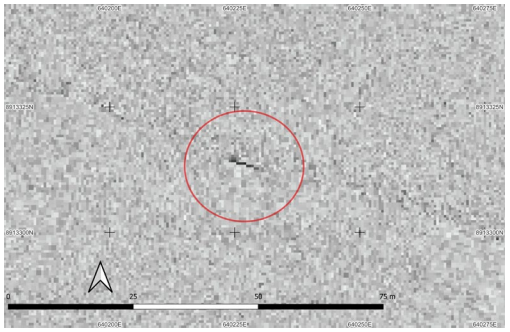
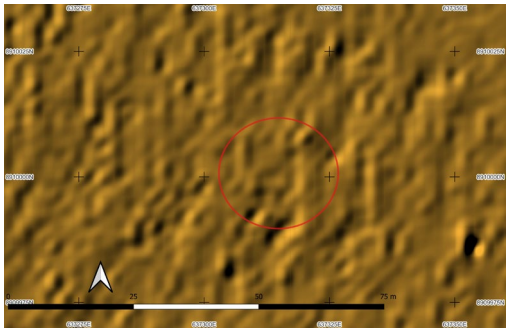
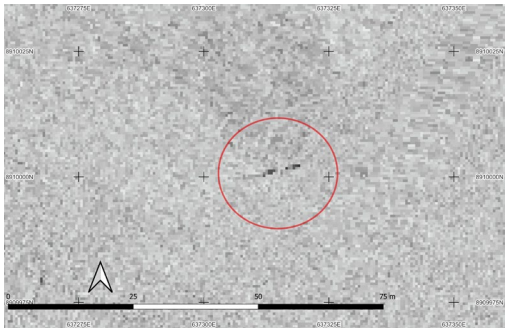
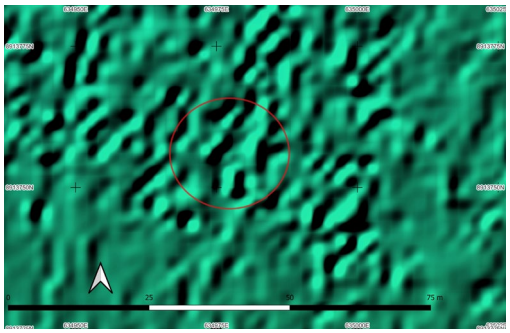
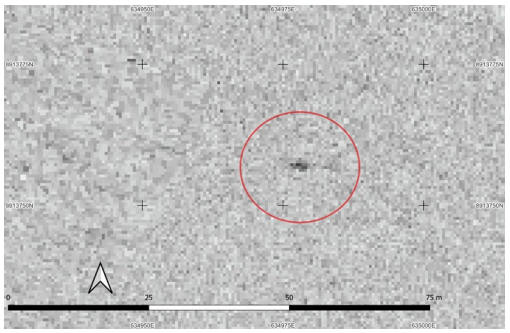
C = Low priority – Identified anthropogenic features determined to be not culturally significant.

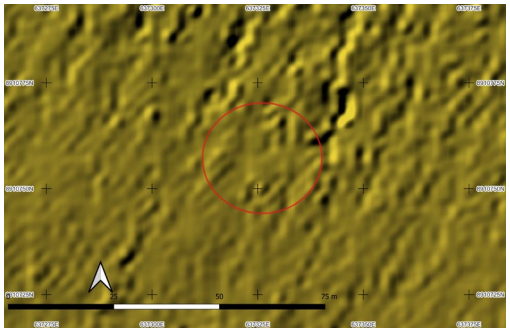
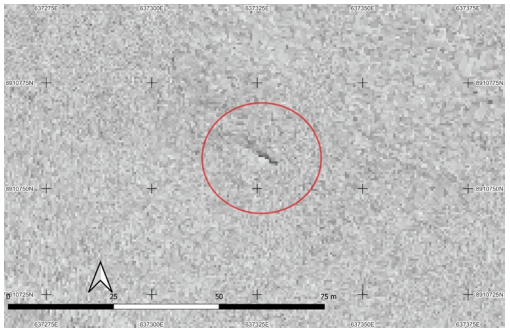
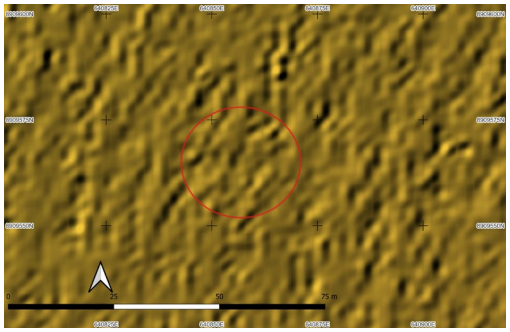
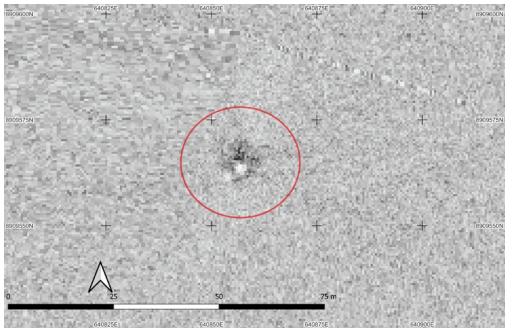
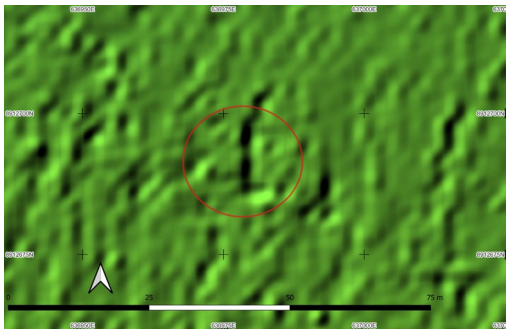
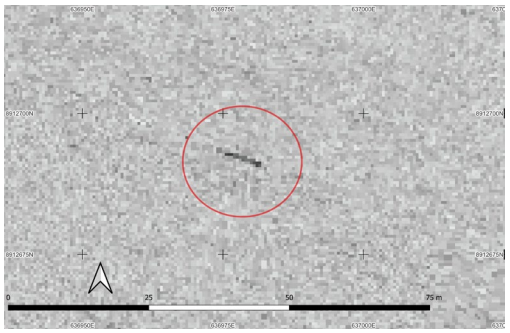
Target ID		Datum: GDA94 UTM Zone 52S		Image MBES	Image SSS	Dimensions (m)	Depth (m)	Distance from nearest works (m)	Nearest infrastructure element
		Easting	Northing						
B	SC_BAR_IF001	642644.87	8914200.70			Length: 2.9 Width: 1.6 Height: 0.3	253	2261	FPSO Mooring line

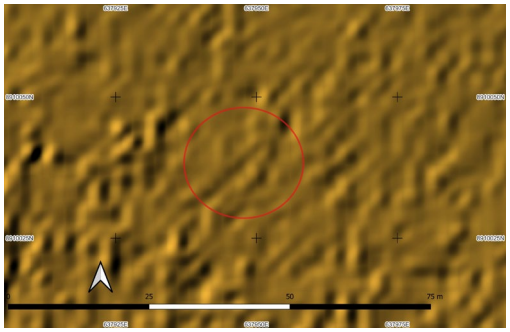
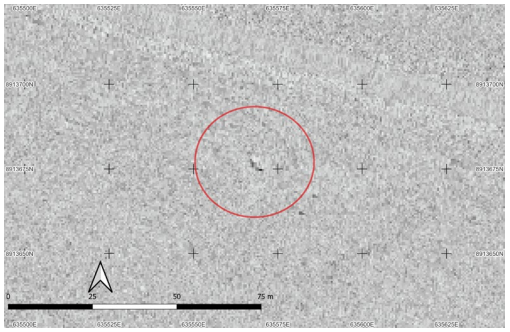
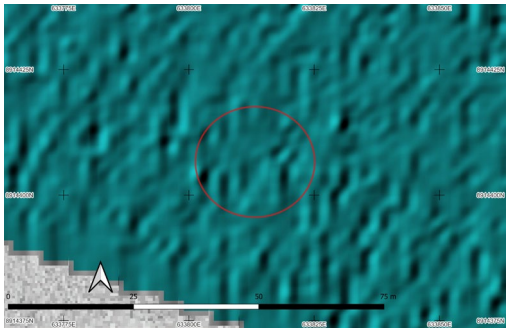
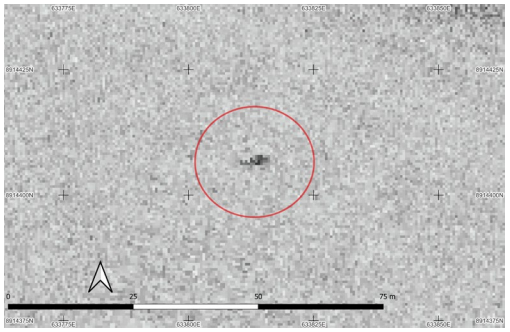
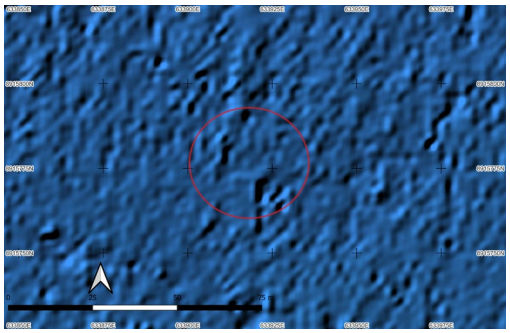
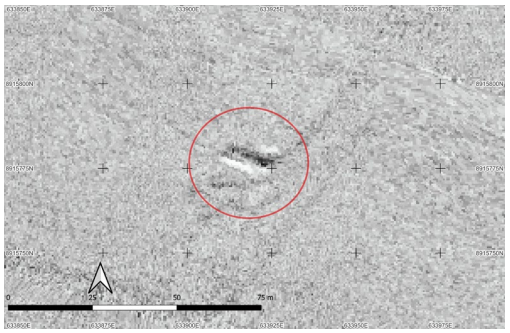
Target ID		Datum: GDA94 UTM Zone 52S		Image MBES	Image SSS	Dimensions (m)	Depth (m)	Distance from nearest works (m)	Nearest infrastructure element
		Easting	Northing						
B	SC_BAR_IF005	633719.50	8917196.70			Length: 0.0 Width: 0.0 Height: 0.0	268	678	N1 production line (between KP 1 and 2)
B	SC_BAR_IF007	638416.67	8913911.80			Length: 2.6 Width: 1.6 Height: 1.2	253	196	GEP
B	SC_BAR_IF012	641457.43	8912156.18			Length: 8.1 Width: 2.6 Height: 0.0	246	585	S2 service line (between KP 3 and 4)

Target ID		Datum: GDA94 UTM Zone 52S		Image MBES	Image SSS	Dimensions (m)	Depth (m)	Distance from nearest works (m)	Nearest infrastructure element
		Easting	Northing						
B	SC_BAR_IF013	638477.06	8913554.52			Length: 0.8 Width: 0.0 Height: 0.0	251	15	FPSO Mooring line
B	SC_BAR_IF014	640172.51	8912591.02			Length: 2.3 Width: 0.9 Height: 0.0	250	39	S2 production line (between KP 4 and 5)
B	SC_BAR_IF017	637709.44	8911036.83			Length: 13.0 Width: 5.0 Height: 0.1	240	353	S1 umbilical (between KP 3 and 4)

Target ID		Datum: GDA94 UTM Zone 52S		Image MBES	Image SSS	Dimensions (m)	Depth (m)	Distance from nearest works (m)	Nearest infrastructure element
		Easting	Northing						
B	SC_BAR_IF019	633442.82	8909398.16			Length: 3.0 Width: 0.8 Height: 0.0	243	1400	S1 drill centre
B	SC_BAR_IF020	637947.86	8910038.54			Length: 5.9 Width: 0.7 Height: 0.0	236	1218	S1 umbilical (between KP 3 and 4)
B	SC_BAR_IF022	638322.86	8909384.32			Length: 6.6 Width: 0.7 Height: 0.1	235	1225	S1 umbilical (between KP 3 and 4)

Target ID		Datum: GDA94 UTM Zone 52S		Image MBES	Image SSS	Dimensions (m)	Depth (m)	Distance from nearest works (m)	Nearest infrastructure element
		Easting	Northing						
B	SC_BAR_IF029	640221.44	8913318.38			Length: 4.4 Width: 6.5 Height: 0.0	253	184	FPSO Mooring line
B	SC_BAR_IF030	637311.90	8910001.46			Length: 0.0 Width: 0.0 Height: 0.0	236	785	S1 umbilical (between KP 2 and 3)
B	SC_BAR_IF035	634990.65	8913750.42			Length: 2.2 Width: 0.9 Height: 0.0	254	281	GEP

Target ID		Datum: GDA94 UTM Zone 52S		Image MBES	Image SSS	Dimensions (m)	Depth (m)	Distance from nearest works (m)	Nearest infrastructure element
		Easting	Northing						
B	CA_04	637324.70	8910757.58			Length: 7.5 Width: 1.4 Height: unk	239	270	S1 umbilical (between KP 3 and 4)
B	CA_07	640857.55	8909564.43			Length: 5.8 Width: 4.8 Height: unk	237	1200	S2 umbilical (between KP 1 and 2)
B	CA_18	636978.79	8912691.60			Length: 7.3 Width: 1.2 Height: unk	247	1130	GEP

Target ID		Datum: GDA94 UTM Zone 52S		Image MBES	Image SSS	Dimensions (m)	Depth (m)	Distance from nearest works (m)	Nearest infrastructure element
		Easting	Northing						
B	CA_20	635568.87	8913676.28			Length: 5.0 Width: 1.9 Height: unk	253	102	GEP
B	CA_21	633814.15	8914406.67			Length: 5.5 Width: 1.6 Height: unk	258	1200	GEP
A	CA_30	633919.69	8915777.08			Length: 15.0 Width: 4.9 Height: 0.3	263	515	N1 umbilical (between KP 1 and 2)

A review of SSS and MBES data from the 2018 survey identified 19 geophysical survey anomalies within the field operational area of the study area. Eighteen anomalies are designated as category B. Target CA_30 is the sole target designated category A and is located over 500 m from the nearest proposed infrastructure location. The size and shape of this anomaly are consistent with the shape of a small boat and may represent a potential shipwreck. The distance between these anomalies and the nearest proposed infrastructure was calculated. Two targets were located within 50 m of proposed infrastructure locations: target SC_BAR_IF013, located 15 m from the FPSO mooring line, and target SC_BAR_IF014, located 39 m from the S2 production line between KP 4 and 5. All other targets are beyond 100 m from nearest proposed infrastructure.

Based on the available information from the marine geophysical survey undertaken for this project, only Target CA_30, located over 500 m from the nearest proposed infrastructure location, appears potentially to be a shipwreck. There does not appear to be the obvious visible remains of a any other shipwrecks, aircraft wrecks, or maritime infrastructure within the survey area. Most of the potential cultural anomalies appear to be either localised fields of debris or isolated objects either discarded or lost. There is a strong possibility that some features are natural, however, the lack of magnetometer or gradiometer data precludes them from being removed from the list of targets.

The cultural heritage significance of these anomalies cannot be definitively stated unless they are inspected by ROV. It can be generally stated however that isolated cultural objects discarded or lost are often of low significance. Larger debris fields may be indication of larger sites, like wrecks, and may be of higher cultural significance.

7 POTENTIAL IMPACTS AND PROPOSED MITIGATION

7.1 Potential physical impacts

Detailed design plans have been provided in several documents and as GIS shapefiles. The primary impacts from infrastructure installation will largely be the placement of anchors, manifolds, and flowlines on the seabed. The drilling of wells will likely have the deepest impact in relation to depth of penetration of the seabed but is localised to three well locations.

With these design plans, the scale and type of impacts from associated drilling and likely infrastructure installation can be assessed. Drilling of wells at three locations (N1, S1, and S2; see Section 1.1, Figure 2) would likely damage or destroy any artefacts or sites, albeit in a very specific location. Installation of spools, flowlines, and manifolds directly on the seabed could disturb or impact larger sites, such as a shipwreck or aircraft wreck, but would likely not destroy such sites.

Twenty anomalies thought to be potential cultural material were identified through review of the geophysical survey data (see Section 6.4). Only two anomalies are located within 50 m of the proposed infrastructure, and the closest target, anomaly SC_BAR_IF019, is located 15 m from the nearest infrastructure. None of the geophysical survey anomalies are deemed likely to be impacted by the proposed infrastructure installation. However, it has been noted by Santos that working vessels may need to anchor during the installation of the three drill centres. Anchoring could affect objects on the seabed within these areas.

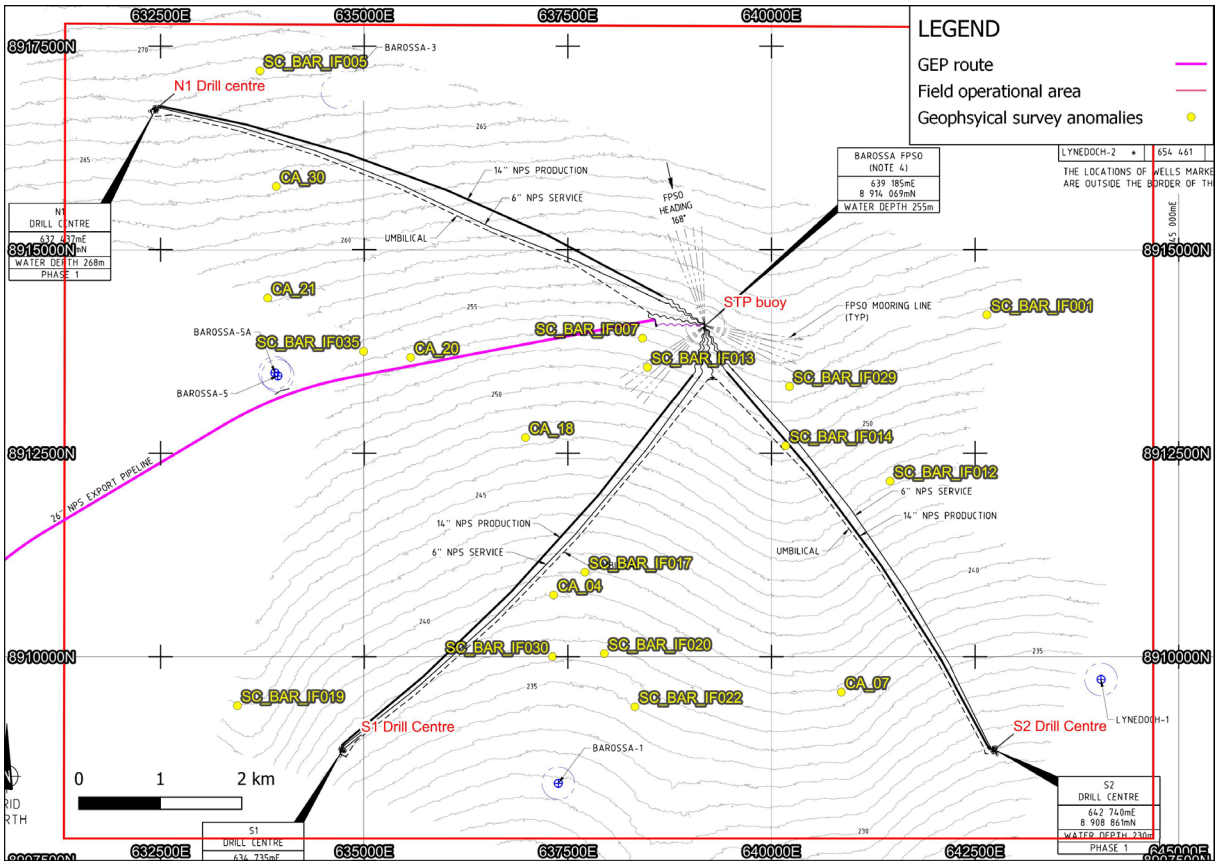


Figure 14: Location of geophysical survey anomalies in relation to proposed infrastructure locations.

7.2 Proposed mitigation

Identified wreck sites are often provided a 50 m buffer to ensure that the body of the wreck and associated debris are not impacted, while smaller objects and isolated targets may have a smaller area avoidance, at least 15 m. None of the anomalies, apart from CA_30, appear to be the visible remains of ship or aircraft wrecks and do not have extensive debris fields around them. CA_30 may be the remains of a small vessel wreck but is determined to have a sufficient distance from proposed infrastructure (515 m) so as not to be likely at risk. None of the anomalies are within 15 m of proposed infrastructure placement, therefore, none are deemed likely to be impacted by infrastructure installation.

It is recommended that if the placement or design of the proposed development changes, the new design is reviewed by a qualified maritime archaeologist.

It is also recommended that any further remote sensing undertaken for the proposed subsea infrastructure should be reviewed by a qualified maritime archaeologist.

It is also recommended that work vessels anchoring for installation of the drill centres avoid placing anchors where they could potentially impact unverified geophysical anomalies.

Finally, though the likelihood of culturally significant maritime archaeological remains being impacted appears low, there is always the possibility of unexpected finds being made during the construction phase. An Unexpected Finds Protocol has been compiled for Santos for use by contractors within the Offshore Development area, as well as the proposed GEP routes.[42] This document outlines the procedures and protocols for identifying, documenting, curating, and reporting any unexpected finds of potential heritage significance.

[42] **Cosmos Archaeology, 2022c,** *Santos (Barossa) Offshore Development: Unexpected Finds Protocol.* Report prepared for Santos Pty Ltd.

8 CONCLUSION

8.1 Summary of findings

A review of historical sources, databases and marine geophysical information has found that;

- The waters of the Timor Sea have been visited over the past four hundred years by Dutch explorers and traders, Macassan trepang traders, and British explorers and attempted settlers.
- Japanese pearling vessels operated in the Timor Sea and near the Tiwi Islands from the late 19th century to the beginning of World War II.
- The study area saw significant military action during World War II, which including the sinking of numerous ships and aircraft within the Timor Sea.
- There are no located shipwrecks, aircraft wrecks, dump sites, maritime infrastructure, or UXO within the study area. The closest shipwreck, the SS *Florence D*, is located approximately 148 km south from the nearest point of the study area.
- There is one unlocated shipwreck recorded to have wrecked within the vicinity of the study area – an Indonesian fishing boat sunk in 1997. This wreck would not be automatically protected under Northern Territory or Commonwealth legislation.
- There are ten unlocated aircraft wrecks recorded to have wrecked within the vicinity of the study area. All ten aircraft are associated with Australian and Japanese air force squadrons operating during World War II.
- The remains of these aircraft, and their contents and fittings, if located within the study area, would be automatically protected under the Cwlth *Underwater Cultural Heritage Act 2018*.
- Side scan sonar data and MBES data from a marine geophysical survey conducted by DOF Subsea in 2018 were reviewed.
- No clear evidence of the presence of a shipwreck or aircraft wreck within the study area was identified.
- Nineteen sonar contacts or anomalies were identified by CA as being probably cultural and hence of potential cultural heritage significance.
- These anomalies could be debris fields or isolated instances of debris and/or discard. Target CA_30 may be the shipwreck remains of a small vessel, and is the only anomaly classified as category A. This anomaly is located over 500 m from the nearest proposed infrastructure location.
- Two anomalies are located within 50 m of proposed infrastructure locations: target SC_BAR_IF013, located 15 m from the FPSO mooring line, and target SC_BAR_IF014, located 39 m from the S2 production line between KP 4 and 5. Both targets appear to potentially be isolated debris, and are designated Category B.
- Infrastructure installation is believed unlikely to impact any geophysical survey anomalies listed as targets in this report. If proposed design for development changes, these changes should be reviewed by a qualified maritime archaeologist.
- It is recommended that if further remote sensing surveys of the proposed subsea infrastructure are undertaken, the additional survey data should be reviewed by a qualified maritime archaeologist.
- Vessels anchoring as part of installation works, especially for the three drill centres, should avoid placing anchors where they may impact unverified geophysical survey anomalies.

- In the unlikely event of significant maritime archaeological remains being discovered during the construction phase an Unexpected Maritime Archaeological Finds Protocol has been prepared to guide the client to responsibly manage such finds.

8.2 Recommendations

The recommendations that are made in this report are based on the findings above and are as follows:

Recommendation 1 ***Review of this report should the design placement of proposed infrastructure change.***

This review should be undertaken by a suitably qualified maritime archaeologist.

Recommendation 2 ***If additional remote sensing data is collected for the proposed subsea infrastructure, it should be reviewed by a qualified maritime archaeologist***

Recommendation 3 ***Vessels anchoring as part of the proposed works should avoid placing anchors where they may impact any unverified geophysical survey anomalies.***

Recommendation 4 ***Prepare and implement an Unexpected Maritime Archaeological Finds Protocol.***

Prior to the commencement of the construction phase an Unexpected Maritime Archaeological Finds Protocol should be prepared by a suitably qualified maritime archaeologist. This protocol should include:

- *Unexpected finds, stop work triggers and notification procedures*
- *Heritage induction for contractors*
- *Recording and reporting methods and procedures*
- *Artefact collection and retention policies*

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Appendix I Santos Barossa oil spill modelling report

SANTOS BAROSSA SURF OPS EP OIL SPILL MODELLING

Report

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Document status

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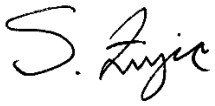
Dr Sasha Zigic  24 August 2023

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TERMS AND ABBREVIATIONS

Terms	Meaning
Actionable oil	Oil which is thick enough for the effective use of mitigation strategies
AMSA	Australian Maritime Safety Authority
API	American Petroleum Institute gravity. A measure of how heavy or light a petroleum liquid is compared to water.
Bonn Agreement	An agreement for cooperation in dealing with pollution of the North Sea by oil and other harmful substances, 1983, includes: Governments of the Kingdom of Belgium, the Kingdom of Denmark, the French Republic, the Federal Republic of Germany, the Republic of Ireland, the Kingdom of the Netherlands, the Kingdom of Norway, the Kingdom of Sweden, the United Kingdom of Great Britain and Northern Ireland and the European Union.
BP	Boiling point. The temperature at which the vapor pressure of the liquid is equal to the pressure exerted on it by the surrounding atmosphere
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
Decay	The process where oil components are changed either chemically or biologically (biodegradation) to another compound. It includes breakdown to simpler organic carbon compounds by bacteria and other organisms, photo-oxidation by solar energy, and other chemical reactions.
Deterministic (single) Oil spill modelling	Oil spill modelling involving a computer simulation of a single hypothetical oil spill event subject to a single sequence of wind, current and other sea conditions over time. Single oil spill modelling, also referred to as “deterministic modelling” provides a simulation of one possible outcome of a given spill scenario, subject to the metocean conditions that are imposed. Single oil spill modelling is commonly used to consider the fate and effects of ‘worst-case’ oil spill scenarios that are carefully selected in consideration of the nature and scale of the offshore petroleum activity and the local environment (NOPSEMA, 2017). Because the outcomes of a single oil spill simulation can only represent the outcome of that scenario under one sequence of metocean conditions, worst-case conditions are often identified from stochastic modelling. It is impossible to calculate the likelihood of any outcome from a single oil spill simulation. Single oil spill modelling is generally used for response planning, preparedness planning and for supporting oil spill response operations in the event of an actual spill
Dynamic viscosity	The dynamic viscosity of a fluid expresses its resistance to shearing flows, where adjacent layers move parallel to each other with different speeds.
Floating oil exposure	Contact by floating oil on the sea surface at concentrations equal to or exceeding defined threshold concentrations. The consequence will vary depending on the threshold and the receptors
HYCOM	Hybrid Coordinate Ocean Model. A data-assimilative, three-dimensional ocean model
HYDROMAP	Advanced ocean/coastal tidal model used to predict tidal water levels, current speed and current direction.
MAHs	Monoaromatic Hydrocarbons
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
PAH	Polynuclear Aromatic Hydrocarbons
Pour Point	The pour point of a liquid is the temperature below which the liquid loses its flow characteristics
Shoreline accumulation	Arrival of oil at or near shorelines at on-water concentrations equal to or exceeding defined threshold concentrations. Shoreline accumulation is judged for floating oil arriving within a 2 km buffer zone from any shoreline as a conservative measure
SIMAP	Spill Impact Model Application Package. SIMAP is designed to simulate the fate and effects of spilled hydrocarbons for surface or subsea releases
Stochastic (multiple) oil spill modelling	Stochastic oil spill modelling is created by overlaying and statistically analysing the outcomes of many single oil-spill simulations of a defined spill scenario, where each simulation was subject to a different sequence of metocean conditions, selected objectively (typically by random selection) from a long sequence of historic conditions for the study area. Analysis of this larger set of simulations provides a more accurate indication of the environment that maybe affected (EMBA) and indicates which location are more likely to be affected (as well as other statistics). Stochastic

	oil spill modelling avoids biases that affect single oil spill modelling (due to the reliance on only one possible sequence of conditions). However, when interpreting stochastic modelling, which is based on a wide range of potential conditions that might happen to occur, it is essential to understand that calculations will encompass a much larger area than could be affected in any single spill event, where a more limited set of conditions will occur. Consequently, it is misleading to imply that the region derived from stochastic modelling indicate the outcomes expected from a single spill event (NOPSEMA, 2017) Stochastic modelling is generally used for risk assessment and preparedness planning by indicating location that could be exposed and may require response or subsequent impact assessment
WGS 1984	World Geodetic System 1984 (WGS84); reference coordinate system

EXECUTIVE SUMMARY

Background

Santos Limited (Santos) is the operator of Barossa gas field, 300 kilometres north of Darwin and will be the source of gas to backfill Darwin LNG when Bayu-Undan ceases production. To support the preparation of the Environmental Plan (EP) and Oil Pollution Emergency Plan (OPEP) for the subsea facilities (SURF), a detailed oil spill modelling study was commissioned to assess the annualised risk and potential exposure from the following hypothetical scenario:

- A 500 m^3 surface release of marine diesel oil (MDO) due to a vessel collision at drill centre S2.

The modelling does not take into consideration any of the spill prevention, mitigation and response capabilities that would be implemented in response to the spill.

Methodology

The modelling study was carried out in stages. Firstly, a 10-year wind and current dataset (2010–2019) that includes the combined influence of large-scale ocean and tidal currents was prepared. Secondly, the currents, winds and detailed oil characteristics were used as inputs in the three-dimensional trajectory and fates model; Spill Impact Model Application Package (SIMAP). The SIMAP model calculates the transport, spreading, entrainment and evaporation of spilled hydrocarbons over time, based on the prevailing wind and current conditions and the physical and chemical properties.

Modelling was conducted using a stochastic (or probabilistic) approach, which involved running 100 spill simulations per season, with each simulation having the same spill information (spill volume, duration and composition of hydrocarbons) but randomly selected start time to ensure a range of wind and current conditions were assessed. Once all 300 simulations were run, the results were combined to determine the annualised potential exposure to the surrounding waters, shorelines and sensitive receptors based on the thresholds outlined in the NOPSEMA Oil Spill Modelling Bulletin (NOPSEMA, 2019).

Oil Characteristics

The MDO used as model input has a density of 829.1 kg/m^3 (API gravity of 37.6) and a dynamic viscosity of 4.0 cP at 25ºC. MDO is characterised by a high percentage of volatile components (95%), which will evaporate when on the sea surface. It also contains 5% persistent hydrocarbons, which will not evaporate, though will decay over time. It is classified as a Group II light persistent oil. It is important to note that the low volatile and persistent components contained in MDO have a strong tendency to physically entrain into the upper water column in the presence of moderate winds (i.e. >12 knots) and breaking waves but can re-float to the surface when the winds ease.

Summary of Modelling Results

- Floating oil concentrations ≥1 g/m^2 could extend up to 402 km from the release location with the distance reducing to 136 km and 35 km as the thresholds increase to 10 g/m^2 and 50 g/m^2, respectively.
- Outer Oceanic Shoals AMP and Sunrise Bank recorded the highest probability of floating oil exposure at 1.33% to concentrations exceeding 1 g/m^2. Floating oil at the same threshold was predicted to reach Sunrise Bank the quickest at 50 hours following the spill commencement.
- No shoreline accumulation was predicted for the 100 g/m^2 and 1,000 g/m^2 thresholds. The highest probability of shoreline oil accumulation at the 10 g/m^2 threshold was forecast for Indonesia-East (0.99%). The maximum volume of oil ashore was 8 m^3 for the same receptor and Indonesia-East was

forecast to record the quickest time before oil accumulation at the 10 g/m^2 threshold at 283 hours (11.8 days).

- Entrained hydrocarbon concentrations exceeding 10 ppb may potentially occur 1,071 km from the release location, with the distance reducing to 591 km as the threshold increases to 100 ppb.
- The probability exposure by entrained hydrocarbon concentrations equal to or greater than 10 ppb and 100 ppb was predicted to be greatest at the Sunrise Bank (20.0% and 12.00%, respectively). The quickest time for exposure at or above 10 ppb was 39 hours for the Sunrise Bank receptor.
- No dissolved hydrocarbon concentrations exceeding 400 ppb were predicted. Concentrations exceeding 10 ppb may potentially occur 322 km from the release location with the distance reducing to 116 km as the exposure threshold increases to 50 ppb.
- The probability of dissolved hydrocarbon exposure at concentrations equal to or greater than 10 ppb is greatest at Sunrise Bank (1.67%), followed by the Outer Oceanic Shoals AMP (0.66%).

1 INTRODUCTION

1.1 Background

Santos Limited (Santos) is the operator of the Barossa gas field, which is an offshore natural gas development located approximately 300 kilometres north-west of Darwin. The development will backfill gas supply to the existing Darwin LNG (DLNG) facility at Wickham Point.

The development is located in Commonwealth waters within petroleum production licence NT/L1 and involves producing natural gas and condensate through subsea wells and a network of subsea flowlines and marine risers to a Floating, Production, Storage and Offloading (FPSO) vessel. Processing will occur on the FPSO to separate the natural gas and condensate. The condensate will be transferred from the FPSO to specialised offtake tankers for export. Gas will be transported from the FPSO to DLNG via a new 262 km Barossa Gas Export Pipeline (Barossa GEP) connected to the existing Bayu-Undan to Darwin pipeline.

To support the preparation of the Environmental Plan (EP) and Oil Pollution Emergency Plan (OPEP) for the subsea facilities (SURF), a detailed oil spill modelling study was commissioned to assess the annualised (any time of year) risk and potential exposure from the following hypothetical scenario:

- A 500 m^3 surface release of marine diesel oil (MDO) due to a vessel collision at drill centre S2.

The coordinates of the release location are presented in Table 1.1 and are illustrated in Figure 1.1.

The spill modelling was performed using an advanced three-dimensional trajectory and fates model; Spill Impact Model Application Package (SIMAP). The SIMAP model calculates the transport, spreading, entrainment and evaporation of spilled hydrocarbons over time, based on the prevailing wind and current conditions and the physical and chemical properties. The modelling does not take into consideration any of the spill prevention, mitigation and response capabilities that would be implemented in response to the spill.

The hydrocarbon spill model, the method and analysis applied herein uses modelling algorithms which have been peer reviewed and published in international journals. Further, RPS warrants that this work meets and exceeds the American Society for Testing and Materials (ASTM) Standard F2067-13 "*Standard Practice for Development and Use of Oil Spill Models*".

Table 1.1 Coordinates of the oil spill modelling release location.

Location	Latitude*	Longitude*	Water depth (m)
Drill centre S2	9° 52' 6.19" S	130° 18' 6.48" E	230

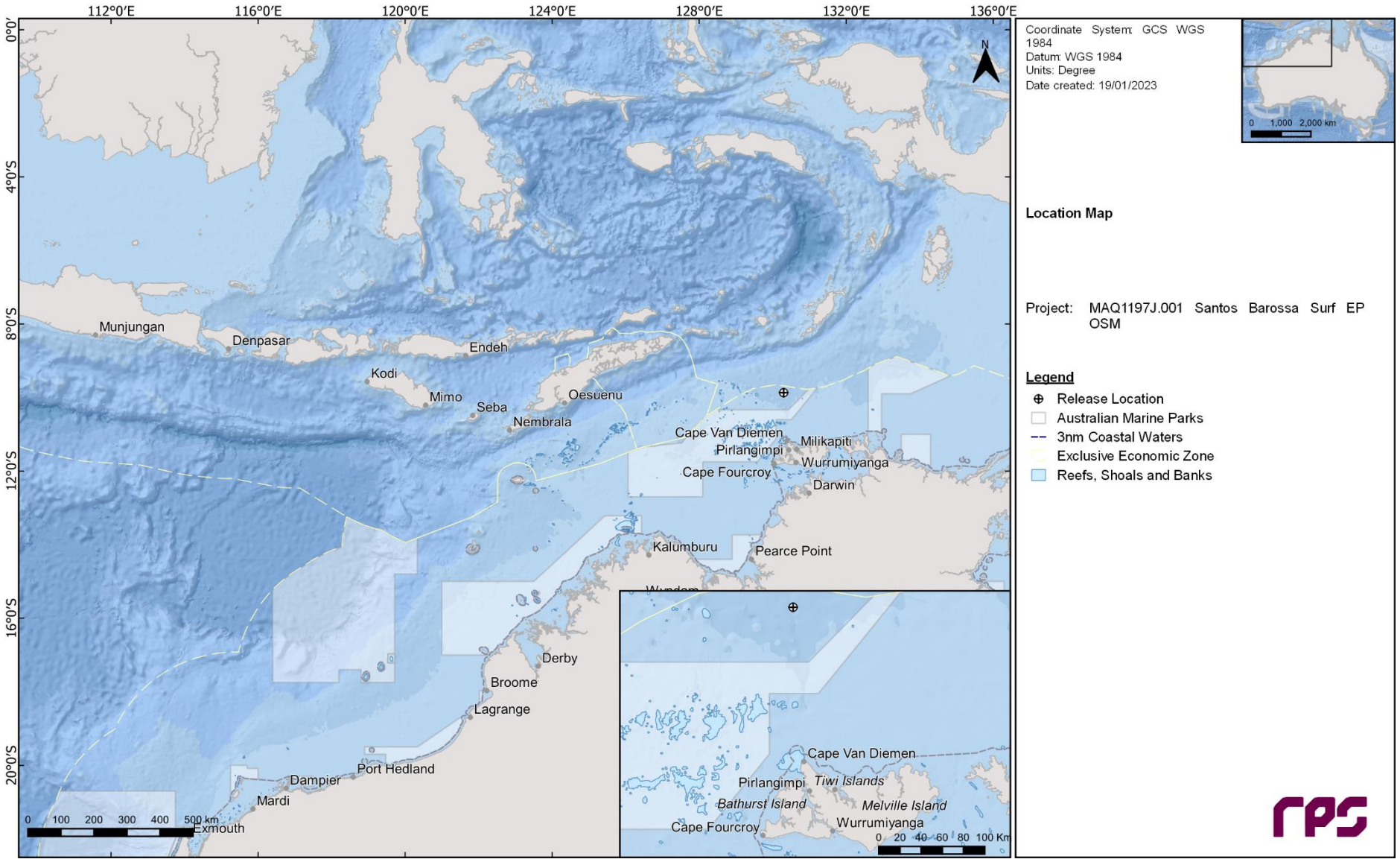

Figure 1.1 Oil spill modelling release location.

What is Oil Spill Modelling?

Oil spill modelling is a valuable tool widely used for risk assessment, emergency response and contingency planning where it can be particularly helpful to proponents and decision makers. By modelling a series of the most likely oil spill scenarios, decisions concerning suitable response measures and strategic location for deploying equipment and materials can be made, and the location at most risk can be identified. The two types of oil spill modelling often used are stochastic and deterministic modelling.

In this study, oil spill modelling was undertaken using a three-dimensional oil spill trajectory and weathering model, SIMAP (Spill Impact Model Application Package), which is designed to simulate the transport, spreading and weathering of specific oil types under the influence of changing meteorological and oceanographic forces. For the subsea release near-field subsurface discharge modelling was undertaken using OILMAP, which predicts the centreline velocity, buoyancy, width and trapping depth (if any) of the rising gas and oil plumes.

1.1.1 Stochastic Modelling (Multiple Spill Simulations)

Stochastic oil spill modelling is created by overlaying a great number (often hundreds) of individual, computer-simulated hypothetical spills (NOPSEMA, 2018; Figure 1.2).

Stochastic modelling is a common means of assessing the potential risks from oil spills related to new projects and facilities. Stochastic modelling typically utilises hydrodynamic data for the location in combination with historic wind data. Typically, 100 simulations are run, which sufficiently samples the historic dataset that is most relevant to the season or timing of the project.

The outcomes are often presented as a probability of exposure and is primarily used for risk assessment purposes in view to understand the range of environments that may be affected or impacted by a spill. Elements of the stochastic modelling can also be used in oil spill preparedness and planning.

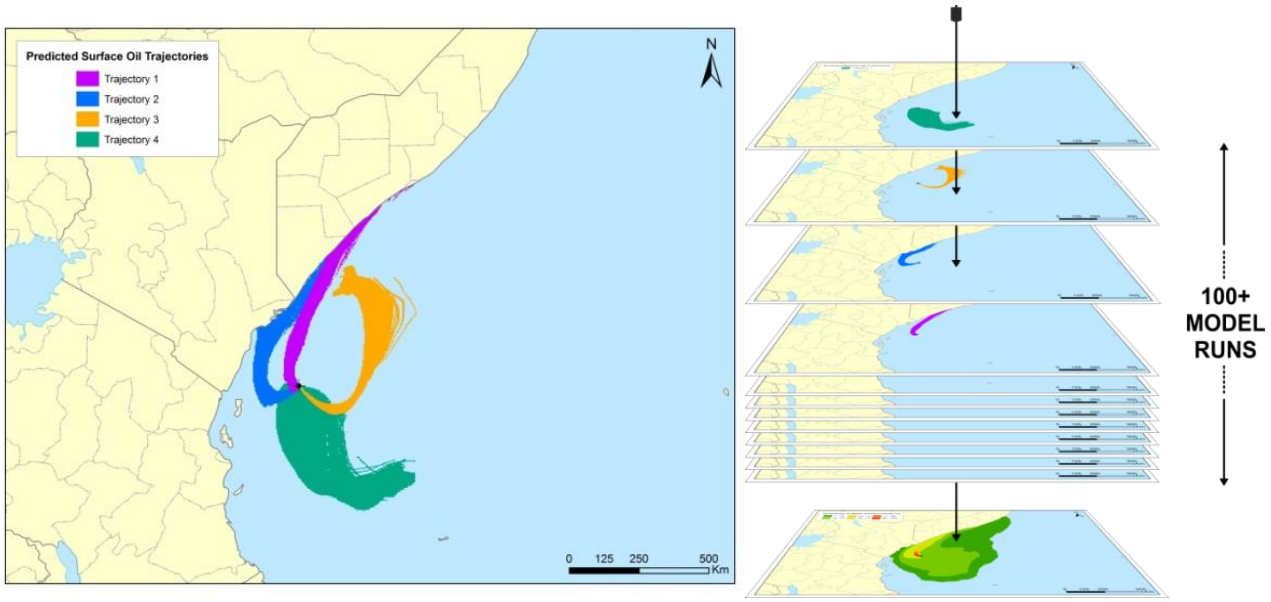

Figure 1.2 Examples of four individual spill trajectories (four replicate simulations) predicted by SIMAP for a spill scenario (left pane). The frequency of contact with given location is used to calculate the probability of impacts during a spill. Essentially, all model runs are overlain (shown as the stacked runs on the right) and the number of times that trajectories contact a given location at a concentration is used to calculate the probability.

1.1.2 Deterministic Modelling (Single Spill Simulation)

Deterministic modelling is the predictive modelling of a single incident subject to a single sample of wind and weather conditions over time (NOPSEMA, 2018).

Deterministic modelling is often paired with stochastic modelling to place the large stochastic footprint into perspective. This deterministic analysis is generally a single run selected from the stochastic analysis and serves as the basis for developing the spill response or scientific monitoring plans.

2 SCOPE OF WORK

The scope of work included the following components:

1. Generate 10 years (2010 to 2019 (inclusive)) of wind and current data. The three-dimensional current data includes the combined influence of ocean and tidal currents;
2. Include the wind data, current data and oil properties into the three-dimensional oil spill model; SIMAP, to model the movement, spreading, entrainment, weathering and potential shoreline accumulation over time;
3. Run 100 simulations for each season (i.e. 300 simulations total), with each simulation having the same spill information (location, volume, duration and oil properties) but randomly varying start times. This ensured that each spill simulation was subjected to unique wind and current conditions;
4. Combine the results from the 300 spill simulations to determine the annualised potential exposure to the surrounding waters, shorelines and sensitive receptors based on the thresholds outlined in the NOPSEMA Oil Spill Modelling Bulletin (NOPSEMA 2019);
5. Identify and present deterministic simulations to inform spill response; and
6. Investigate if a 10% reduction in the fuel tank spill volume would reduce the potential risk of exposure to the Tiwi Islands.

3 REGIONAL CURRENTS

The study site is located within the influence of the Indonesian Throughflow, a large-scale current system characterised as a series of migrating gyres and connecting jets that are steered by the continental shelf. As these gyres migrate through the area, large spatial variations in the speed and direction of currents will occur at a given location over time. The Holloway current, which flows southwest and close to the coastline, intensifies during April to July due to increased wind forcing.

A comprehensive description of the circulation patterns of the Northwest Shelf and Bonaparte Gulf is provided in a review by Condie & Andrewartha (2008). A schematic of the ocean currents along the Northwest Australian continental shelf is shown in Figure 3.1.

While, the tidal currents are generally weaker in the deeper waters, its influence is greatest along the near shore, coastal passage regions and, in and around islands. Therefore, to accurately account for the movement of an oil spill, which can move between the nearshore and offshore region, ocean and tidal currents were combined as part of the study.

Figure 3.2 to Figure 3.4 present summer, winter and transitional current trends within the Timor Sea.

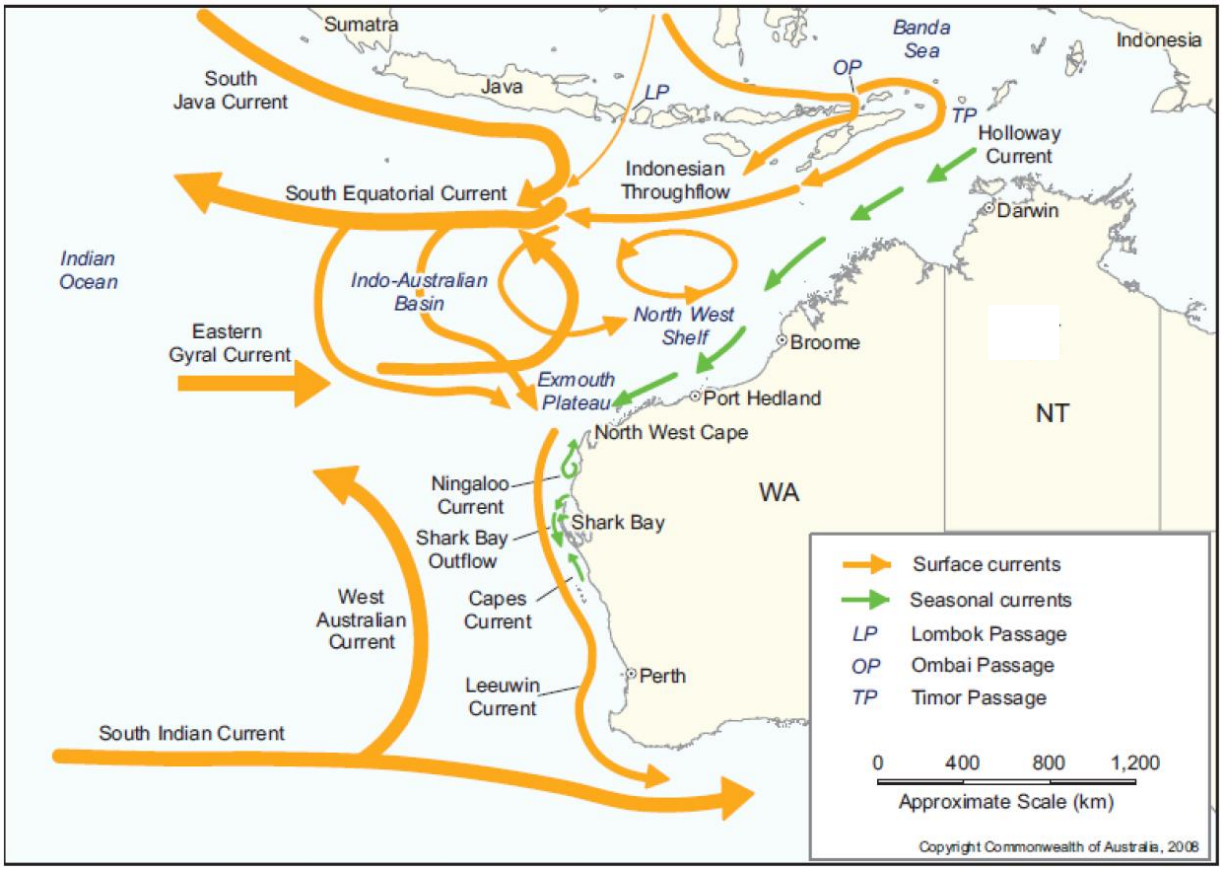

Figure 3.1 Schematic of ocean currents along the Northwest Australian continental shelf. Image adapted from DEWHA (2008).

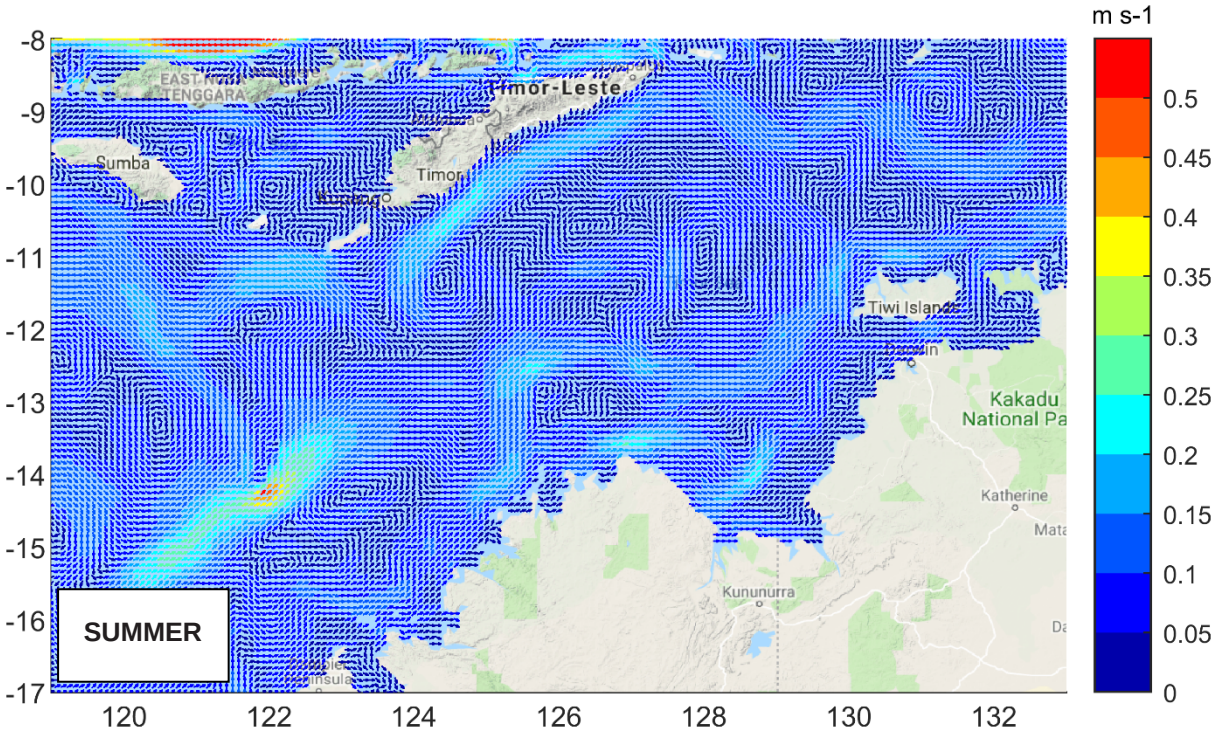

Figure 3.2 **Example surface drift currents during summer (vectors display a snapshot of current directions during the summer period).**

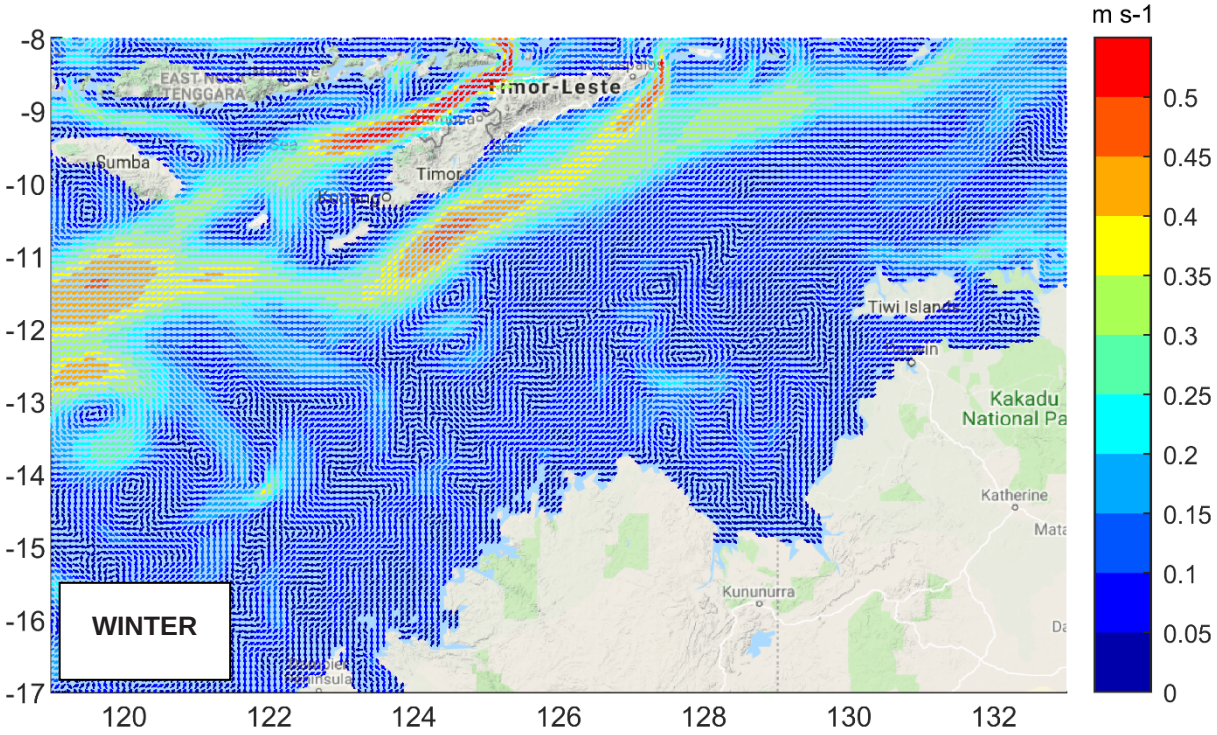

Figure 3.3 **Example surface drift currents during winter (vectors display a snapshot of current directions during the winter period).**

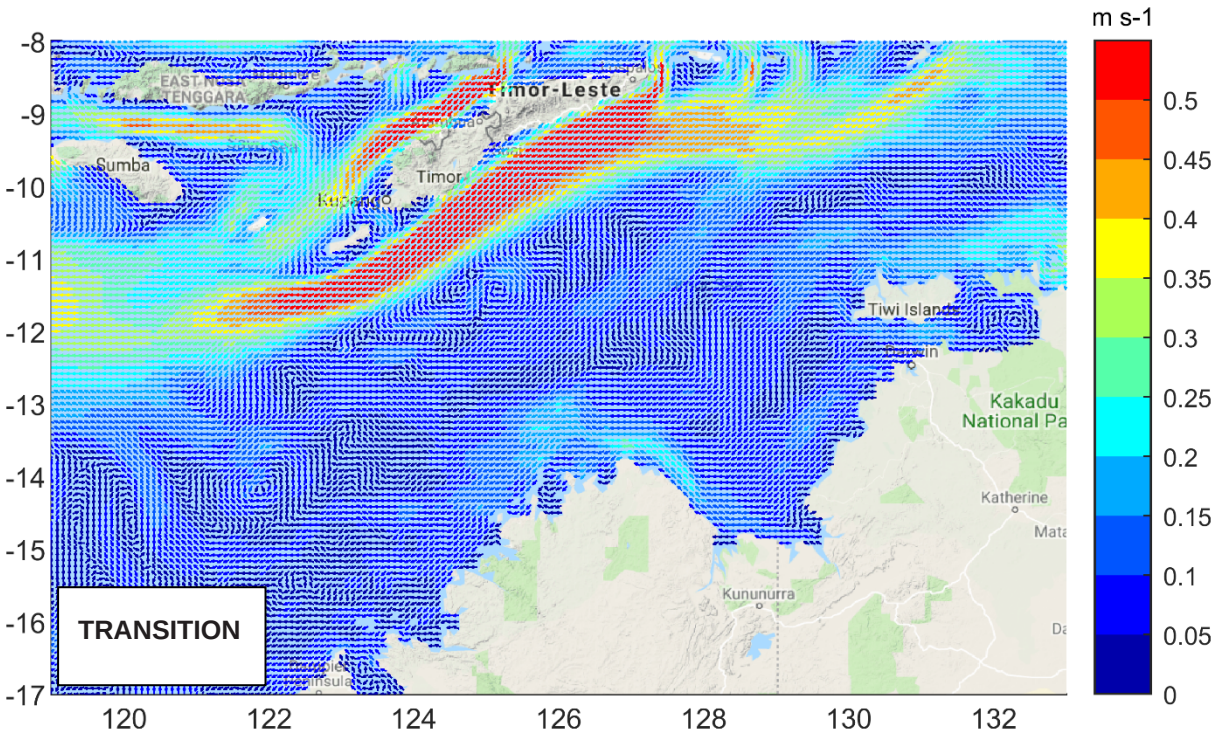

Figure 3.4 Example surface drift currents during the transition period (vectors display a snapshot of current directions during the transition period).

3.1 Tidal Currents

Tidal current data was generated using RPS's advanced ocean/coastal model, HYDROMAP. The HYDROMAP model has been thoroughly tested and verified through field measurements throughout the world over the past 38 years (Isaji & Spaulding, 1984; Isaji, et al., 2001; Zigic, et al., 2003). HYDROMAP tidal current data has been used as input to forecast (in the future) and hindcast (in the past) pollutant spills in Australian waters and forms part of the Australian National Oil Spill Emergency Response System operated by AMSA (Australian Maritime Safety Authority).

HYDROMAP employs a sophisticated sub-gridding strategy, which supports up to six levels of spatial resolution, halving the grid cell size as each level of resolution is employed. The sub-gridding allows for higher resolution of currents within areas of greater bathymetric and coastline complexity, and/or of particular interest to a study.

The numerical solution methodology follows that of Davies (1977a and 1977b) with further developments for model efficiency by Owen (1980) and Gordon (1982). A more detailed presentation of the model can be found in Isaji & Spaulding (1984) and Isaji et al. (2001).

3.1.1 Grid Setup

The tidal model domain has been sub-gridded to a resolution of 500 m for shallow and coastal regions, starting from an offshore (or deep water) resolution of 8 km. The finer grids were allocated in a step-wise fashion to resolve flows more accurately along the coastline, around islands and over regions with more complex bathymetry.

A combination of datasets was used and merged to describe the shape of the seabed within the grid domain (Figure 3.5). These included spot depths and contours which were digitised from nautical charts released by the hydrographic offices as well as Geoscience Australia database and depths extracted from the Shuttle Radar Topography Mission (SRTM30_PLUS) Plus dataset (see Becker et al., 2009).

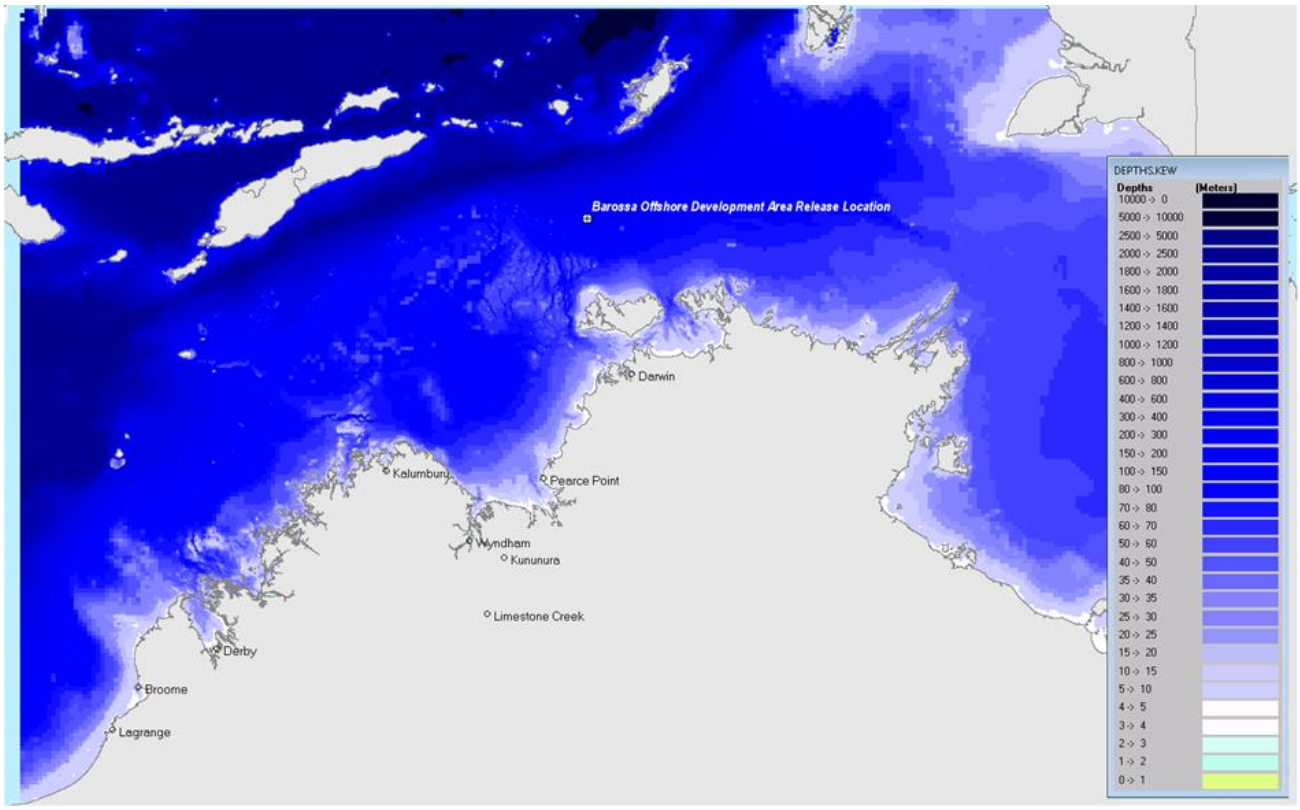

Figure 3.5 Zoomed in view of the bathymetry defined for the tidal model domain.

3.1.2 Tidal Conditions

The ocean boundary data for the regional model was obtained from satellite measured altimetry data (TOPEX/Poseidon 7.2) which provided estimates of the eight dominant tidal constituents at a horizontal scale of approximately 0.25 degrees. The eight major tidal constituents used were K_2, S_2, M_2, N_2, K_1, P_1, O_1 and Q_1. Using the tidal data, surface heights were firstly calculated along the open boundaries, at each time step in the model.

The TOPEX/Poseidon satellite data has a global resolution of 0.25 degrees and is produced and quality controlled by NASA (National Aeronautics and Space Administration). The satellites equipped with two highly accurate altimeters and capable of taking sea level measurements with an accuracy of ± 5 cm measured oceanic surface elevations (and the resultant tides) for over 13 years (1992–2005). In total, these satellites carried out 62,000 orbits of the planet.

The TOPEX/Poseidon tidal data has been widely used amongst the oceanographic community, being included in more than 2,100 research publications (e.g. Andersen, 1995; Ludicone et al., 1998; Matsumoto et al., 2000; Kostianoy et al., 2003; Yaremchuk & Tangdong, 2004; Qiu & Chen 2010). As such the TOPEX/Poseidon tidal data is considered suitably accurate for this study.

3.2 Ocean Currents

Data describing the flow of ocean currents was obtained from HYCOM (Hybrid Coordinate Ocean Model, (Chassignet et al., 2007), which is operated by the HYCOM Consortium, sponsored by the National Ocean Partnership Program (NOPP), as part of the U.S. Global Ocean Data Assimilation Experiment (GODAE). HYCOM is a data-assimilative, three-dimensional ocean model that is run as a hindcast (for a past period), assimilating time-varying observations of sea surface height, sea surface temperature and in-situ temperature and salinity measurements (Chassignet et al., 2009). The HYCOM predictions for drift currents are produced at a horizontal spatial resolution of approximately 8.25 km (1/12th of a degree) over the region, at a frequency of every 3 hours. HYCOM uses isopycnal layers in the open, stratified ocean, but uses the

layered continuity equation to make a dynamically smooth transition to a terrain following coordinate in shallow coastal regions, and to z-level coordinates in the mixed layer and/or unstratified seas.

For this study, the HYCOM hindcast currents were obtained for the years 2010 to 2019 (inclusive).

3.3 Surface Currents

Figure 3.6 and Figure 3.7 present the monthly and total current roses in the vicinity of the release location. Note the convention for defining current direction throughout this report is the direction the current flows towards. Each branch of the current rose distribution represents the currents flowing to that direction, with north to the top of the diagram. The branches are divided into segments of different colour, which represent the current speed ranges for each direction. Speed intervals of 0.1 m/s are typically used in these current roses. The length of each coloured segment within a branch is proportional to the frequency of currents flowing within the corresponding speed and direction.

The month average surface current speeds in the vicinity of the release location ranged between 0.15 m/s (February) and 0.33 m/s (May). Additionally, the monthly maximums ranged between 0.51 m/s (August) and 0.77 m/s (May). The general annual current directions were predominantly towards the west.

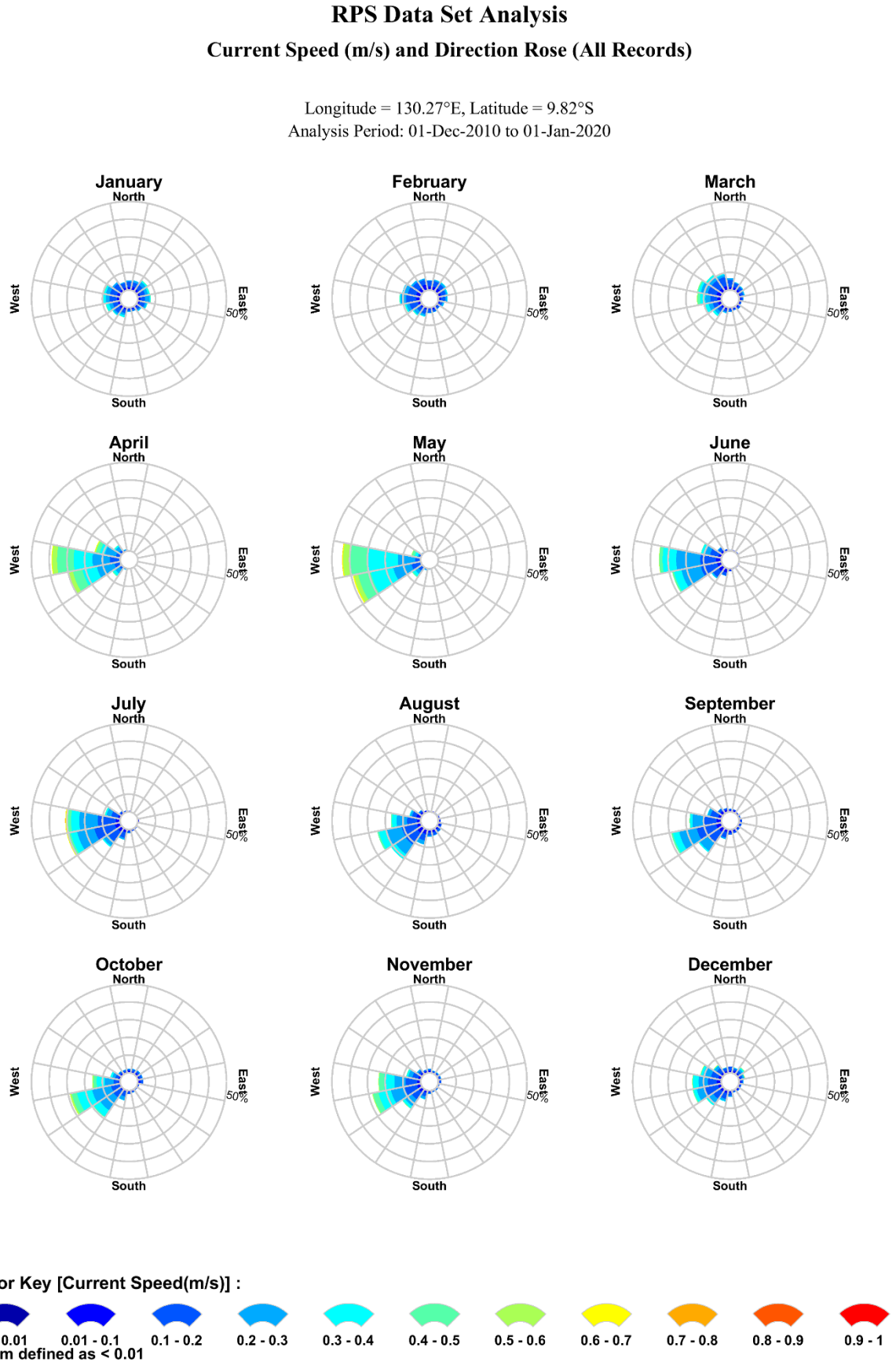

Figure 3.6 Monthly surface current rose distributions at the release location, derived from the 2010 to 2019 modelled dataset.

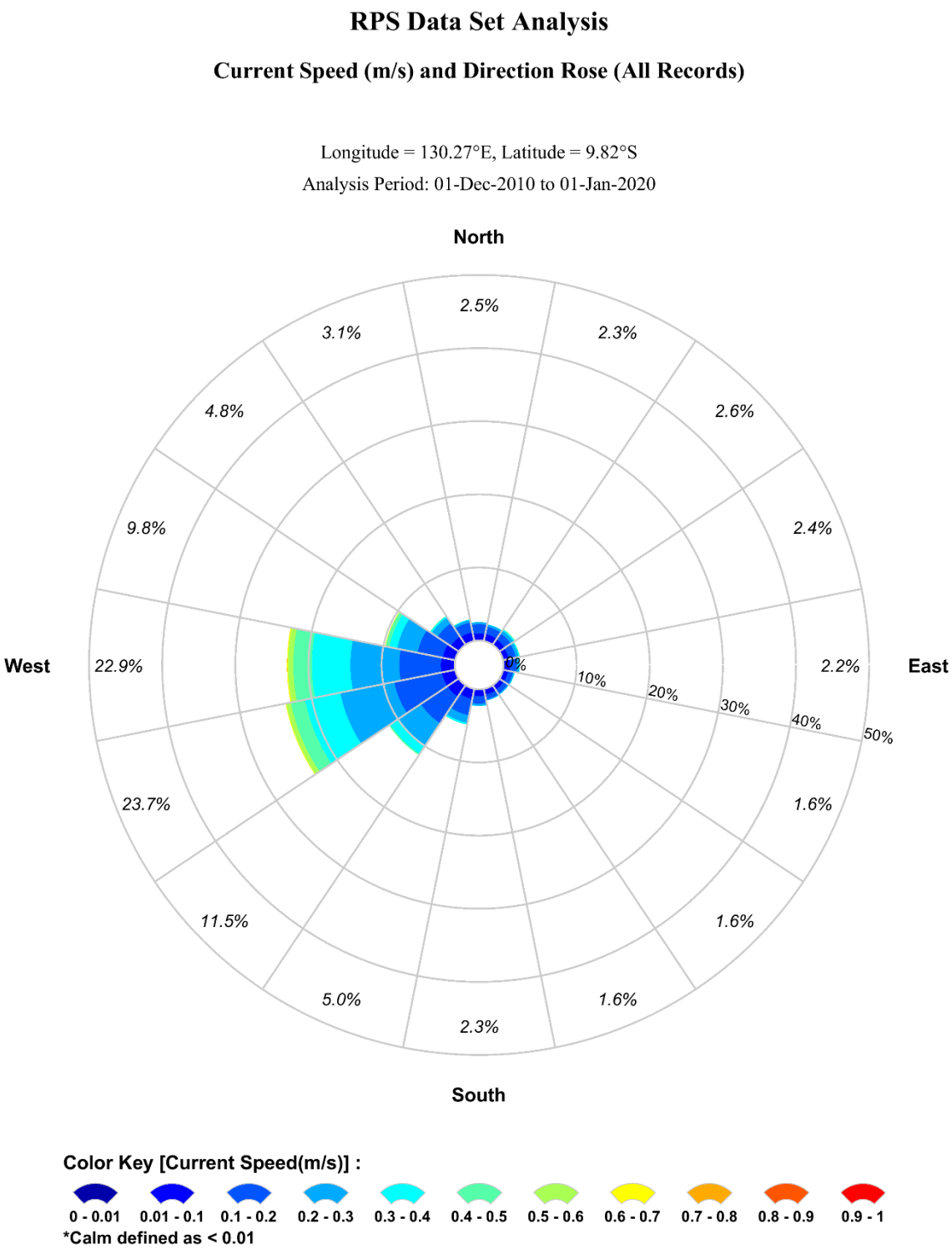

Figure 3.7 Total surface current rose plot at the release location, derived from the 2010 to 2019 modelled dataset.

4 WIND DATA

To account for the influence of the wind on the floating oil, wind data from 2010 to 2019 (inclusive) was sourced from the National Centre for Environmental Prediction (NCEP) Climate Forecast System Reanalysis (CFSR; see Saha et al., 2010). The CFSR wind model includes observations from many data sources; surface observations, upper-atmosphere air balloon observations, aircraft observations and satellite observations. The model is capable of accurately representing the interaction between the earth's oceans, land and atmosphere. The gridded wind data output is available at ¼ of a degree resolution (~33 km) and 1-hourly time intervals. Figure 4.1 shows the spatial resolution of the wind field used as input into the oil spill model.

Figure 4.2 and Figure 4.3 illustrates the monthly and total wind rose distributions near the release location, respectively.

Note that the atmospheric convention for defining wind direction, that is, the direction the wind blows from, is used to reference wind direction throughout this report. Each branch of the rose represents wind coming from that direction, with north to the top of the diagram. Sixteen directions are used. The branches are divided into segments of different colour, which represent wind speed ranges from that direction. Speed ranges of 5 knot intervals are typically used in these wind roses. The length of each segment within a branch is proportional to the frequency of winds blowing within the corresponding range of speeds from that direction.

The model wind data demonstrated that this region typically experiences moderate winds all year round and with monthly average wind speeds ranging between 5.5 knots (November) to 15.2 knots (June). The maximum monthly wind speeds ranged between 18.5 knots (November) and 37.1 knots (January). Winds typically blow from the west during the summer months, while winds are typically much stronger and from the southeast during the winter months.

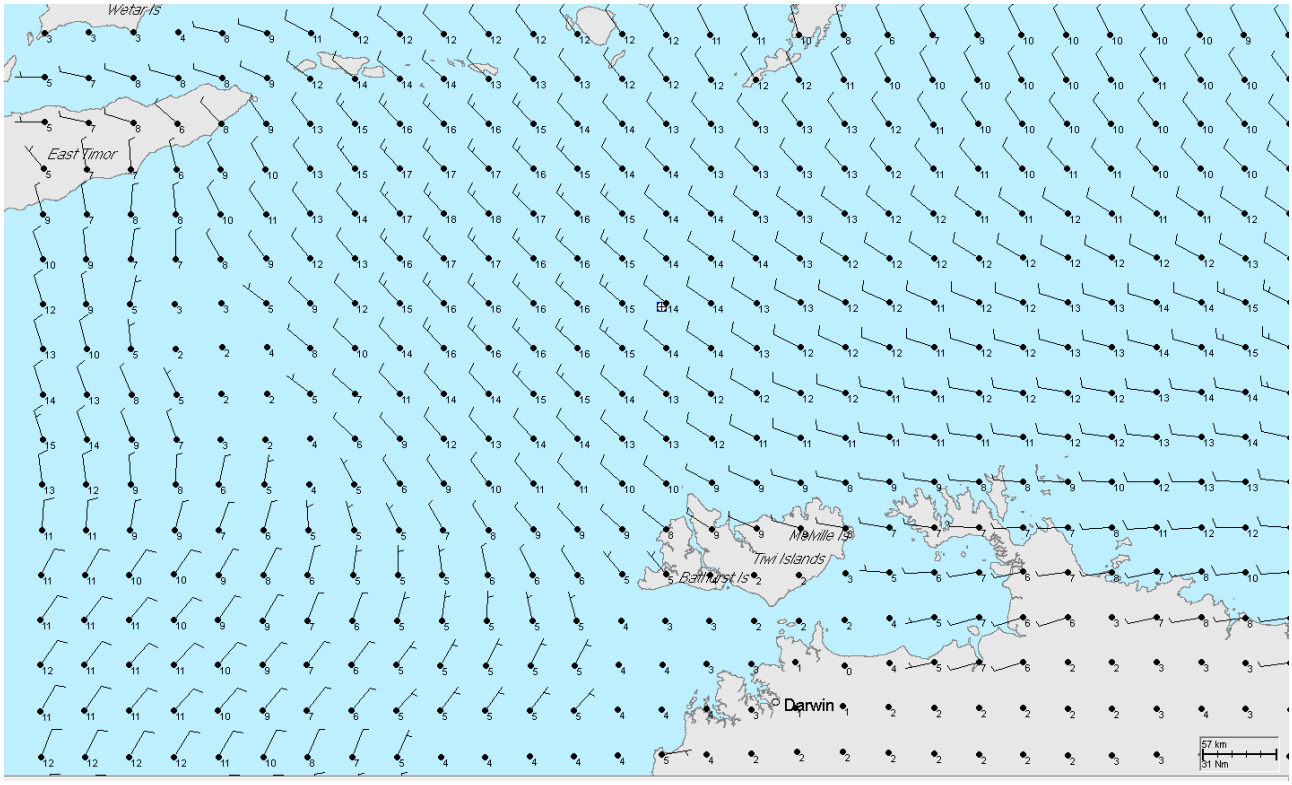

Figure 4.1 Spatial resolution of the CFSR modelled wind data used as input into the oil spill model. Note, for ease viewing only every second wind vector is displayed on the map.

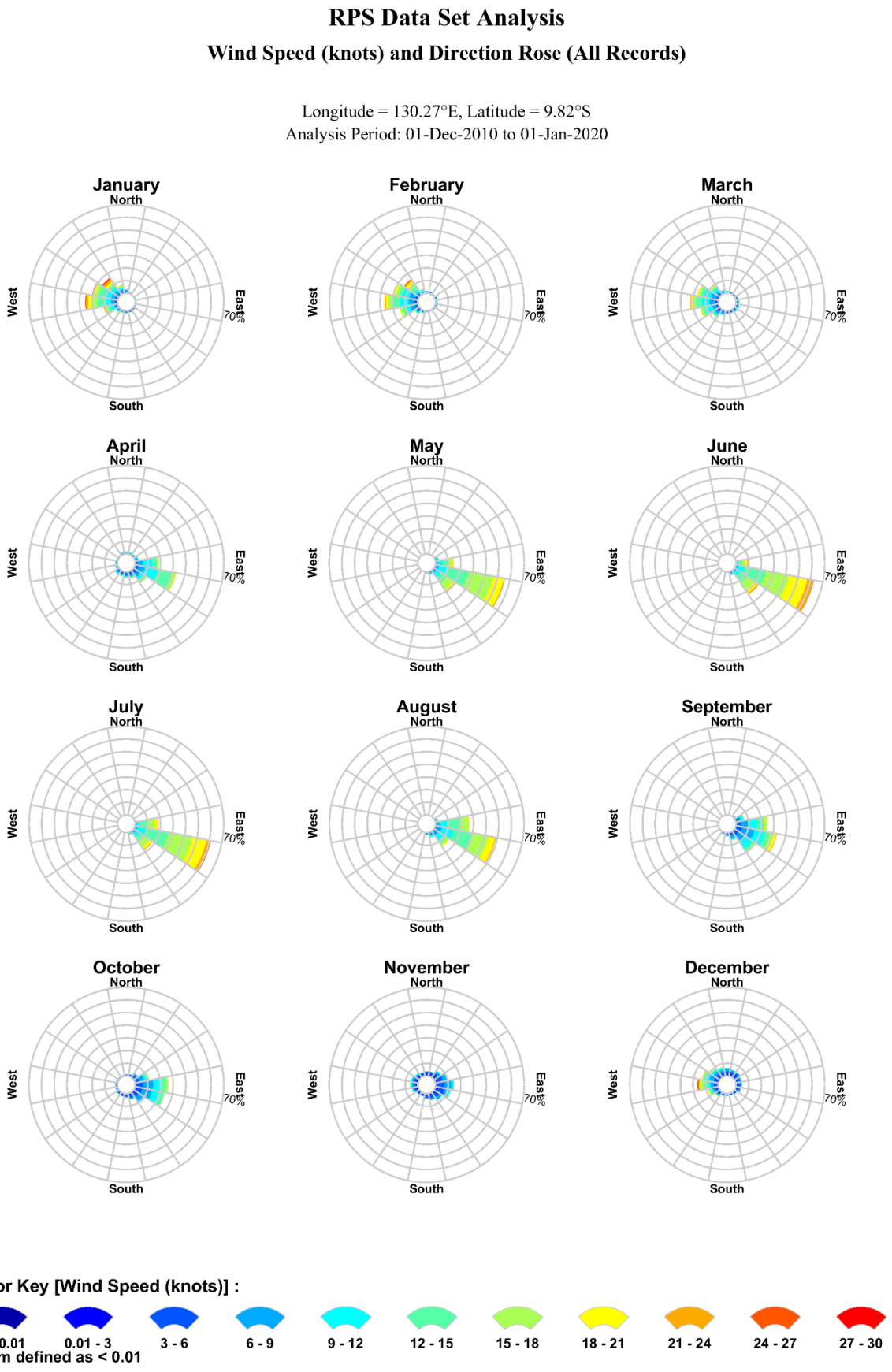

Figure 4.2 Monthly wind rose distributions adjacent to the release location, derived from the 2010 to 2019 modelled dataset.

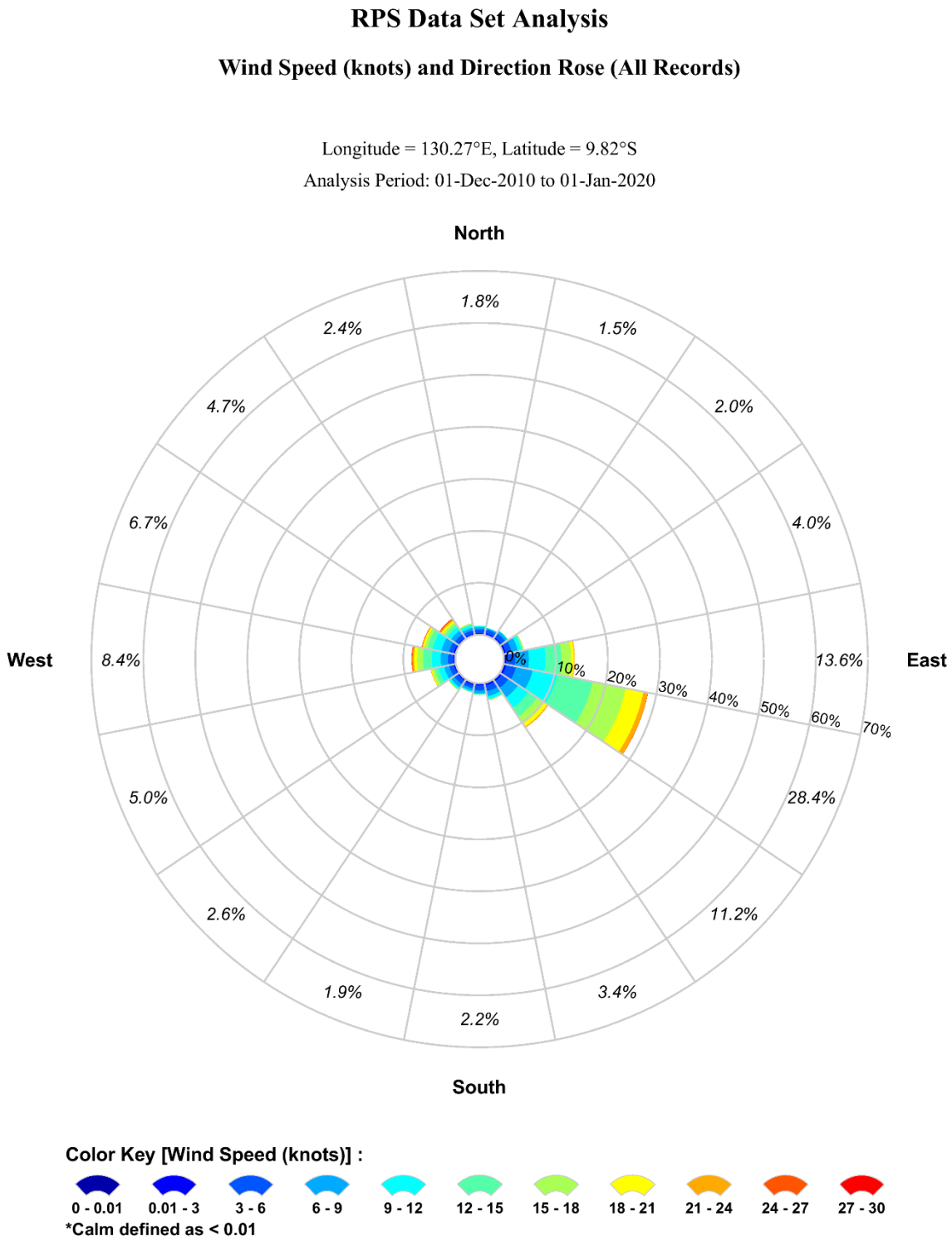

Figure 4.3 Total wind rose distributions adjacent to the release location, derived from the 2010 to 2019 modelled dataset.

5 WATER TEMPERATURE AND SALINITY

The monthly depth-varying water temperature and salinity profiles nearest to the release location was obtained from the World Ocean Atlas 2013 database produced by the National Oceanographic Data Centre (National Oceanic and Atmospheric Administration) and its co-located World Data Center for Oceanography (Levitus et al., 2013). The data is used to inform the weathering, movement and evaporative loss of hydrocarbon spills in the surface and subsurface layers.

Table 5.1 shows that the monthly average sea surface temperatures, which ranged from 26.8 °C (July) to 30.4 °C (December). Salinity remained consistent throughout the year ranging between 33.5 ppt (August) and 34.6 ppt (December).

Figure 5.1 the vertical profile of sea temperature and salinity nearby the release location.

The water temperature and salinity values from the World Ocean Atlas 2013 database compared well to collected data by Fugro as part of the Barossa marine studies program (Fugro, 2015).

Table 5.1 Monthly average sea surface temperature and salinity near the release location in the 0-5 m depth layer.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Temperature (°C)	29.5	28.5	28.8	29.4	28.8	27.1	26.8	26.9	27.1	28.1	29.7	30.4
Salinity (psu)	34.4	34.3	34.1	34.1	34.1	34.1	33.6	33.5	34.4	34.4	34.5	34.6

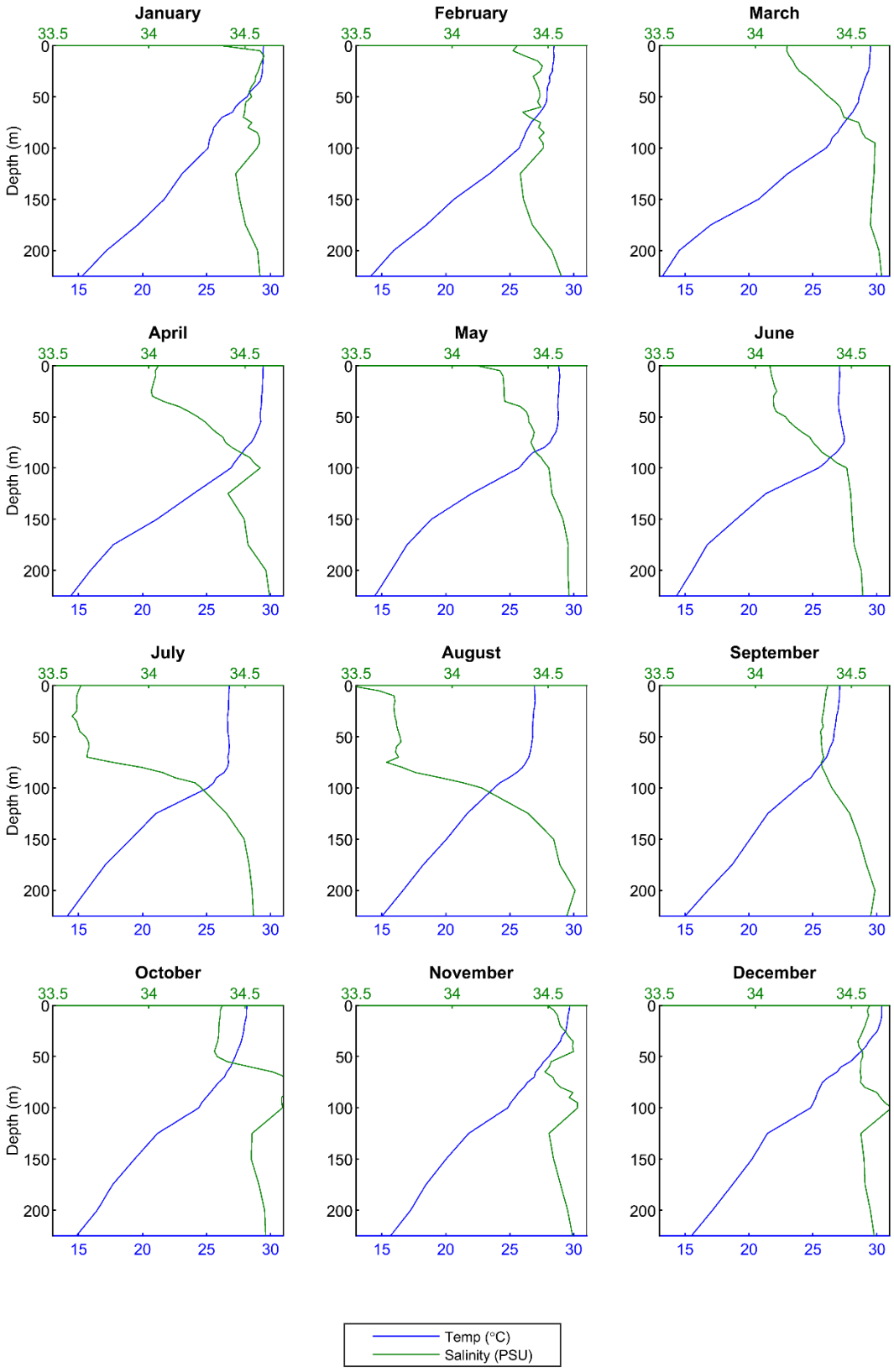

Figure 5.1 Monthly temperature and salinity profiles throughout the water column near the release location.

6 OIL SPILL MODEL SIMAP

The spill modelling was carried out using a purpose-developed oil spill trajectory and fates model, SIMAP. This model is designed to simulate the transport and weathering processes that affect the outcomes of hydrocarbon spills to the sea, accounting for the specific oil type, spill scenario, and prevailing wind and current circulation patterns.

SIMAP is the evolution of the United States Environmental Protection Agency (US EPA) Natural Resource Damage Assessment model (French et al., 1999) and is designed to simulate the fate and effects of spilled oils and fuels for both the surface slick and the three-dimensional plume that is generated in the water column. SIMAP includes algorithms to account for both physical transport and weathering processes. The latter are important for accounting for the partitioning of the spilled mass over time between the water surface (surface slick), water column (entrained oil and dissolved compounds), atmosphere (evaporated compounds) and land (stranded oil). The model also accounts for the interaction between weathering and transport processes.

The physical algorithms calculate transport and spreading by physical forces, including surface tension, gravity and wind and current forces for both surface slicks and oil within the water column. The fates algorithms calculate all the weathering processes known to be important for oil spilled to marine waters. These include droplet and slick formation, entrainment by wave action, emulsification, dissolution of soluble components, sedimentation, evaporation, bacterial and photo-chemical decay and shoreline interactions. These algorithms account for the specific oil type being considered.

Entrainment is the physical process where globules of oil are transported from the sea surface into the water column by wind and wave-induced turbulence or be generated subsea by a pressurised discharge at depth. It has been observed that entrained oil is broken into droplets of varying sizes. Small droplets spread and diffuse into the water column, while larger ones rise rapidly back to the surface (Delvigne & Sweeney, 1988; Delvigne, 1991).

Dissolution is the process by which soluble hydrocarbons enter the water from a surface slick or from entrained droplets. The lower molecular weight hydrocarbons tend to be both more volatile and more soluble than those of higher molecular weight.

The formation of water-in-oil emulsions, or mousse, which is termed ‘emulsification’, depends on oil composition and sea state. Emulsified oil can contain as much as 80% water in the form of micrometre-sized droplets dispersed within a continuous phase of oil (Daling & Brandvik, 1991; Bobra, 1991; Daling et al., 1997; Fingas, 1995, 1997).

Entrainment, dissolution and emulsification rates are correlated to wave energy, which is accounted for by estimating wave heights from the sustained wind speed, direction and fetch (i.e. distance downwind from land barriers) at different location in the domain. Dissolution rates are dependent upon the proportion of soluble, short-chained hydrocarbon compounds, and the surface area at the oil/water interface of slicks. Dissolution rates are also strongly affected by the level of turbulence. For example, dissolution rates will be relatively high at the site of the release for a deep-sea discharge at high pressure.

Evaporation can result in the transfer of large proportions of spilled oil from the sea surface to the atmosphere, depending on the type of oil. Evaporation rates vary over space and time dependent on the prevailing sea temperatures, wind and current speeds, the surface area of the slick and entrained droplets that are exposed to the atmosphere as well as the state of weathering of the oil. Evaporation rates will decrease over time, depending on the calculated rate of loss of the more volatile compounds. By this process, the model can differentiate between the fates of different oil types.

Decay (degradation) of hydrocarbons may occur as the result of photolysis, which is a chemical process energised by ultraviolet light from the sun, and by biological breakdown, termed biodegradation. Many types of marine organisms ingest, metabolise and utilise oil as a carbon source, producing carbon dioxide and water as by-products.

The SIMAP weathering algorithms include terms to represent these dynamic processes. Technical descriptions of the algorithms used in SIMAP and validations against real spill events are provided in French et al., (1999) and French-McCay (2004).

Input specifications for oil types include density, viscosity, pour-point, distillation curve (volume of oil distilled off versus temperature) and the aromatic/aliphatic component ratios within given boiling point ranges. The model calculates a distribution of the oil by mass into the following components:

- Surface-bound or floating oil;
- Entrained oil (non-dissolved oil droplets that are physically entrained by wave action);
- Dissolved hydrocarbons (principally the aromatic and short-chained aliphatic compounds);
- Evaporated hydrocarbons;
- Sedimented hydrocarbons; and
- Decayed hydrocarbons.

7 THRESHOLDS

The SIMAP model will track oil concentrations to very low levels. Hence, it is useful to define meaningful threshold concentrations for the recording of contact by oil components and determining the probability of exposure at a location (calculated from the number of replicate simulations in which this contact occurred).

The judgement of meaningful levels is complicated and will depend upon the mode of action, sensitivity of the biota contacted, the duration of the contact and the toxicity of the compounds that are represented in the oil. The latter factor is further complicated by the change in the composition of an oil type over time due to weathering processes. Without specific testing of the oil types, at different states of weathering against a wide range of the potential local receptors, such considerations are beyond the scope of this investigation.

It is important to note that the thresholds herein are based on the thresholds outlined in the NOPSEMA Oil Spill Modelling Bulletin (NOPSEMA, 2019), which are summarised in Table 7.1. Their relationship to exposure for the sea surface, shoreline, and water column (entrained and dissolved hydrocarbons) are presented in Sections 7.1 to 7.3. Supporting justifications of the adopted thresholds applied during the study and additional context relating to the area of influence are also provided.

Table 7.1 Summary of the thresholds applied in this study.

Floating Oil Concentration (g/m^2)	Shoreline Oil Accumulation (g/m^2)	Entrained Hydrocarbons Concentration (ppb)	Instantaneous Dissolved Hydrocarbons (ppb)
1	10	10	10
10	100	100	50
50	1,000		400

7.1 Floating Oil

Floating oil concentrations are relevant to describing the risks of oil coating emergent reefs, vegetation in the littoral zone and shoreline habitats, as well as the risk to wildlife found on the water surface, such as marine mammals, reptiles, and birds. Floating oil is also visible at relatively low concentrations (> ~0.05 g/m^2). Hence, the area affected by visible oil, which might trigger social or economic impacts, will be larger than the area where biological impacts might be expected.

The low threshold for floating oil exposure was set to 1 g/m^2, which equates approximately to an average thickness of 1 µm. It represents the practical limit of observing hydrocarbon sheens in the marine environment. This threshold is considered below levels which would cause environmental harm and is more indicative of the areas perceived to be affected due to its visibility on the sea-surface and potential to trigger temporary closures of areas (i.e., fishing grounds) as a precautionary measure.

Oil of this thickness is described as rainbow sheen in appearance, according to the Bonn Agreement Oil Appearance Code (Bonn Agreement, 2009; AMSA, 2014) (see Table 7.2). Figure 7.1 shows photographs highlighting the difference in appearance between a silvery sheen, rainbow sheen and metallic sheen.

Ecological impact has been estimated to occur at 10 g/m^2 (a film thickness of approximately 10 µm or 0.01 mm) (French et al.,1996 and French-McCay, 2009) as this level of fresh oiling has been observed to mortally impact some birds through adhesion of oil to their feathers, exposing them to secondary effects such as hypothermia. The appearance of oil at this average thickness has been described as a metallic sheen (Bonn Agreement, 2009). Concentrations above 10 g/m^2 is also considered the lower actionable threshold, where oil may be thick enough for containment and recovery as well as dispersant treatment (AMSA, 2015).

Oil concentrations on the sea surface of 25 g/m^2 (or greater) would be harmful for all birds that have landed in an oil film due to potential contamination of their feathers, with secondary effects such as loss of temperature regulation and ingestion of oil through preening (Scholten et al., 1996; Koops et al., 2004). The appearance of oil at this thickness is also described as metallic sheen (Bonn Agreement, 2009). For this study the high exposure threshold was set to 50 g/m^2 and above based on NOPSEMA (2019). This threshold can also be used to inform response planning. Table 7.3 provides a summary of each threshold.

Table 7.2 The Bonn Agreement Oil Appearance Code.

Code	Description Appearance	Layer Thickness Interval (g/m^2 or µm)	Litres per km^2
1	Sheen (silvery/grey)	0.04 – 0.30	40 – 300
2	Rainbow	0.30 – 5.0	300 – 5,000
3	Metallic	5.0 – 50	5,000 – 50,000
4	Discontinuous True Oil Colour	50 – 200	50,000 – 200,000
5	Continuous True Oil Colour	≥ 200	≥ 200,000

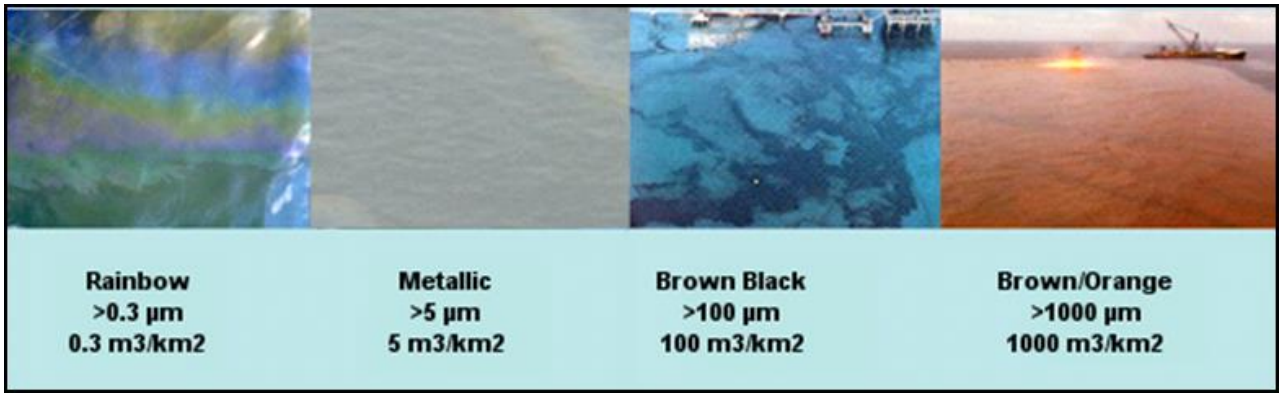

Figure 7.1 Photographs showing the difference between oil colour and thickness on the sea surface (source: adapted from Oil Spill Solutions, 2015).

Table 7.3 Floating oil exposure thresholds used in the oil spill modelling study (in alignment with NOPSEMA, 2019).

Threshold level	Floating oil (g/m^2)	Description
Low	1	Approximates range of socio-economic effects and establishes planning area for scientific monitoring
Moderate	10	Approximates lower limit for harmful exposures to birds and marine mammals
High	50*	Approximates surface oil slick and informs response planning

* 50 g/m^2 also used to define the threshold for actionable floating oil.

7.2 Shoreline Oil Accumulation

There are many different types of shorelines, ranging from cliffs, rocky beaches, sandy beaches, mud flats and mangroves, and each of these influences the volume of oil that can remain stranded ashore and its thickness before the shoreline saturation point occurs. For instance, a sandy beach may allow oil to percolate through the sand, thus increasing its ability to hold more oil ashore over tidal cycles and various wave actions than an equivalent area of water; hence oil can increase in thickness onshore over time. A sandy beach shoreline was assumed as the default shoreline type for the modelling in this study, as it allows for the highest carrying capacity of oil (of the available open/exposed shoreline types).

Previous risk assessment studies, a threshold of 10 g/m^2 was used to assess the potential for shoreline accumulation (French-McCay et al.,2005a; 2005b). This is a conservative threshold used to define regions of

socio-economic impact, such as triggering temporary closures of adjoining fisheries or the need for shore clean-up on beaches or man-made features/amenities (breakwaters, jetties, marinas, etc.). It would equate to approximately 2 teaspoons of hydrocarbon per square meter of shoreline accumulation. The appearance is described as a stain/film. On that basis, the 10 g/m^2 has been selected to define the low threshold.

French et al. (1996) and French-McCay (2009) define a shoreline oil accumulation threshold of 100 g/m^2, or above, would potentially harm shorebirds and wildlife (fur-bearing aquatic mammals and marine reptiles on or along the shore) based on studies for sub-lethal and lethal impacts. This threshold has been used in previous environmental risk assessment studies (see French-McCay, 2003; French-McCay et al., 2004, French-McCay et al., 2011; 2012; NOAA, 2013). Additionally, this threshold is also recommended in AMSA's foreshore assessment guide as the acceptable minimum thickness that does not inhibit the potential for recovery and is best remediated by natural coastal processes alone (AMSA, 2015). This threshold equates to approximately ½ a cup of oil per square meter of shoreline accumulation and is described as a thin oil coat. The 100 g/m^2 has been selected to define the moderate threshold.

Observations by Lin & Mendelssohn (1996) demonstrated that loadings of more than 1,000 g/m^2 of hydrocarbon during the growing season would be required to impact marsh plants significantly. Similar thresholds have been found in studies assessing hydrocarbon impacts on mangroves (Grant et al., 1993; Suprayogi & Murray, 1999). This loading equates to approximately 1 litre of hydrocarbon per square meter of shoreline accumulation and the appearance is described as a hydrocarbon cover. A loading of 1,000 g/m^2 has been selected to define high threshold.

Table 7.4 is a summary of each threshold.

Table 7.4 Shoreline accumulation thresholds used in oil spill modelling study (in alignment with NOPSEMA, 2019).

Threshold level	Shoreline loading(g/m^2)	Description
Low	10	Predicts potential for some socio-economic impact
Moderate	100*	Loading predicts area likely to require clean-up effort
High	1,000	Loading predicts area likely to require intensive clean-up effort

* 100 g/m^2 also used to define the threshold for actionable shoreline oil.

7.3 In-water

Oil is a mixture of thousands of hydrocarbons of varying physical, chemical, and toxicological characteristics, and therefore, demonstrate varying fates and impacts on organisms. As such, for in-water exposure, the SIMAP model provides separate outputs for dissolved and entrained hydrocarbons from oil droplets. The consequences of exposure to dissolved and entrained components will differ because they have different modes and magnitudes of effect.

Entrained hydrocarbon concentrations were calculated based on oil droplets that are suspended in the water column, though not dissolved. The composition of this oil would vary with the state of weathering (oil age) and may contain soluble hydrocarbons when the oil is fresh. Calculations for dissolved hydrocarbons specifically calculates oil components which are dissolved in water, which are known to be the primary source of toxicity exerted by oil.

A complicating factor that should be considered when assessing the consequence of dissolved and entrained oil distributions is that there will be some areas where both physically entrained oil droplets and dissolved hydrocarbons co-exist. Higher concentrations of each will tend to occur close to the source where sea conditions can force mixing of relatively unweathered oil into the water column, resulting in more rapid dissolution of soluble compounds.

7.3.1 Dissolved Hydrocarbons

Laboratory studies have shown that dissolved hydrocarbons exert most of the toxic effects of oil on aquatic biota (Carls et al., 2008; Nordtug et al., 2011; Redman, 2015). The mode of action is a narcotic effect, which is positively related to the concentration of soluble hydrocarbons in the body tissues of organisms (French-McCay, 2002). Dissolved hydrocarbons are taken up by organisms directly from the water column by absorption through external surfaces and gills, as well as through the digestive tract. Thus, soluble hydrocarbons are termed “bioavailable”.

Hydrocarbon compounds vary in water-solubility and the toxicity exerted by individual compounds is inversely related to solubility, however bioavailability will be modified by the volatility of individual compounds (Nirmalakhandan & Speece, 1988; Blum & Speece, 1990; McCarty, 1986; McCarty et al., 1992a, 1992b; McCarty & Mackay, 1993; Verhaar et al., 1992, 1999; Swartz et al., 1995; French-McCay, 2002; McGrath & Di Toro, 2009). Of the soluble compounds, the greatest contributor to toxicity for water-column and benthic organisms are the lower-molecular-weight aromatic compounds, which are both volatile and soluble in water. Although they are not the most water-soluble hydrocarbons within most oil types, the polynuclear aromatic hydrocarbons (PAHs) containing 2 – 3 aromatic ring structures typically exert the largest narcotic effects because they are semi-soluble and not highly volatile, so they persist in the environment long enough for significant accumulation to occur (Anderson et al., 1974, 1987; Neff & Anderson, 1981; Malins & Hodgins, 1981; McAuliffe, 1987; NRC, 2003). The monoaromatic hydrocarbons (MAHs), including the BTEX compounds (benzene, toluene, ethylbenzene, and xylenes), and the soluble alkanes (straight chain hydrocarbons) also contribute to toxicity, but these compounds are highly volatile, so that their contribution will be low when oil is exposed to evaporation and higher when oil is discharged at depth where volatilisation does not occur (French-McCay, 2002).

French-McCay (2002) reviewed available toxicity data, where marine biota was exposed to dissolved hydrocarbons prepared from oil mixtures, finding that 95% of species and life stages exhibited 50% population mortality (LC_{50}) between 6 and 400 ppb (with an average of 50 ppb) total PAH concentration after 96 hrs exposure. Therefore, concentrations lower than 6 ppb total PAH value should be protective of 97.5% of species and life stages even with exposure periods of days (at least 96 hours). Early life-history stages of fish appear to be more sensitive than older fish stages and invertebrates.

Exceedances of 10, 50 or 400 ppb over a 1-hour timestep (see Table 7.5) were applied in this study to indicate the increasing potential for sub-lethal to lethal toxic effects (or low to high), based on NOPSEMA (2019).

7.3.2 Entrained Hydrocarbons

Entrained hydrocarbons consist of oil droplets that are suspended in the water column and insoluble. Insoluble compounds in oil cannot be absorbed from the water column by aquatic organisms, therefore they are not bioavailable through absorption of compounds from the water. Exposure to these compounds would require routes of uptake other than absorption of soluble compounds. The route of exposure of organisms to whole oil alone include direct contact with tissues of organisms and uptake of oil by direct consumption, with potential for biomagnification through the food chain (NRC, 2003).

Thresholds of 10 ppb and 100 ppb were applied over a 1-hour time exposure (Table 7.5) as per NOPSEMA (2019).

The 10-ppb threshold exposure zone is not considered to be of significant biological impact and is therefore outside the adverse exposure zone. This exposure zone represents the area contacted by the spill.

Table 7.5 Dissolved and entrained hydrocarbon exposure thresholds assessed over a 1-hour time step used in the oil spill modelling study (in alignment NOPSEMA 2019).

	Exposure level	In-water threshold (ppb)	Description
Dissolved hydrocarbons	Low	10	Establishes planning area for scientific monitoring based on potential for exceedance of water quality triggers
	Moderate	50	Approximates potential toxic effects, particularly sublethal effects to sensitive species
	High	400	Approximates toxic effects including lethal effects to sensitive species
Entrained hydrocarbons	Low	10	Establishes planning area for scientific monitoring based on potential for exceedance of water quality triggers
	Moderate	100	As appropriate given oil characteristics for informing risk evaluation

7.4 Dispersion

A horizontal dispersion coefficient of 10 m^2/s was used to account for dispersive processes acting at the surface that are below the scale of resolution of the input current field, based on typical values for open waters (Okubo, 1971). Dispersion rates within the water column (applicable for entrained and dissolved plumes of hydrocarbons) were specified at 1 m^2/s, based on empirical data for the dispersion of hydrocarbon plumes over the North West Shelf (King & McAllister, 1998).

8 HYDROCARBON PROPERTIES

The physical properties and boiling point distributions of the MDO used in the modelling assessment are presented in Table 8.1 and Table 8.2, respectively.

The MDO has a density of 829.1 kg/m^3 (API gravity of 37.6) and a low pour point of -14°C. The low viscosity (4 cP) indicates that this oil will spread quickly when released and will form a thin to low thickness film on the sea surface, increasing the rate of evaporation.

Generally, about 6.0% of the MDO mass should evaporate within the first 12 hours (Boiling point (BP) < 180°C); a further 34.6% should evaporate within the first 24 hours (180°C < BP < 265°C); and an additional 54.4% should evaporate over several days (265°C < BP < 380°C). Approximately 5% (by mass) of MDO will not evaporate, though will decay slowly over time.

The oil is categorised as a group II oil (light-persistent) according to the International Tankers Owners Pollution Federation (ITOPF, 2022) and US EPA/USCG classifications. The classification is based on the specific gravity of hydrocarbons in combination with relevant boiling point ranges.

It is important to note that some heavy components contained within the MDO will have a strong tendency to physically entrain into the upper water column in the presence of moderate winds (i.e. >12 knots) and breaking waves but can re-float to the surface if these energies abate.

Table 8.1 Physical properties of MDO.

Characteristic	Marine Diesel Oil (MDO)
Density (kg/m^3)	829.1 (at 25 °C)
API gravity	37.6
Dynamic viscosity (cP)	4.0 (at 25 °C)
Wax content (%)	0
Pour point (°C)	-14
Hydrocarbon property category	Group II
Hydrocarbon property classification	Light - Persistent

Table 8.2 Boiling point ranges of and MDO.

Oil Type	Component	Non-Persistent			Persistent
		Volatile (%)	Semi-volatile (%)	Low volatility (%)	Residual (%)
	Boiling point (°C)	<180 [C_4 to C_{10}]	180-265 [C_{11} to C_{15}]	265-380 [C_{16} to C_{20}]	>380 [>C_{20}]
Marine diesel oil (MDO)	% of total	6.0	34.6	54.4	5.0

8.1 Weathering Characteristics

A series of weathering tests were conducted to illustrate the potential behaviour of this MDO when exposed to idealised and representative environmental conditions:

- Instantaneous 50 m^3 surface release under calm wind conditions (constant 2.6 m/s or 5 knots), 27°C water temperature and currents.
- Instantaneous 50 m^3 surface release under typically moderate wind conditions (5–8 m/s or 11–16 knots) and variable directions, 27°C water temperature and currents.

The first case is indicative of weathering rates under calm conditions that would not generate entrainment, while the second case would be more representative of the moderate winds experienced over the region. Both scenarios provide examples of potential behaviour during periods of a spill event once the diesel reaches the surface.

The mass balance forecast for the calm-wind case (Figure 8.1) shows that 36.1% of the diesel is predicted to evaporate within 24 hours. Majority of the remaining MDO on the water surface will weather at a slower rate due to being comprised of the longer-chain compounds with higher boiling points. Evaporation of the residual compounds will slow significantly, and they will then be subject to more gradual decay through biological and photochemical processes.

Under the variable-wind case (Figure 8.2), where the winds are of greater strength on average, entrainment of MDO into the water column is predicted to increase. Approximately 24 hours after the spill, 80.5% of the MDO is forecast to have entrained and a further 15.0% is forecast to have evaporated, leaving only a small proportion floating on the water surface (<1%). The residual compounds will tend to remain entrained beneath the surface under conditions that generate wind waves (approximately >6 m/s).

The increased level of entrainment in the variable-wind case will result in a higher percentage of biological and photochemical degradation, where the decay of the floating slicks and MDO droplets in the water column occurs at an approximate rate of 2.90% per day with an accumulated total of 20.3% after 7 days, in comparison to a rate of 0.37% per day and an accumulated total of 2.60% after 7 days in the constant-wind case. Given the proportion of entrained MDO and the tendency for it to remain mixed in the water column, the remaining hydrocarbons will decay over time scales of several weeks.

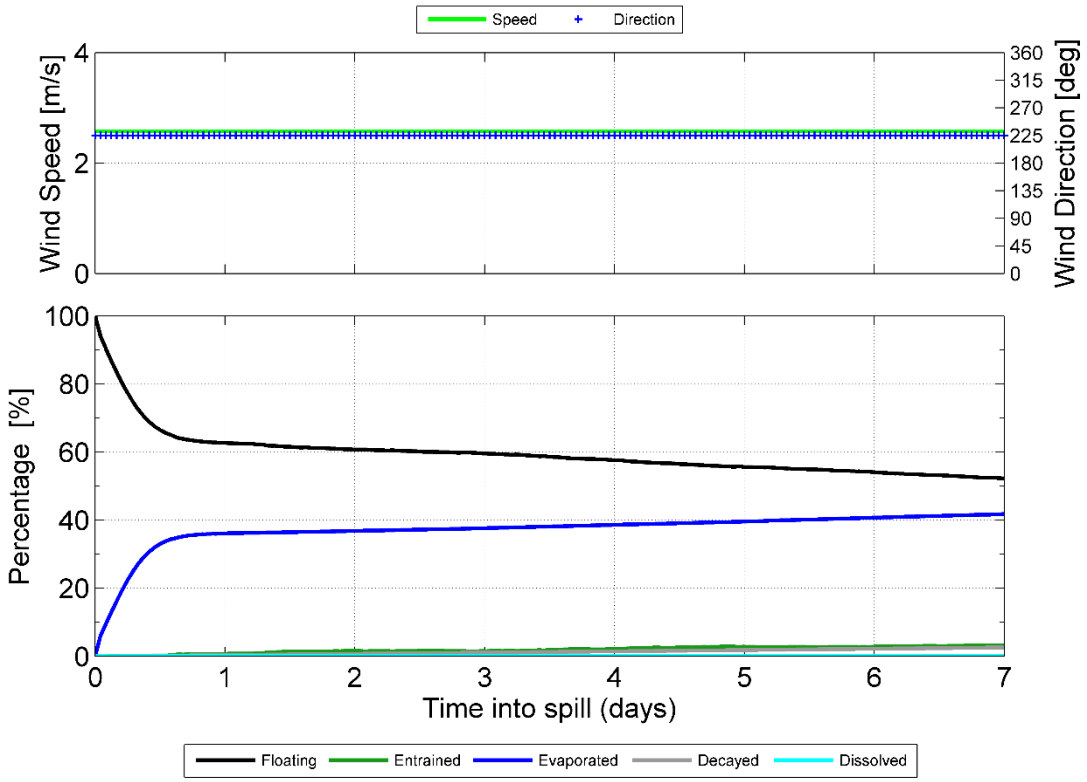

Figure 8.1 **Proportional mass balance plot representing the weathering of marine diesel oil spilled onto the water surface as a one-off instantaneous release and subject to a constant 5 knots (2.6 m/s) wind at 27°C water temperature.**

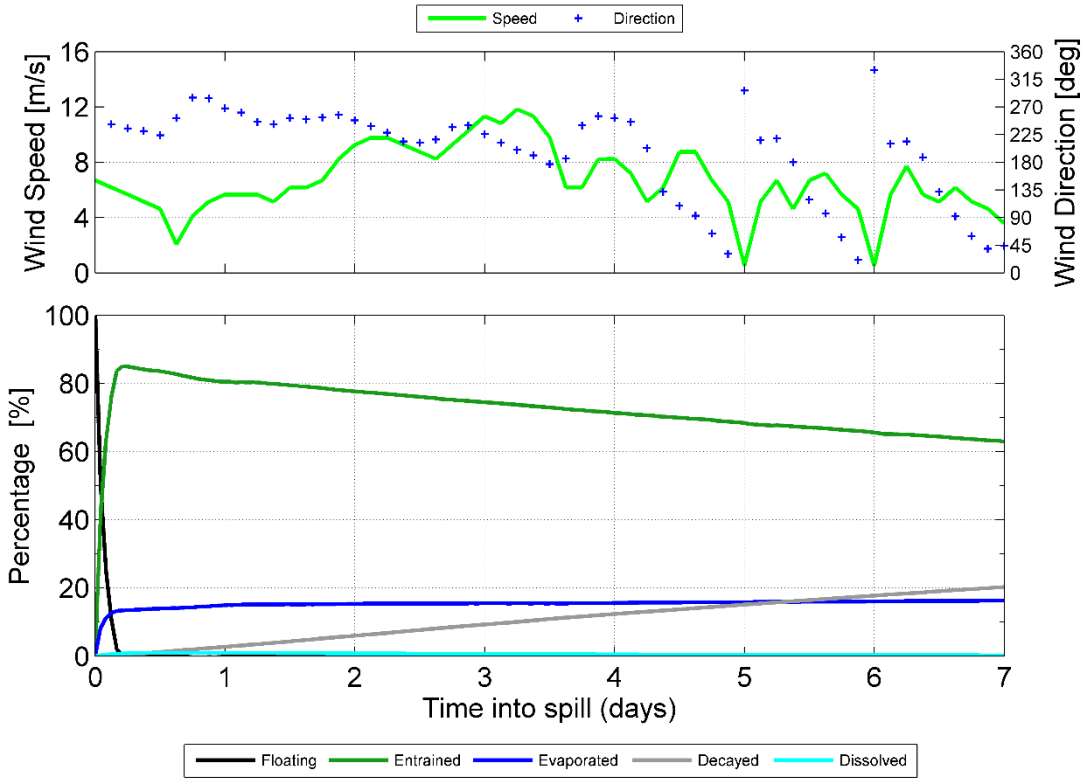

Figure 8.2 **Proportional mass balance plot representing the weathering of marine diesel oil spilled onto the water surface as a one-off instantaneous release and subject to variable wind speeds at 27°C water temperature.**

9 RECEPTORS

A range of environmental value areas (or receptors) were defined by Santos (displayed in Figure 9.1 to Figure 9.3) were assessed for floating oil exposure, shoreline accumulation and in-water exposure (entrained and dissolved hydrocarbons) as part of the study. Table 9.1 provides a list of the environmental value areas (EVA), feature type (emergent, intertidal or submerged), whether there are shorelines and the priority score. Risk of exposure were separately calculated for each environmental value area and only the results for receptors predicted to be exposed at or above the minimum thresholds have been presented. In addition, Western Australian State Waters (State Water – WA) and Northern Territory Waters (NT Waters) were also included as a receptor as part of the study. Floating oil and shoreline accumulation was not assessed for submerged and intertidal receptors.

Table 9.1 Environmental value areas defined by Santos.

Environmental Value Areas	Feature type	Shoreline present	Environmental Priority Ranking
Abrolhos - Nearshore	Submerged	no	4
Abrolhos - Offshore NW	Submerged	no	4
Abrolhos - Offshore Perth North	Submerged	no	4
Abrolhos - Outer Island Shoals	Submerged	no	3
Abrolhos Islands Easter Group	Emergent	yes	4
Abrolhos Islands Pelsaert Group	Emergent	yes	4
Abrolhos Islands Wallabi Group	Emergent	yes	3
Abrolhos West	Submerged	no	3
Adele Island	Emergent	yes	4
Afghan Shoal	Submerged	no	5
Albany - Esperance	Emergent	yes	2
Arnhem AMP	Submerged	no	4
Ashmore Reef AMP	Emergent	yes	2
Ashmore-Cartier - Outer	Submerged	no	4
Augusta - Walpole	Emergent	yes	4
Barracouta Shoals	Submerged	no	5
Barrow Island	Emergent	yes	3
Barrow-Montebello Surrounds	Intertidal	no	3
Beagle and Dingo Reefs	Intertidal	no	5
Beagle Gulf-Darwin Coast	Emergent	yes	4
Beagle Knoll	Submerged	no	5
Bedout Island	Emergent	yes	4
Bennett Shoal	Submerged	no	5
Bremer AMP	Submerged	no	4
Brewis Reef	Submerged	no	5
Britomart Shoal	Submerged	no	5
Broome - Roebuck	Emergent	yes	2
Broome North Coast	Emergent	yes	4
Browse Island	Emergent	yes	4
Camden Sound	Emergent	yes	3
Camplin Shoal	Submerged	no	5
Carnarvon - Inner Shark Bay	Emergent	yes	2

Carnarvon Canyon AMP	Submerged	no	5
Cartier Island AMP	Emergent	yes	4
Central Arnhem AMP	Submerged	no	5
Christmas Island	Emergent	yes	4
Christmas Island AMP	Submerged	no	5
Clerke Reef MP	Emergent	yes	3
Cobourg Peninsula-Nhulunbuy	Emergent	yes	3
Cocos Islands	Emergent	yes	3
Cocos Islands AMP	Submerged	no	5
Cod Bank	Submerged	no	5
Cooper Shoal	Submerged	no	5
Dampier AMP	Submerged	no	4
Dampier Archipelago	Emergent	yes	3
Dart Shoal	Submerged	no	5
Dawesville - Bunbury	Emergent	yes	4
Djukbinj NP	Emergent	yes	5
Eastern Recherche AMP	Submerged	no	4
Echo Shoals	Submerged	no	5
Echuca Shoals	Submerged	no	5
Eighty Mile Beach	Emergent	yes	2
Eighty Mile Beach AMP	Submerged	no	4
Esperance - Cape Arid NP	Emergent	yes	3
Eugene McDermott Shoal	Submerged	no	5
Exmouth Gulf Coast	Emergent	yes	2
Exmouth Reef	Submerged	no	5
Fantome Shoals	Submerged	no	5
Flat Top Bank	Submerged	no	5
Gale Bank	Submerged	no	4
Gascoyne AMP	Submerged	no	3
Geographe - Augusta Deep	Submerged	no	4
Geographe - Offshore Augusta 1	Submerged	no	3
Geographe - Offshore Augusta 2	Submerged	no	3
Geographe - Outer	Submerged	no	3
Geographe Bay	Emergent	yes	2
Geographe Bay - Augusta	Emergent	yes	4
Geraldton - Jurien Bay	Emergent	yes	3
Glomar Shoals	Submerged	no	5
Hancox Shoal	Submerged	no	5
Harris Reef	Intertidal	no	5
Heywood Shoals	Submerged	no	5
Hibernia Reef	Intertidal	no	5
Holothuria Banks North	Submerged	no	5
Imperieuse Reef MP	Emergent	yes	3
Indonesia - East*	Emergent	yes	5
Indonesia - West	Emergent	yes	5

Inner Geographe AMP	Submerged	no	3
JBG East Coast	Emergent	yes	4
JBG South Coast	Emergent	yes	1
JBG West Coast	Emergent	yes	4
Johnson Bank	Submerged	no	4
Jones Shoal	Submerged	no	5
Joseph Bonaparte Gulf AMP	Submerged	no	3
Jurien AMP	Submerged	no	3
Jurien Bay - Yanchep	Emergent	yes	3
Kalbarri - Geraldton	Emergent	yes	3
Kalimantan	Emergent	yes	5
Karratha-Port Hedland	Emergent	yes	5
Kimberley AMP	Submerged	no	3
Kimberley Coast PMZ	Emergent	yes	2
King Sound	Emergent	yes	2
Lacepede Islands	Emergent	yes	3
Larkin Shoal	Submerged	no	5
Limmen AMP	Submerged	no	5
Lowendal Islands	Emergent	yes	3
Lowry Shoal	Submerged	no	5
Madeleine Shoals	Submerged	no	4
Mandurah - Dawesville	Emergent	yes	2
Margaret Harries Bank	Submerged	no	5
Marsh Shoal	Submerged	no	5
Mavis Reef	Intertidal	no	5
Mermaid Reef AMP	Intertidal	no	2
Middle Islands Coast	Emergent	yes	4
Minor Indonesian Islands	Emergent	yes	5
Montebello AMP	Submerged	no	3
Montebello Islands	Emergent	yes	3
Moresby Shoals	Submerged	no	5
Muiron Islands	Emergent	yes	2
Newby Shoal	Submerged	no	5
Nhulunbuy-Borroloola	Emergent	yes	4
Ningaloo - Offshore	Submerged	no	2
Ningaloo - Outer Coast North	Submerged	no	1
Ningaloo - Outer NW	Submerged	no	3
Ningaloo Coast North	Emergent	yes	1
Ningaloo Coast South	Emergent	yes	2
Northern Arafura AMP	Submerged	no	5
Northern Islands Coast	Emergent	yes	3
Orontes Reef	Submerged	no	5
Outer Argo-Rowley Terrace AMP	Submerged	no	4
Outer Oceanic Shoals AMP	Submerged	no	4
Papua Region	Emergent	yes	5

Penguin Bank	Submerged	no	5
Penguin Shoal	Submerged	no	5
Perth Canyon AMP	Submerged	no	3
Perth Northern Coast	Emergent	yes	3
Perth South - Geographe - Offshore	Submerged	no	4
Perth Southern Coast	Emergent	yes	1
Poivre Reef	Intertidal	no	5
Port Hedland-Eighty Mile Beach	Emergent	yes	4
Rankin Bank	Submerged	no	5
Ripple Shoals	Submerged	no	5
Roebuck - Eighty Mile Beach	Emergent	yes	3
Roebuck AMP	Submerged	no	4
Rosily Shoals	Submerged	no	5
Rottnest Island	Emergent	yes	4
Rowley Shoals surrounds	Submerged	no	3
Sahul Banks	Submerged	no	5
Scott Reef North	Intertidal	no	4
Scott Reef South	Emergent	yes	3
Seringapatam Reef	Intertidal	no	4
Shark Bay - Coast Outer	Emergent	yes	3
Shark Bay AMP	Submerged	no	4
Shepparton Shoal	Submerged	no	5
Skottowe Shoal	Submerged	no	5
Snapper Shoal	Submerged	no	5
Southern Arafura AMP	Emergent	yes	5
Southern Islands Coast	Emergent	yes	4
South-west Corner AMP	Submerged	no	3
Sulawesi	Emergent	yes	5
Sultan Reef	Submerged	no	5
Sumatra	Emergent	yes	5
Sunrise Bank	Submerged	no	5
The Boxers Area	Submerged	no	4
Thevenard Islands	Emergent	yes	4
Tiwi Islands	Emergent	yes	5
Trap Reef	Submerged	no	5
Twilight AMP	Submerged	no	4
Two Rocks AMP	Submerged	no	3
Van Cloon-Deep Shoals	Submerged	no	4
Van Dieman Gulf Coast	Emergent	yes	1
Van Diemen Gulf Shoals	Intertidal	no	5
Vernon Islands CR	Emergent	yes	5
Vulcan Shoals	Submerged	no	5
Walpole - Albany	Emergent	yes	4
Wessel AMP	Submerged	no	4
Western Abrolhos AMP	Submerged	no	4

Western Sahul Bank Shoals	Submerged	no	5
Western Shark Bay AMP	Submerged	no	5
Woodbine Bank	Submerged	no	5
Zuytdorp Cliffs - Kalbarri	Emergent	yes	4

* Indonesia - East encompasses Indonesia East and Timor Leste

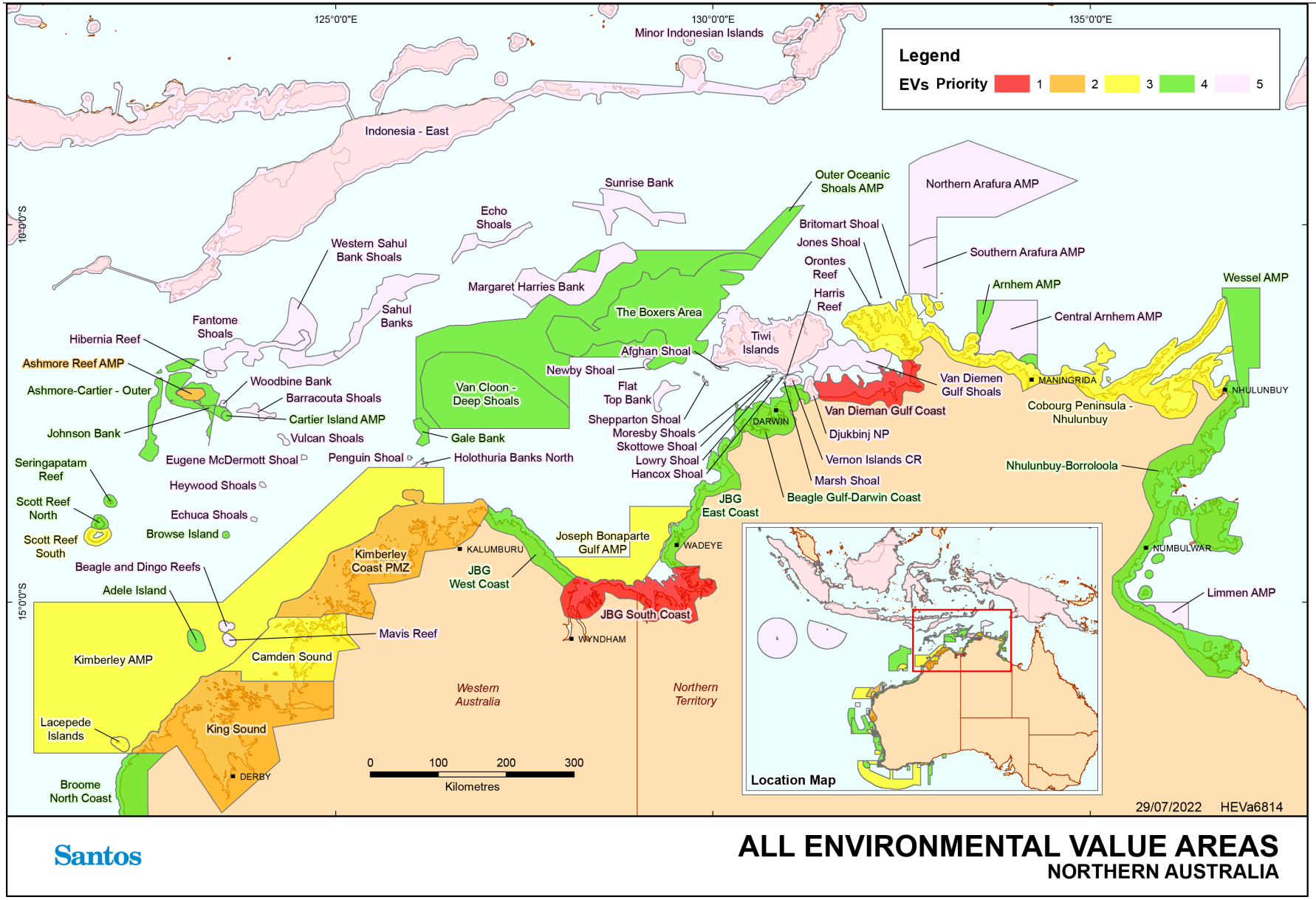

Figure 9.1 Northern environmental value areas (source: Santos August 2022).

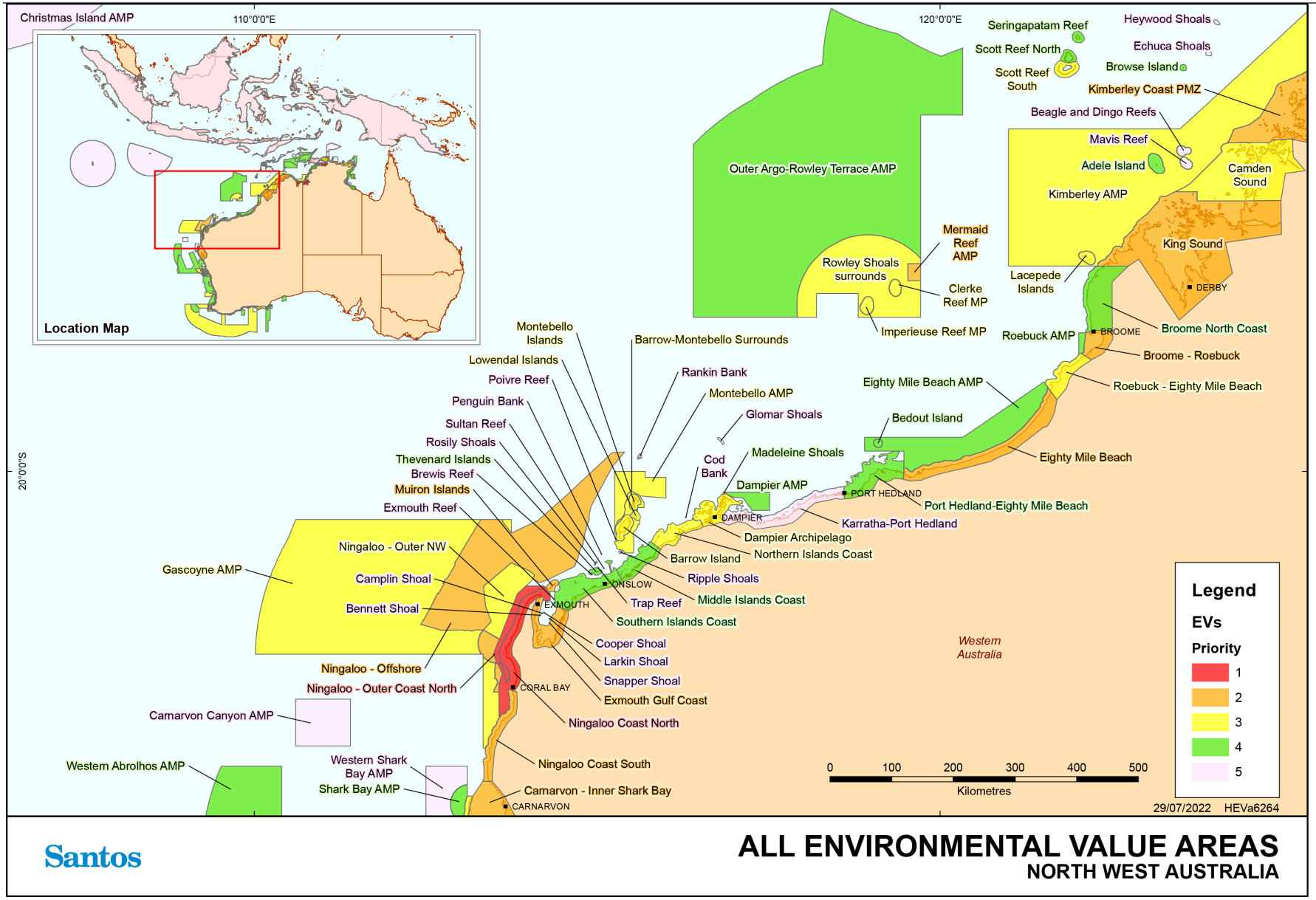

Figure 9.2 North west environmental value areas (source: Santos August 2022).

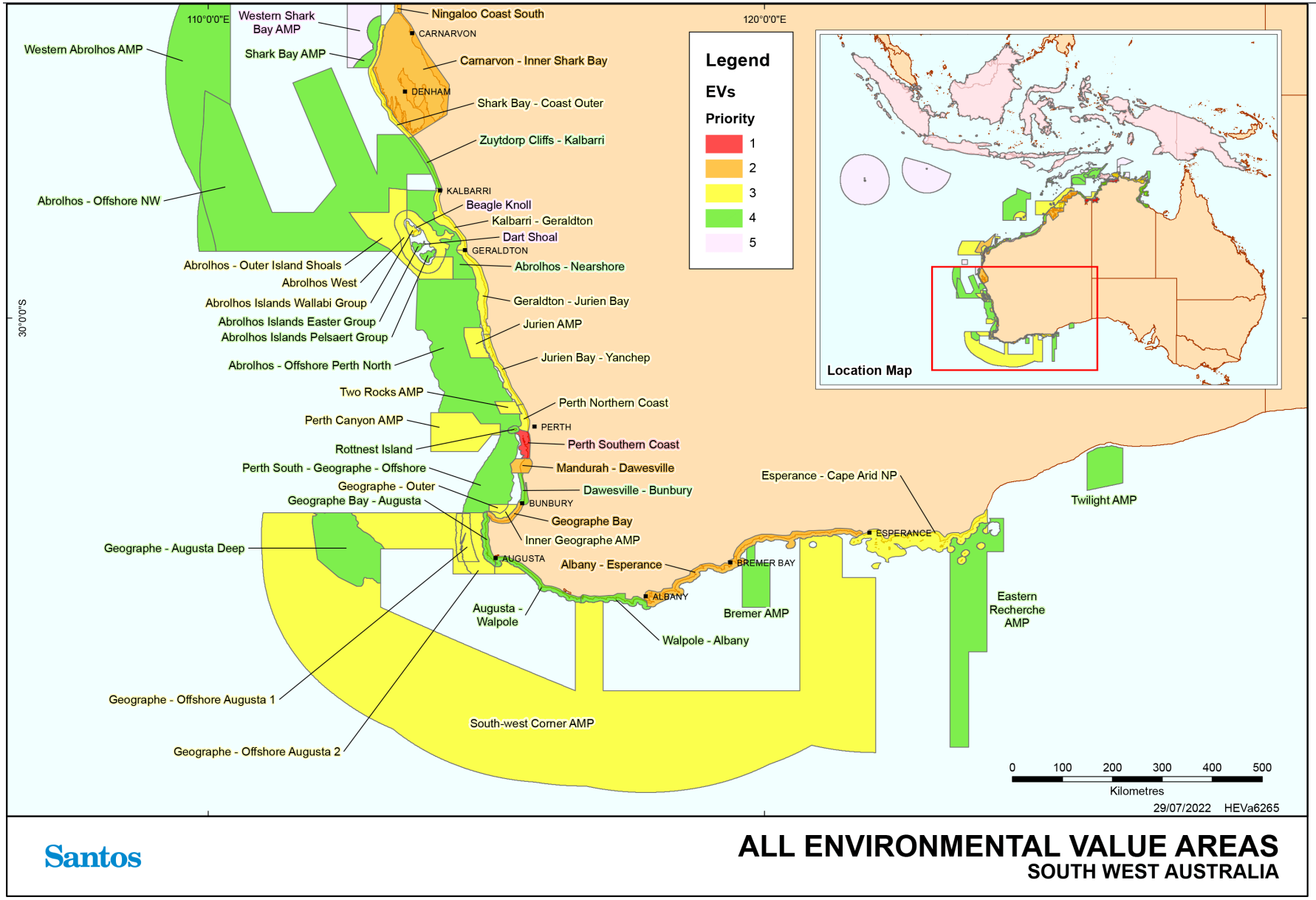

Figure 9.3 Southern environmental value areas.

10 MODEL SETTINGS

Table 10.1 provides a summary of the oil spill model settings.

Table 10.1 Summary of the oil spill model settings used in this assessment.

	Scenario
Description	Vessel tank rupture
Number of spill simulations with randomly selected start times	300 total (100 per season)
Spill volume	500 m^3
Oil type	MDO
Release depth	Surface
Release duration	Instantaneous
Simulation length	30 days
Floating oil (NOPSEMA) thresholds	1 g/m^2, low exposure 10 g/m^2, moderate exposure 50 g/m^2, high exposure
Shoreline accumulation (NOPSEMA) thresholds	10 g/m^2, low exposure 100 g/m^2, moderate exposure 1,000 g/m^2, high exposure
Dissolved hydrocarbon (NOPSEMA) thresholds	10 ppb over 1 hour, low exposure 50 ppb over 1 hour, moderate exposure 400 ppb over 1 hour, high exposure
Entrained hydrocarbon (NOPSEMA) thresholds	10 ppb over 1 hour, low exposure 100 ppb over 1 hour moderate exposure

11 PRESENTATION AND INTERPRETATION OF MODEL RESULTS

The results from the modelling study are presented in a number of tables and figures, which aim to provide an understanding of the predicted sea-surface and water column (subsurface) exposure and shoreline accumulation (if predicted).

11.1 Stochastic Modelling

If readers are not fully familiar with how to interpret stochastic modelling outputs, please refer to the relevant NOPSEMA factsheet (NOPSEMA, 2018) before reading this report section.

Predictions for the probability of contact and time to contact by oil concentrations equalling or exceeding defined thresholds for floating and shoreline oil, entrained and dissolved hydrocarbons are provided in the following sections to summarise the results of the annualised stochastic modelling.

The stochastic results are calculated and presented as follows:

- ***Areas of Exposure*** - encompasses the area that could be affected and was derived from the seasonal stochastic modelling results (i.e., results from all replicate simulations across all seasons) based on the following thresholds:

  Low threshold (or Environment That May Be Affected (EMBA))

  – Floating oil – 1 g/m^2.
  – Shoreline oil accumulation – 10 g/m^2.
  – Dissolved hydrocarbon – 10 pb; and
  – Entrained hydrocarbons –10 ppb.

  Moderate Exposure Value Area (MEVA)

  – Floating oil – 10 g/m^2.
  – Shoreline oil accumulation – 100 g/m^2.
  – Dissolved hydrocarbon – 50 pb; and
  – Entrained hydrocarbons – 100 ppb.

  High Exposure Value Area (HEVA)

  – Floating oil – 50 g/m^2.
  – Shoreline oil accumulation – 1,000 g/m^2; and
  – Dissolved aromatic hydrocarbon – 400 pb.

- ***Annualised Cross-sections of entrained and dissolved hydrocarbon concentrations*** – The predicted maximum entrained and dissolved hydrocarbon concentrations within the water column, along east-west and north-south transects in the vicinity of the release location.
- ***Predicted zones of potential exposure*** – maps of floating oil exposure, shoreline oil accumulation, entrained oil and dissolved hydrocarbons exposure were generated based on the following thresholds:
  – Floating oil – 1-10 g/m^2 (Low), 10-50 g/m^2 (Moderate) and ≥50 g/m^2 (High).
  – Shoreline oil accumulation – 10-100 g/m^2 (Low), 100-1,000 g/m^2 (Moderate) and ≥1,000 g/m^2 (High).
  – Entrained hydrocarbons – 10-100 ppb (Low) and ≥100 ppb (Moderate).
  – Dissolved hydrocarbon – 10-50 ppb (Low), 50-400 ppb (Moderate) and ≥400 ppb (High).
- ***The probability of oil exposure on the sea surface, in-water or shorelines*** – is calculated by dividing the number of spill simulations passing over a given grid cell at a given reporting threshold, divided by the total number of simulations.

- ***The minimum time before oil exposure on the sea surface, in-water or shorelines*** – is determined by ranking the elapsed time before sea surface exposure, entrained oil exposure or shoreline accumulation (at a given reporting threshold) to a given location/grid cell for each of the spill simulations.
- ***The maximum local accumulated concentration averaged over all replicate spills*** – the greatest concentration calculated for any point on the shoreline after averaging over all replicate simulations.
- ***The maximum local accumulated concentration in the worst replicate spill*** – the greatest accumulation predicted for any point on the shoreline during any replicate simulation, and thus represents an extreme estimate.
- ***The average volume of oil ashore*** – is determined by averaging the volume of oil ashore across all simulations predicted to make shoreline contact.
- ***The maximum volume of oil ashore in the worst replicate spill*** – the greatest volume of oil predicted for any point on the shoreline during any replicate simulation, and thus represents an extreme estimate.

The mean and maximum shoreline concentrations indicate the concentrations forecast to potentially accumulate over time on any discrete part of a shoreline; calculated for individual portions of 1 km in length. Accumulated concentrations are calculated by summing the mass of oil that arrives at any concentration (including < threshold) over time at a model cell and subtracting any mass lost through evaporation and washing off, where relevant.

Note that it is possible that oil films arriving at concentrations that are less than the threshold may accumulate over the course of a spill event to result in concentrations that apparently exceed the threshold. Hence, the mean expected, and maximum concentrations of accumulated oil can exceed the threshold applied to the probability calculations for the arrival of floating oil even where no instantaneous exceedances above threshold are predicted. It is important to understand that the two parameters (floating concentration and shoreline concentration) are quite distinct, calculated in different ways and representative of alternative outcomes. The floating probability estimates, and the shoreline accumulative estimates should therefore be treated as independent estimators of different exposure outcomes, and not directly compared.

Readers should note that the contour maps presented in the stochastic modelling results, do not represent the predicted coverage of any one hydrocarbon spill or a depiction of a slick or plume at any instant in time. Rather, the contours are a composite of many theoretical slick paths, integrated over the full duration of the simulations relevant to each scenario. The stochastic modelling contour maps should be treated as indications of the probability of exposure at defined concentrations, for individual location, at some point in time after the defined spill commences, given the trends and variations in metocean conditions that occur around the study area.

Location with higher probability ratings were exposed during a greater number of spill simulations, indicating that the combination of the prevailing wind and current conditions are more likely to result in contact to these location if the spill scenario were to occur in the future. The areas outside of the lowest-percentage contour indicate that contact will be less likely under the range of prevailing conditions for this region than areas falling within higher probability contours. It is important to note that the probabilities are derived from the samples of data used in the modelling. Therefore, location that are not calculated to receive exposure at threshold concentrations or greater in any of the replicate simulations might possibly be contacted if very unusual conditions were to occur. Hence, we do not attribute a probability of nil to areas beyond the lowest probability contour.

12 MODELLING RESULTS: VESSEL TANK RUPTURE

The scenario investigated the potential exposure to surrounding regions from a 500 m^3 surface release of MDO from a vessel tank rupture due to a vessel collision at drill centre S2. The spill was tracked for 30 days to allow oil concentrations to decrease below the minimum thresholds. The modelling assumed no mitigation efforts are undertaken to collect or otherwise affect the natural transport and weathering of the oil.

Section 12.1 presents the stochastic results including the areas of exposure (Section12.1.1), while Section 12.2 presents the results for the deterministic simulation.

12.1 Stochastic Analysis

12.1.1 Areas of Exposure

Figure 12.1 presents the low, moderate and high value exposure areas, which were derived by combining the results from all 300 spill simulations.

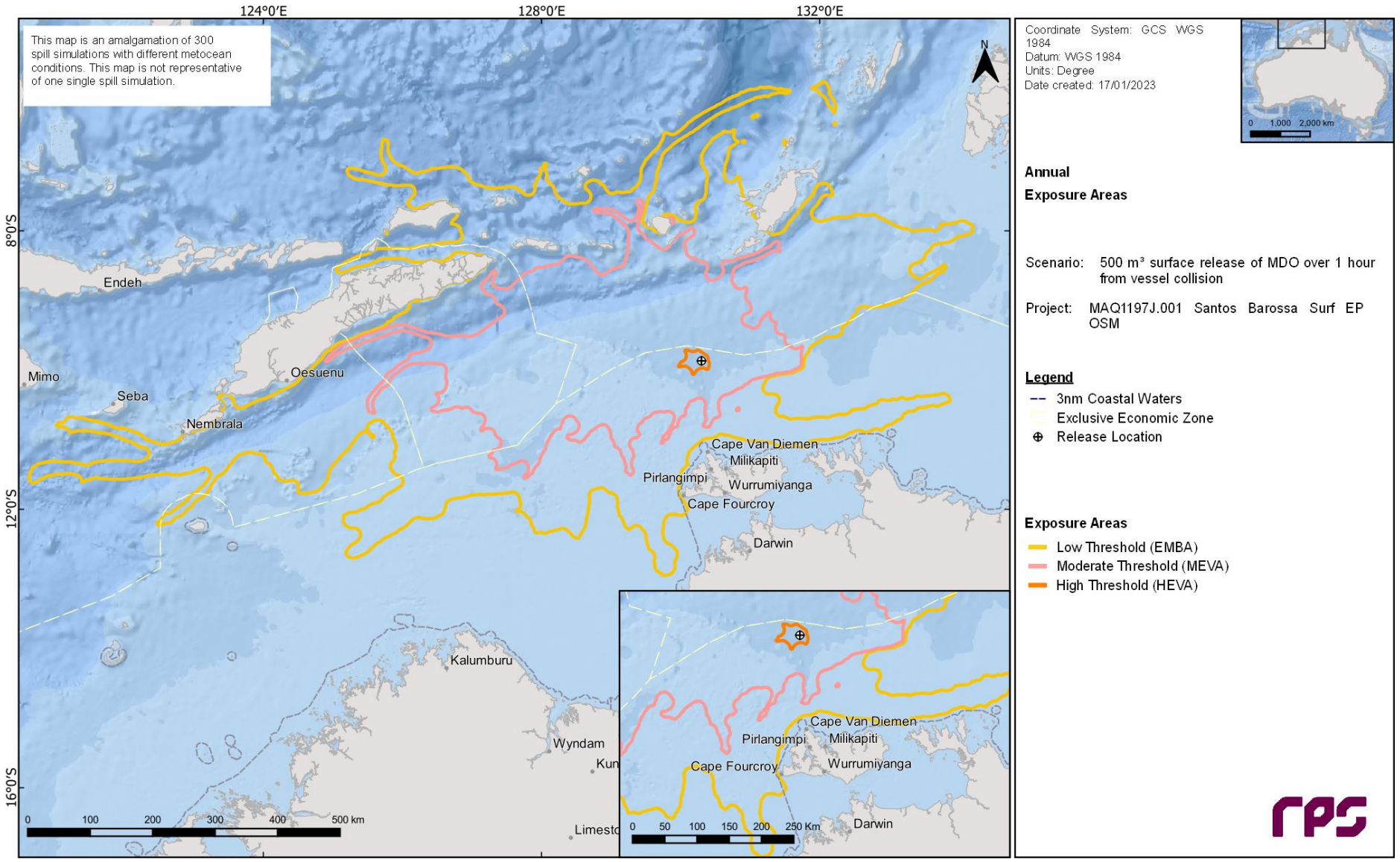

Figure 12.1 Predicted areas of exposure following a vessel tank rupture, derived from all 300 spill simulations.

12.1.2 Floating Oil Exposure

Table 12.1 summarises the maximum distances from the release location to floating oil exposure thresholds. Floating oil concentrations ≥1 g/m^2 could extend up to 402 km from the release location with the distance reducing to 136 km and 35 km as the thresholds increase to 10 g/m^2 and 50 g/m^2, respectively.

Table 12.2 presents the predicted floating oil exposure for EVAs. Only the results for receptors predicted to be exposed at or above the low threshold have been presented.

Outer Oceanic Shoals AMP and Sunrise Bank recorded the highest probability of exposure at 1.33% to concentrations exceeding 1 g/m^2. Floating oil at the same threshold was predicted to reach Sunrise Bank the quickest at 50 hours following the spill commencement.

Figure 12.2 presents the zones of floating oil exposure, while the probabilities and minimum times before exposure are presented in Figure 12.3 to Figure 12.8.

Table 12.1 Maximum distances from the release location to floating oil exposure thresholds for the annualised results, following a vessel tank rupture. The results were calculated from 300 spill simulations.

Distance and direction travelled	Floating oil exposure thresholds		
	1 g/m^2	10 g/m^2	50 g/m^2
Maximum distance travelled (km) by a spill simulation	402	136	35
Direction of maximum travel	West	West	West

Table 12.2 Summary of floating oil exposure for environmental value areas following a vessel tank rupture based on annualised results. The results were calculated from 300 spill simulations.

Environmental Value Areas	Probability (%) of floating oil exposure at			Minimum time before floating oil exposure (hours) at		
	≥ 1 g/m²	≥ 10 g/m²	≥ 50 g/m²	≥ 1 g/m²	≥ 10 g/m²	≥ 50 g/m²
Margaret Harries Bank	1.00	<0.33	<0.33	121	NC	NC
Outer Oceanic Shoals AMP	1.33	0.33	<0.33	87	100	NC
Sunrise Bank	1.33	0.33	<0.33	50	52	NC
The Boxers Area	0.33	<0.33	<0.33	111	NC	NC

^: If exposure is predicted for a receptor at the low threshold but not at the moderate and/or high threshold, then the probability presented is <0.33%.

NC: No contact to receptor predicted for specified threshold.

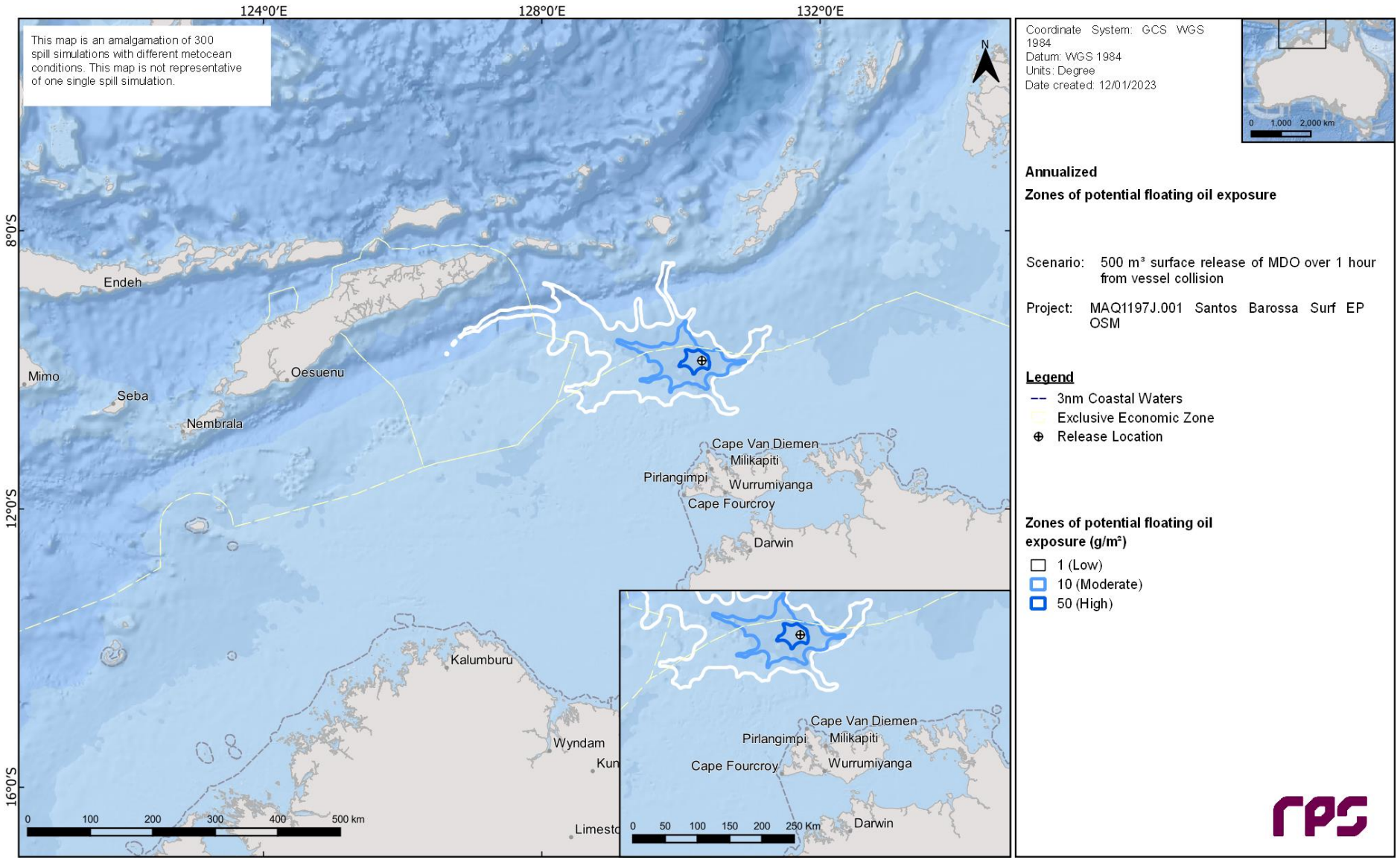

Figure 12.2 Predicted zones of floating oil exposure during annual conditions from a vessel tank rupture. The results were calculated from all 300 spill simulations.

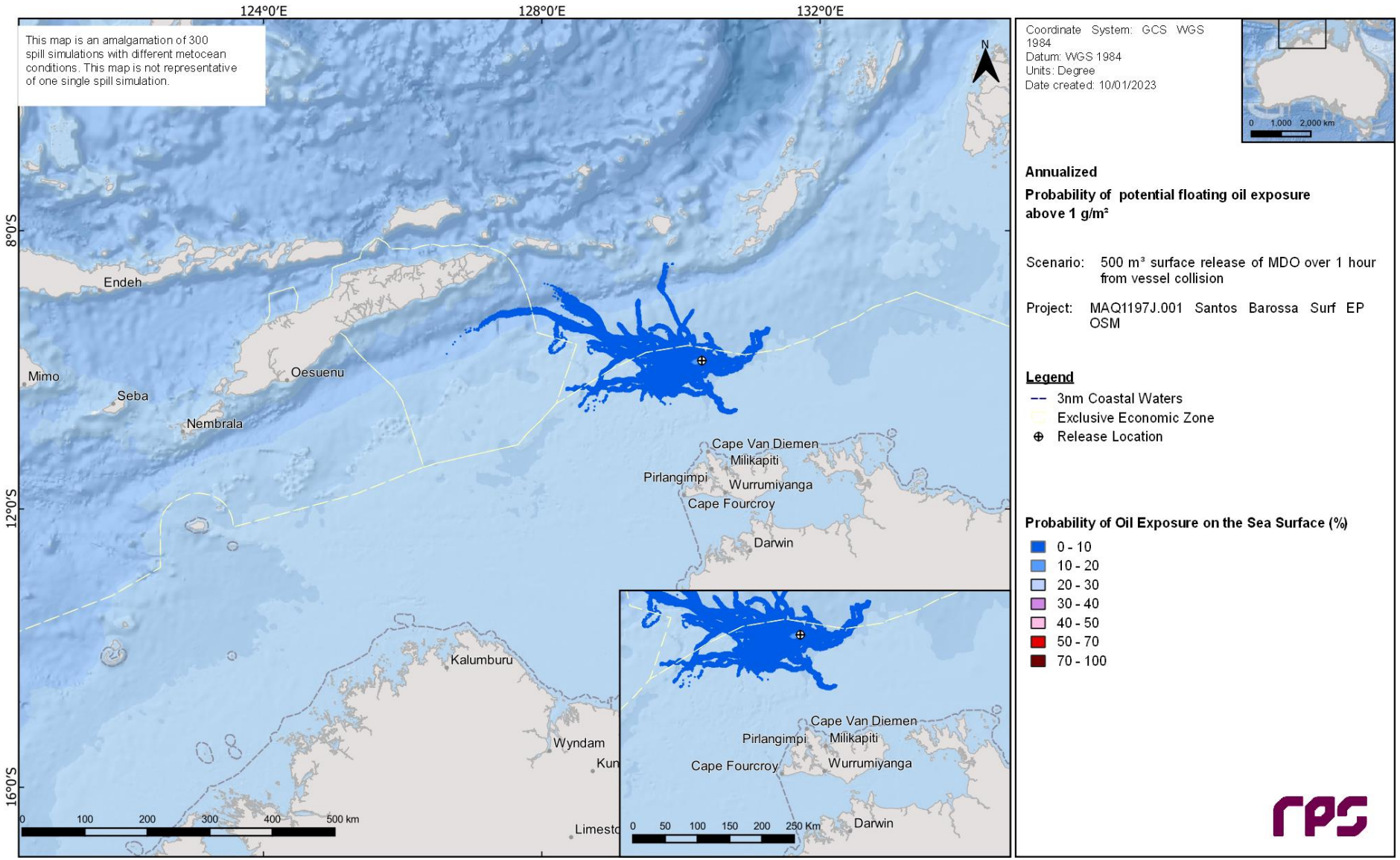

Figure 12.3 Predicted probability of floating oil exposure at or above 1 g/m² during annual conditions from a vessel tank rupture. The results were calculated from all 300 spill simulations.

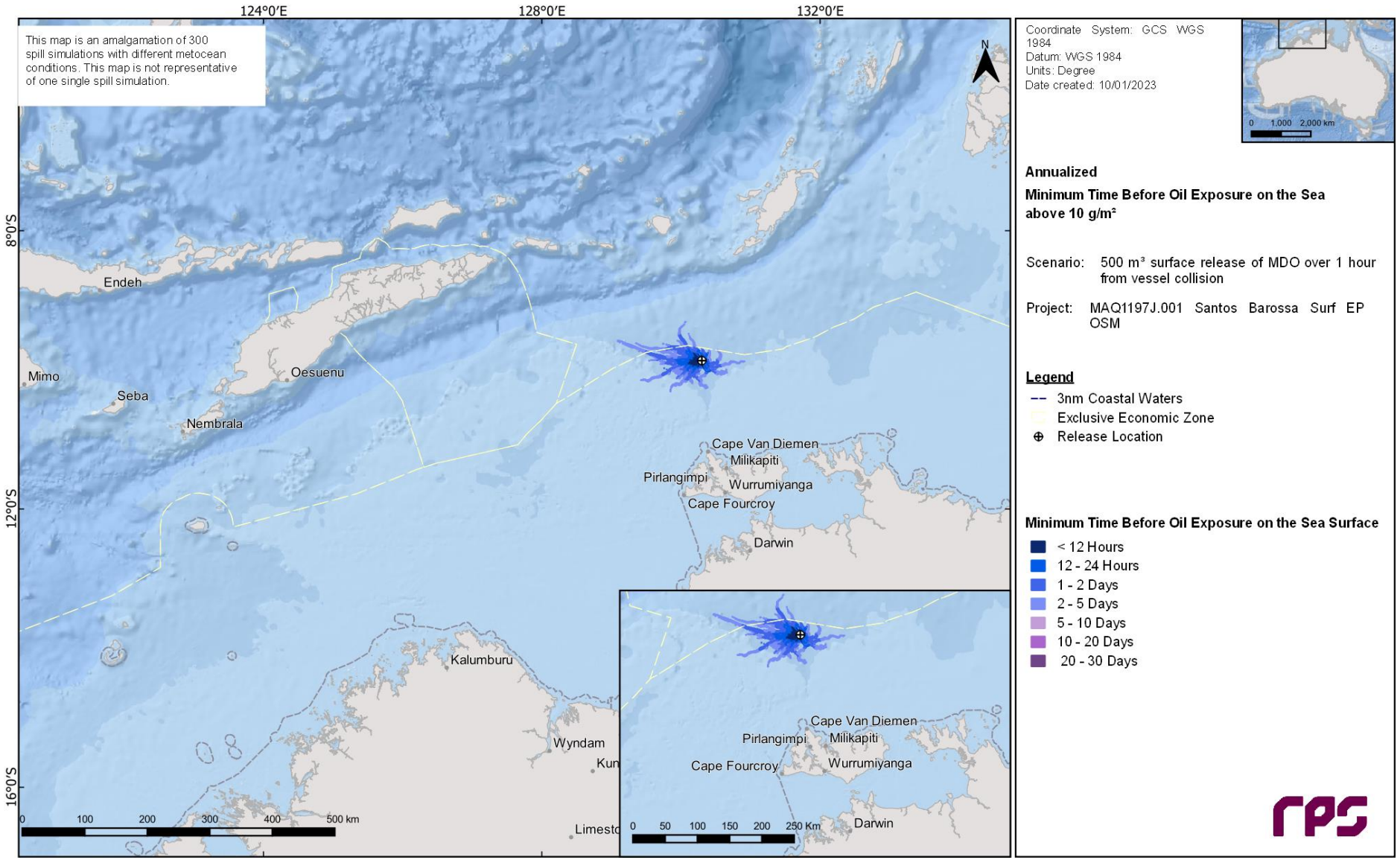

Figure 12.4 Predicted probability of floating oil exposure at or above 10 g/m² during annual conditions from a vessel tank rupture. The results were calculated from all 300 spill simulations.

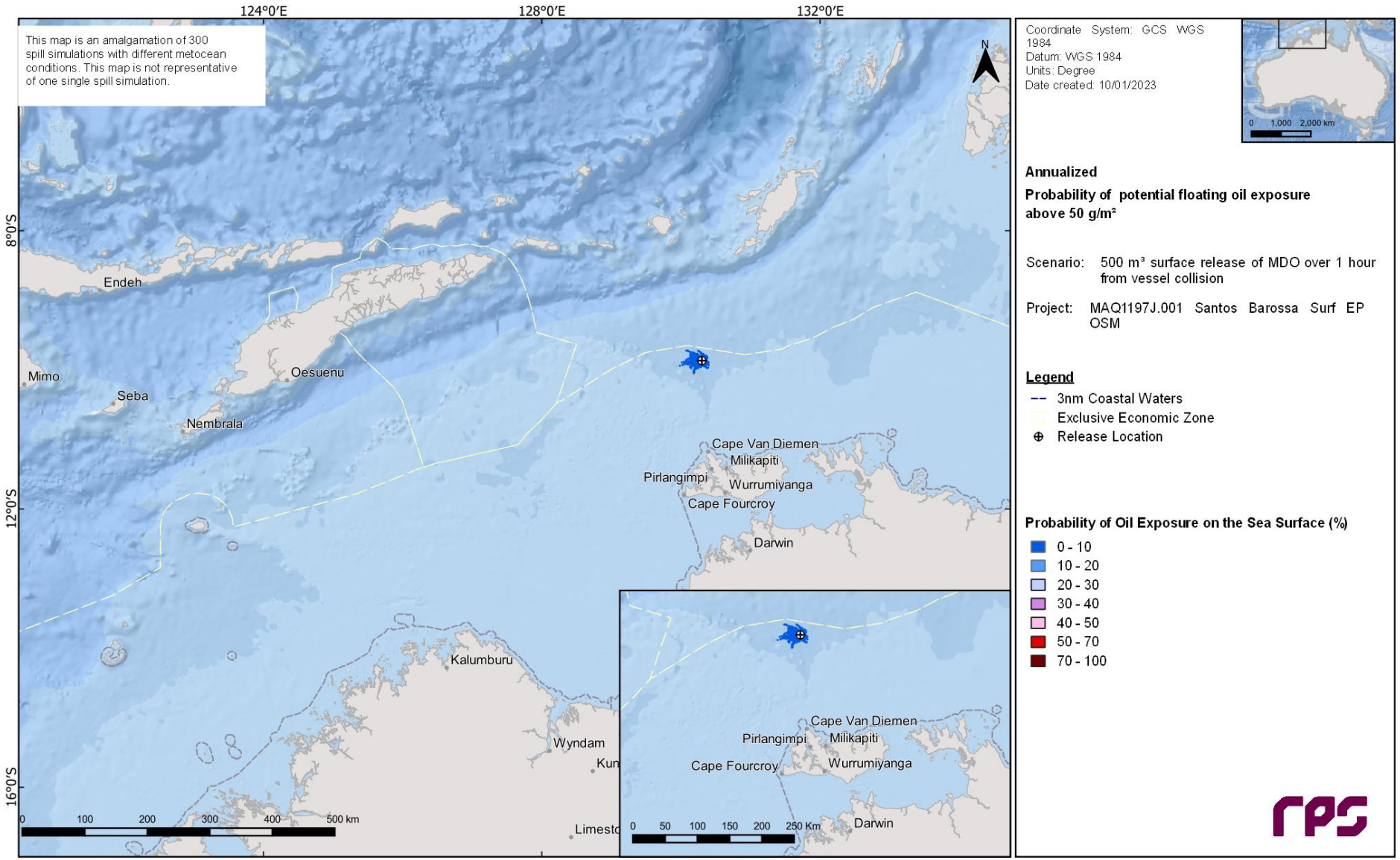

Figure 12.5 Predicted probability of floating oil exposure at or above 50 g/m² during annual conditions from a vessel tank rupture. The results were calculated from all 300 spill simulations.

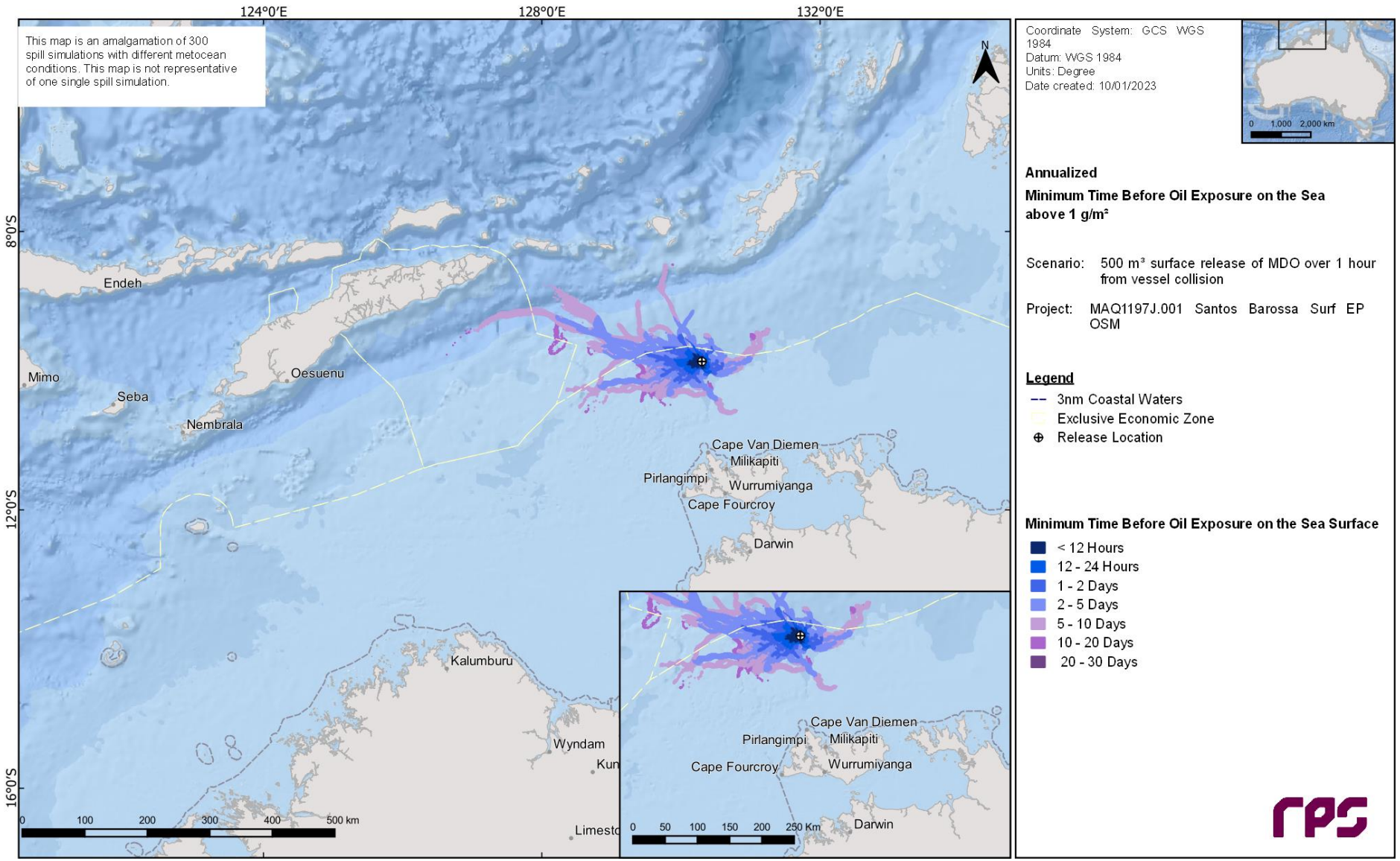

Figure 12.6 Predicted minimum times before floating oil exposure at or above 1 g/m² during annual conditions from a vessel tank rupture. The results were calculated from all 300 spill simulations.

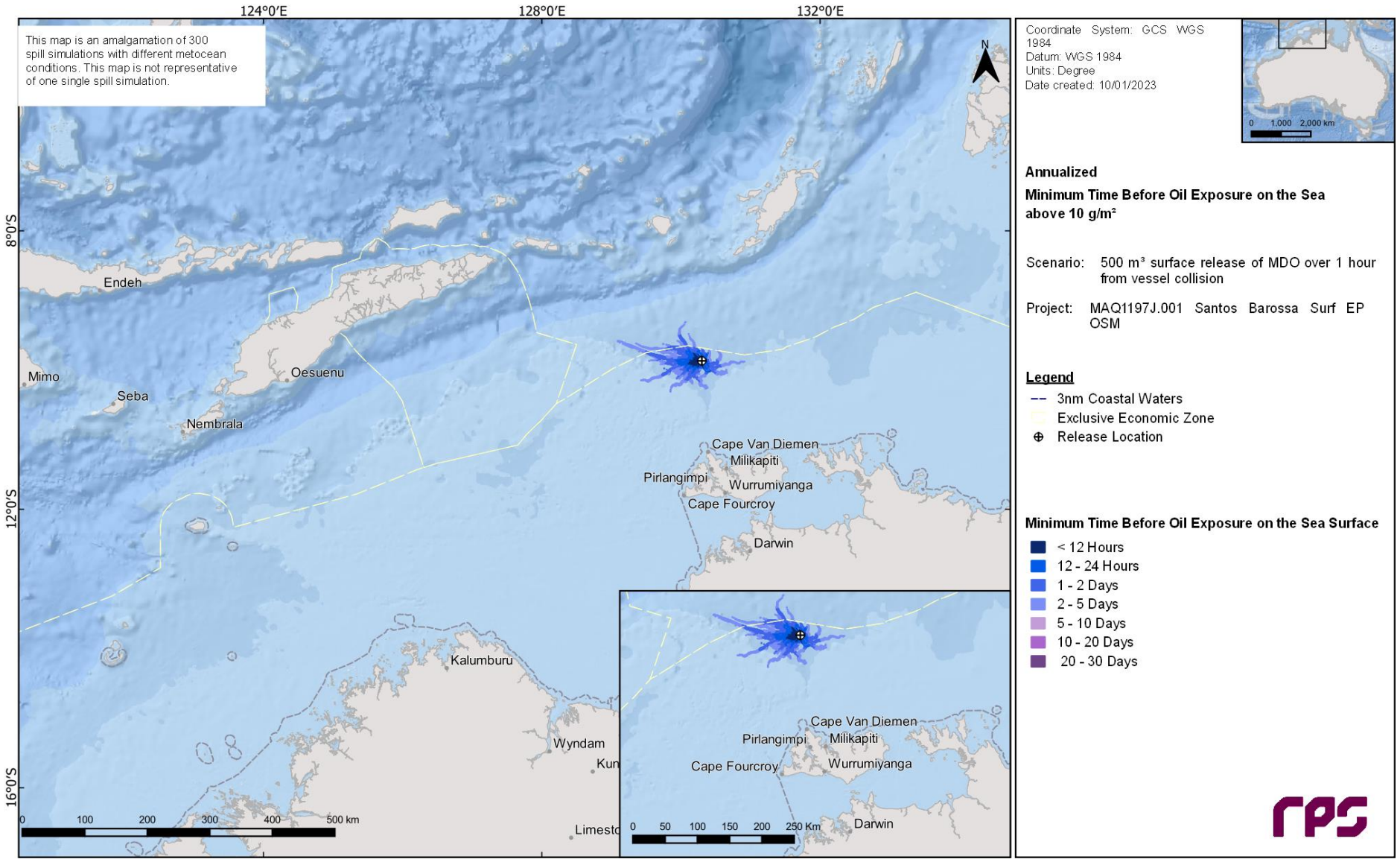

Figure 12.7 Predicted minimum times before floating oil exposure at or above 10 g/m² during annual conditions from a vessel tank rupture. The results were calculated from all 300 spill simulations.

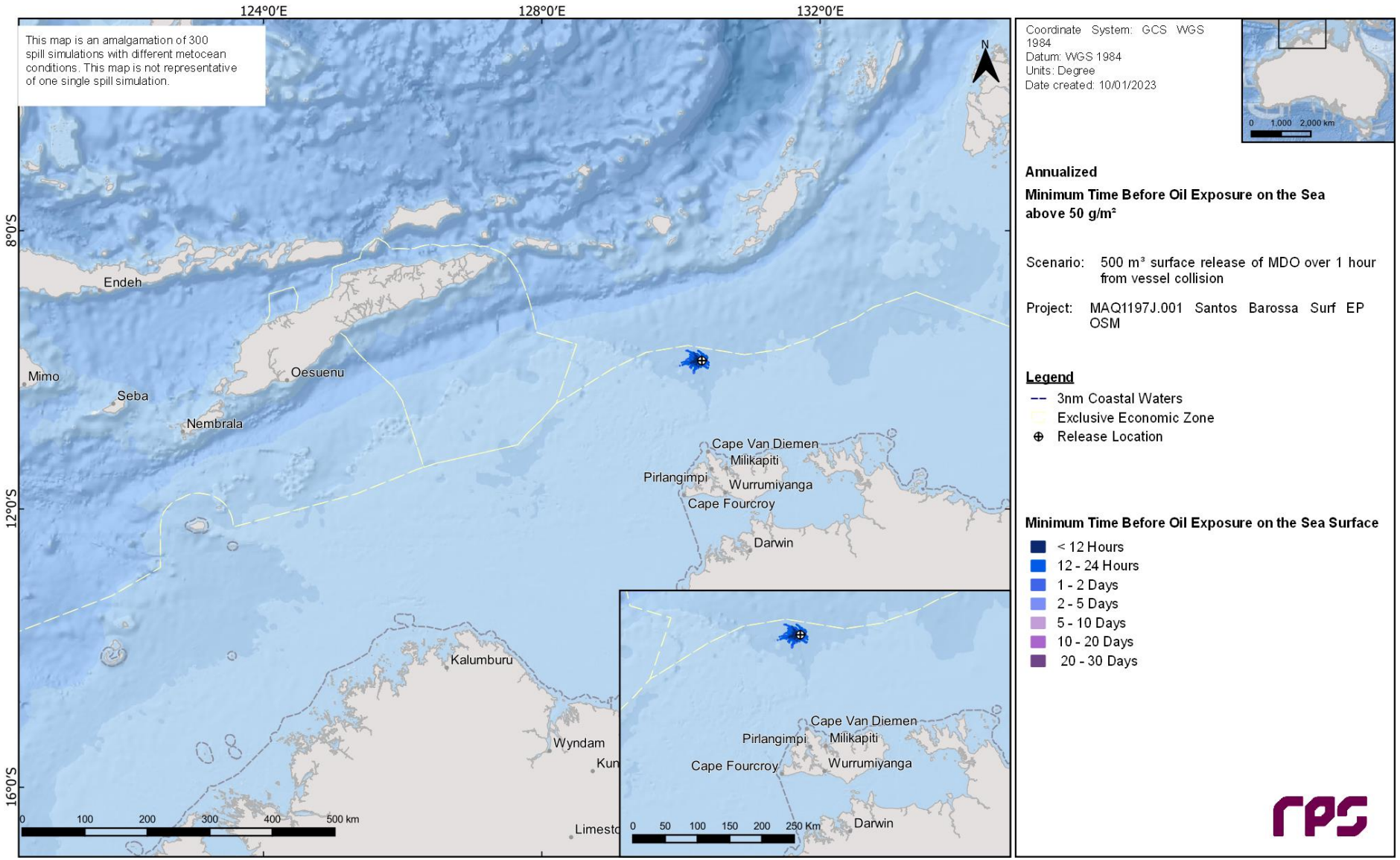

Figure 12.8 Predicted minimum times before floating oil exposure at or above 50 g/m² during annual conditions from a vessel tank rupture. The results were calculated from all 300 spill simulations.

12.1.3 Shoreline Oil Accumulation

Table 12.3 summarises the shoreline oil accumulation for EVAs based on annualised results. Only the results for receptors predicted to be exposed at or above the low threshold have been presented. The results were calculated from all 300 spill simulations. No shoreline accumulation was predicted for the 100 g/m^2 and 1,000 g/m^2 thresholds.

The highest probability of shoreline oil accumulation at the 10 g/m^2 threshold was forecast for Indonesia-East (0.99%). The maximum volume of oil ashore was 8 m^3 for the same receptor and Indonesia-East was forecast to record the quickest time before oil accumulation at the 10 g/m^2 threshold at 283 hours (11.8 days).

The maximum potential oil accumulation is presented in Figure 12.9 and probabilities at the 10 g/m^2 threshold are presented in Figure 12.10.

Table 12.3 Summary of the shoreline oil accumulation for environmental value areas based on annualised results, following a vessel tank rupture. The results were calculated from all 300 spill simulations.

Environmental Value Areas	Probability (%) of shoreline oil on receptors at			Minimum time to receptor (hours) for shoreline oil at			Maximum local accumulated concentration (g/m²)		Maximum accumulated volume (m³) along this shoreline		Maximum length of shoreline (km) with concentrations ≥ 10 g/m²		Maximum length of shoreline (km) with concentrations ≥ 100 g/m²		Maximum length of shoreline (km) with concentrations ≥ 1,000 g/m²	
	≥ 10 g/m²	≥ 100 g/m²	≥ 1,000 g/m²	≥ 10 g/m²	≥ 100 g/m²	≥ 1,000 g/m²	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate simulations	in the worst replicate simulation	averaged over all replicate simulations	in the worst replicate simulation	averaged over all replicate simulations	in the worst replicate simulation	averaged over all replicate simulations	in the worst replicate simulation
Indonesia – East*	0.99	<0.33	<0.33	283	NC	NC	0.3	76	<1	8	<1	18	NC	NC	NC	NC
Minor Indonesian Islands	0.33	<0.33	<0.33	512	NC	NC	<0.1	15	<1	2	<1	4	NC	NC	NC	NC
Tiwi Islands	0.33	<0.33	<0.33	665	NC	NC	0.1	41	<1	5	<1	13	NC	NC	NC	NC

^: If exposure is predicted for a receptor at the low threshold but not at the moderate and/or high threshold, then the probability presented is <0.33%.

NC: No contact to receptor predicted for specified threshold.

* Indonesia - East encompasses Indonesia East and Timor Leste

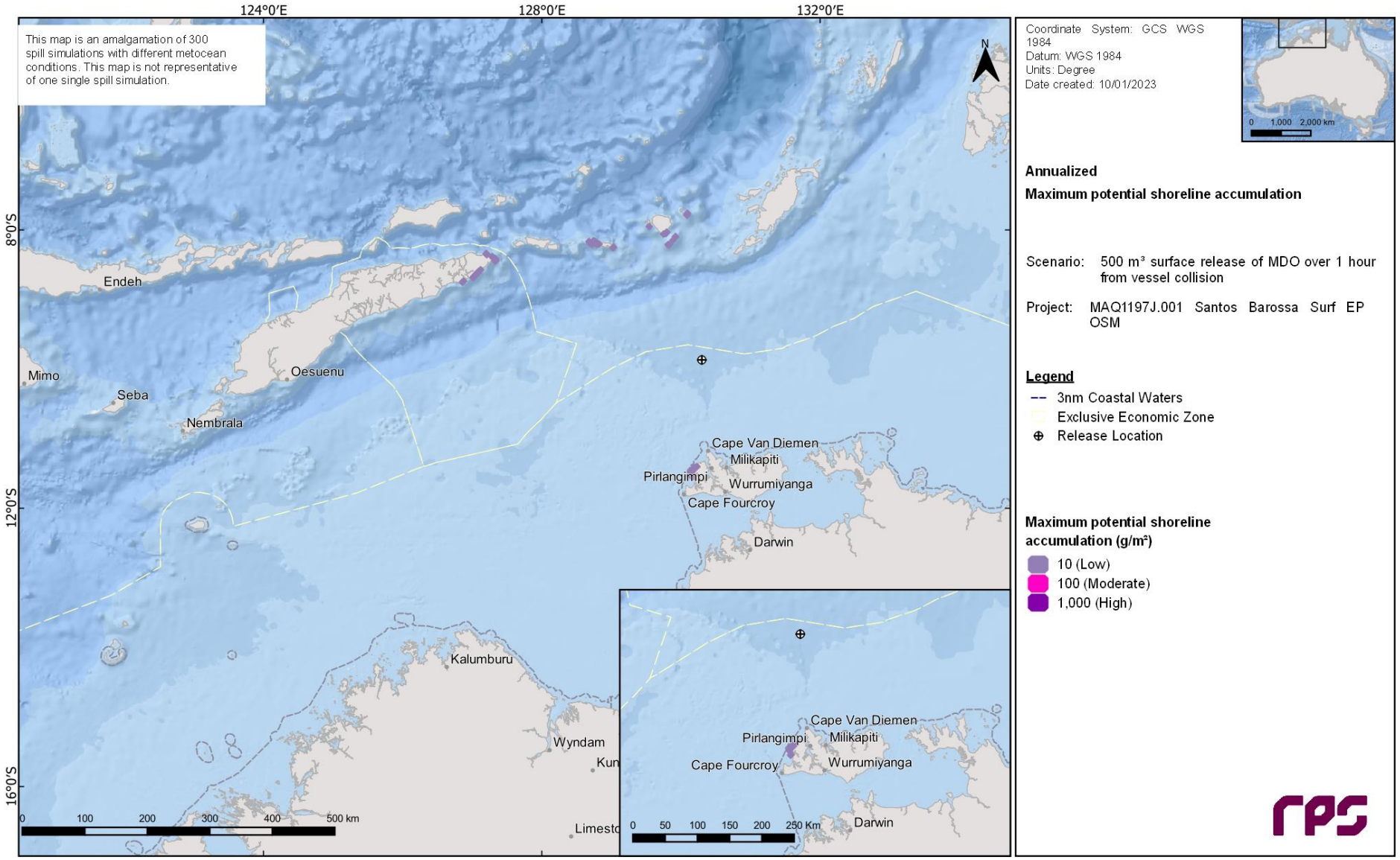

Figure 12.9 Maximum potential shoreline oil accumulation during annual conditions from a vessel tank rupture. The results were calculated from all 300 spill simulations.

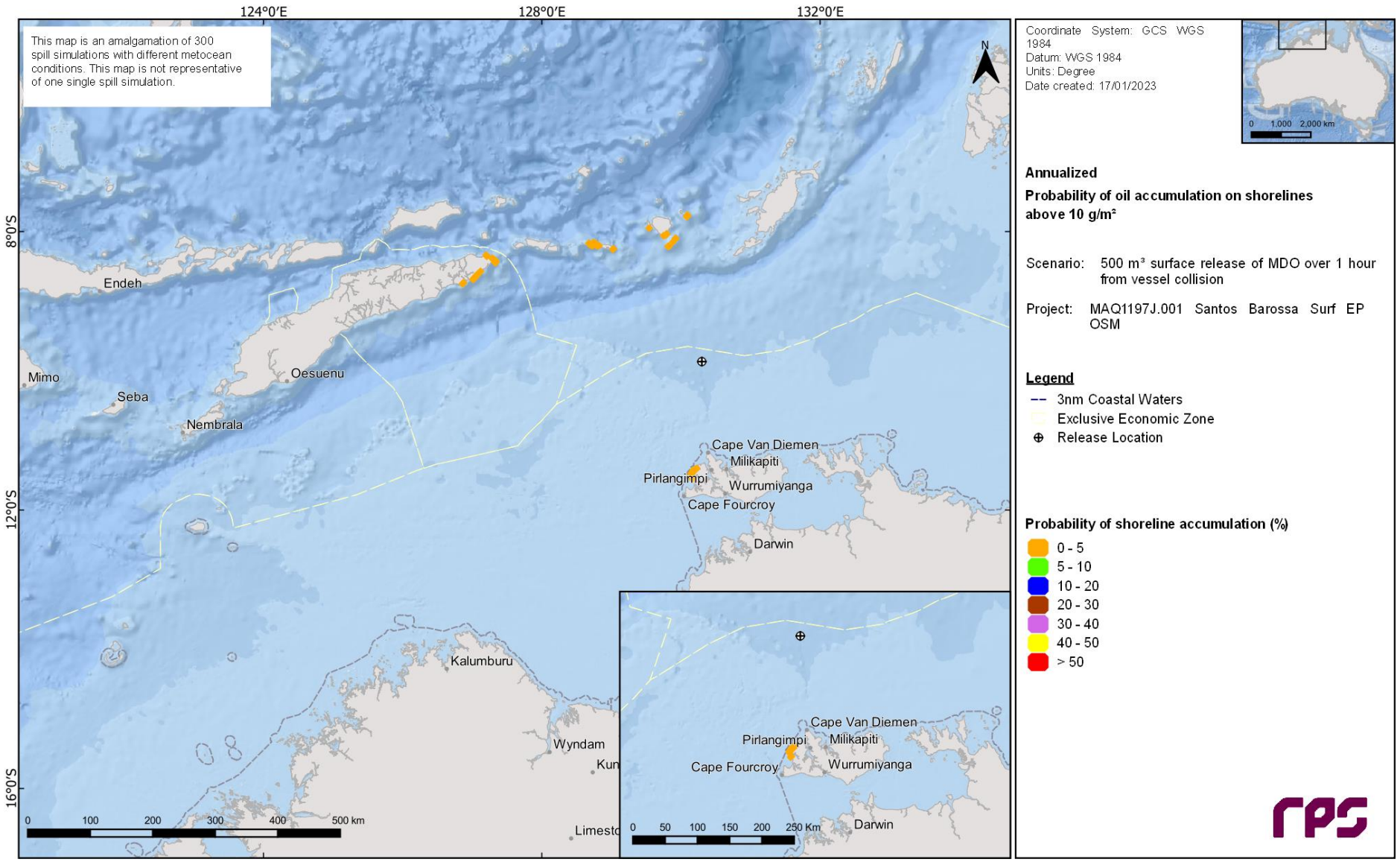

Figure 12.10 Predicted probability of shoreline oil accumulation at or above 10 g/m² during annual conditions from a vessel tank rupture. The results were calculated from all 300 spill simulations.

12.1.4 In-water Exposure

12.1.4.1 Entrained Hydrocarbons

Table 12.4 summarises the maximum distances from the release location to entrained hydrocarbons exposure thresholds. Entrained hydrocarbon concentrations exceeding 10 ppb may potentially occur 1,071 km from the release location, with the distance reducing to 591 km as the threshold increases to 100 ppb.

Table 12.5 presents the predicted exposure for EVAs. Only the results for receptors predicted to be exposed at or above the low threshold have been presented.

The probability of exposure for concentrations equal to or greater than 10 ppb and 100 ppb was predicted to be greatest at the Sunrise Bank (20% and 12%, respectively). The quickest time for exposure at or above 10 ppb was 39 hours for the Sunrise Bank receptor.

The highest concentration was predicted at Sunrise Bank at 2,108 ppb.

Figure 12.11 presents the zones of entrained hydrocarbon exposure, while the probabilities and minimum times before exposure are presented in Figure 12.12 to Figure 12.15 for the 10 ppb and 100 ppb thresholds.

Cross-sectional transects (north-south and east-west) of the maximum entrained hydrocarbons in the vicinity of the release site are presented in Figure 12.16 and Figure 12.17.

Table 12.4 Maximum distances from the release location to entrained hydrocarbon exposure thresholds for the annualised results, following a vessel tank rupture. The results were calculated from 300 spill simulations.

Distance and direction travelled	Entrained hydrocarbon exposure thresholds	
	10 ppb	100 ppb
Maximum distance travelled (km) by a spill simulation	1,071	591
Direction of maximum travel	West	West

Table 12.5 Summary of predicted entrained hydrocarbon exposure for environmental value areas based on annualised results. The results were calculated from 300 spill simulations.

Environmental Value Areas	Probability (%) of entrained hydrocarbon exposure at		Minimum time before entrained exposure (hours) at		Maximum entrained hydrocarbon concentrations (ppb)	
	≥ 10 ppb	≥ 100 ppb	≥ 10 ppb	≥ 100 ppb	averaged over all simulations	for the worst simulation
Ashmore-Cartier - Outer	0.33	<0.33	666	NC	<1	15
Echo Shoals	6.67	1.32	200	204	3	239
Fantome Shoals	0.33	<0.33	556	NC	<1	22
Flat Top Bank	0.66	<0.33	428	NC	<1	33
Indonesia - East*	2.00	0.66	169	177	2	243
Jones Shoal	0.33	<0.33	563	NC	<1	13
Margaret Harries Bank	10.33	2.33	122	146	8	451
Minor Indonesian Islands	1.00	<0.33	401	NC	<1	65
Newby Shoal	1.33	<0.33	570	NC	<1	25
Northern Arafura AMP	0.33	<0.33	552	NC	<1	17
Outer Oceanic Shoals AMP	9.33	3.67	62	72	11	811
Sahul Banks	1.33	<0.33	431	NC	<1	61
Shepparton Shoal	0.99	<0.33	384	NC	<1	56
Southern Arafura AMP	0.66	<0.33	430	NC	<1	20
NT Waters**	0.66	<0.33	665	NC	<1	18
Sunrise Bank	20.00	12.00	39	40	57	2,108
The Boxers Area	4.67	0.99	133	136	3	301
Tiwi Islands	0.33	<0.33	640	NC	<1	34
Van Cloon-Deep Shoals	2.00	<0.33	456	NC	<1	58
Western Sahul Bank Shoals	1.00	<0.33	494	NC	<1	43

^: If exposure is predicted for a receptor at the low threshold but not at the moderate and/or high threshold, then the probability presented is <0.33%.

NC: No contact to receptor predicted for specified threshold.

* Indonesia - East encompasses Indonesia East and Timor Leste

**: This receptor is not an environmental value area defined by Santos listed in Section 9 (Table 9.1).

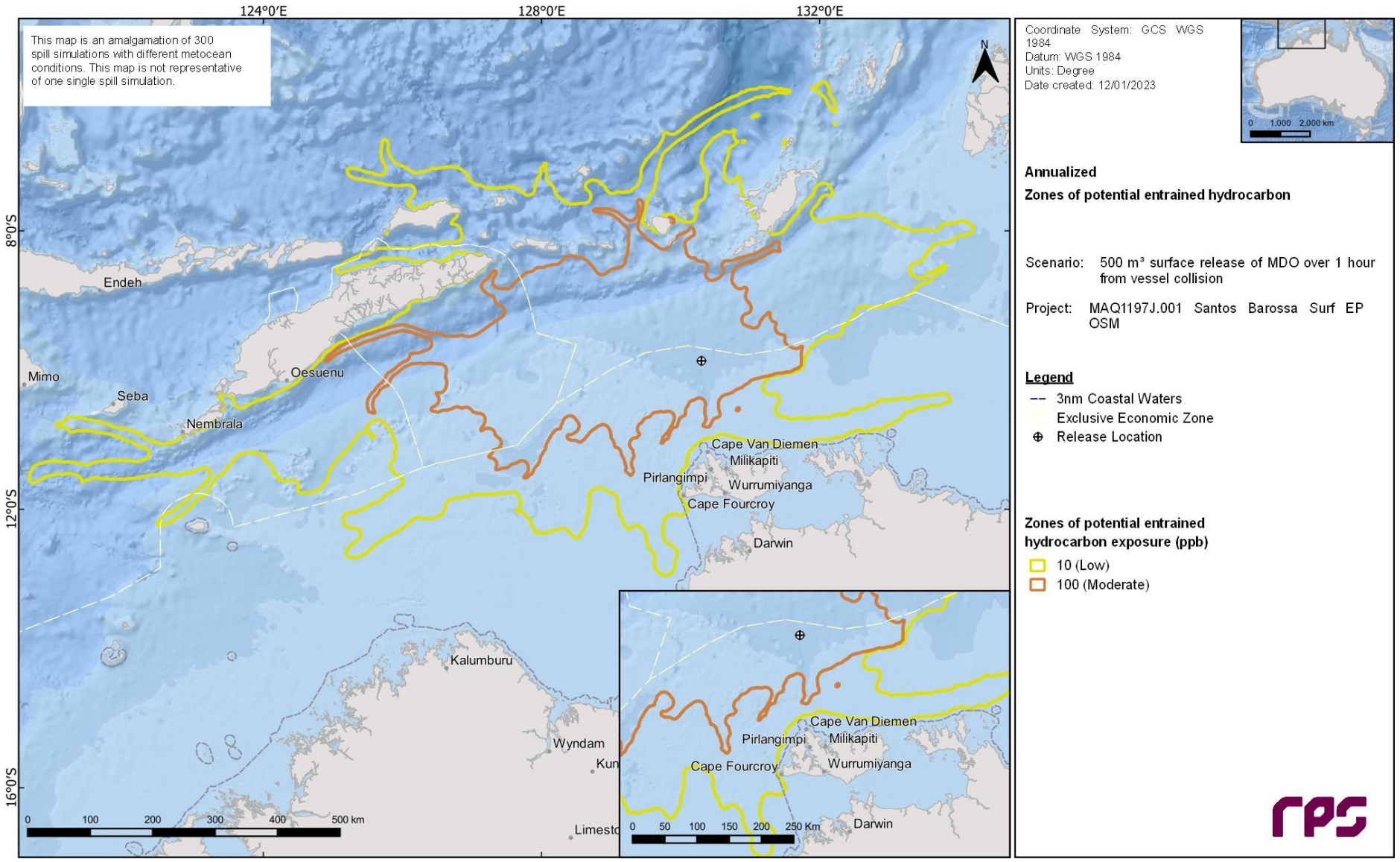

Figure 12.11 Predicted zones of entrained hydrocarbon exposure during annual conditions from a vessel tank rupture. The results were calculated from all 300 spill simulations.

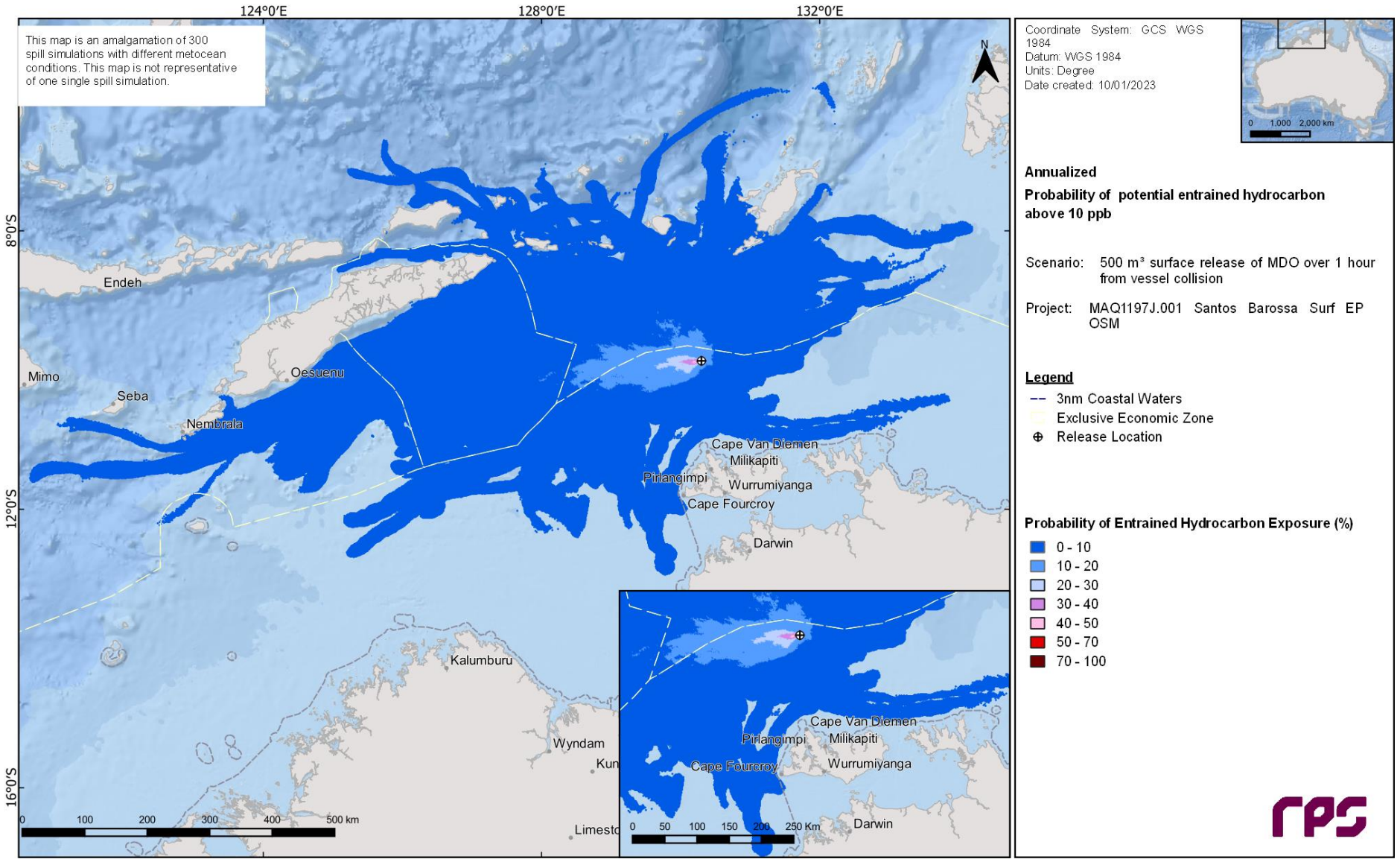

Figure 12.12 Predicted probability of entrained hydrocarbon exposure at or above 10 ppb during annual conditions from a vessel tank rupture. The results were calculated from all 300 spill simulations.

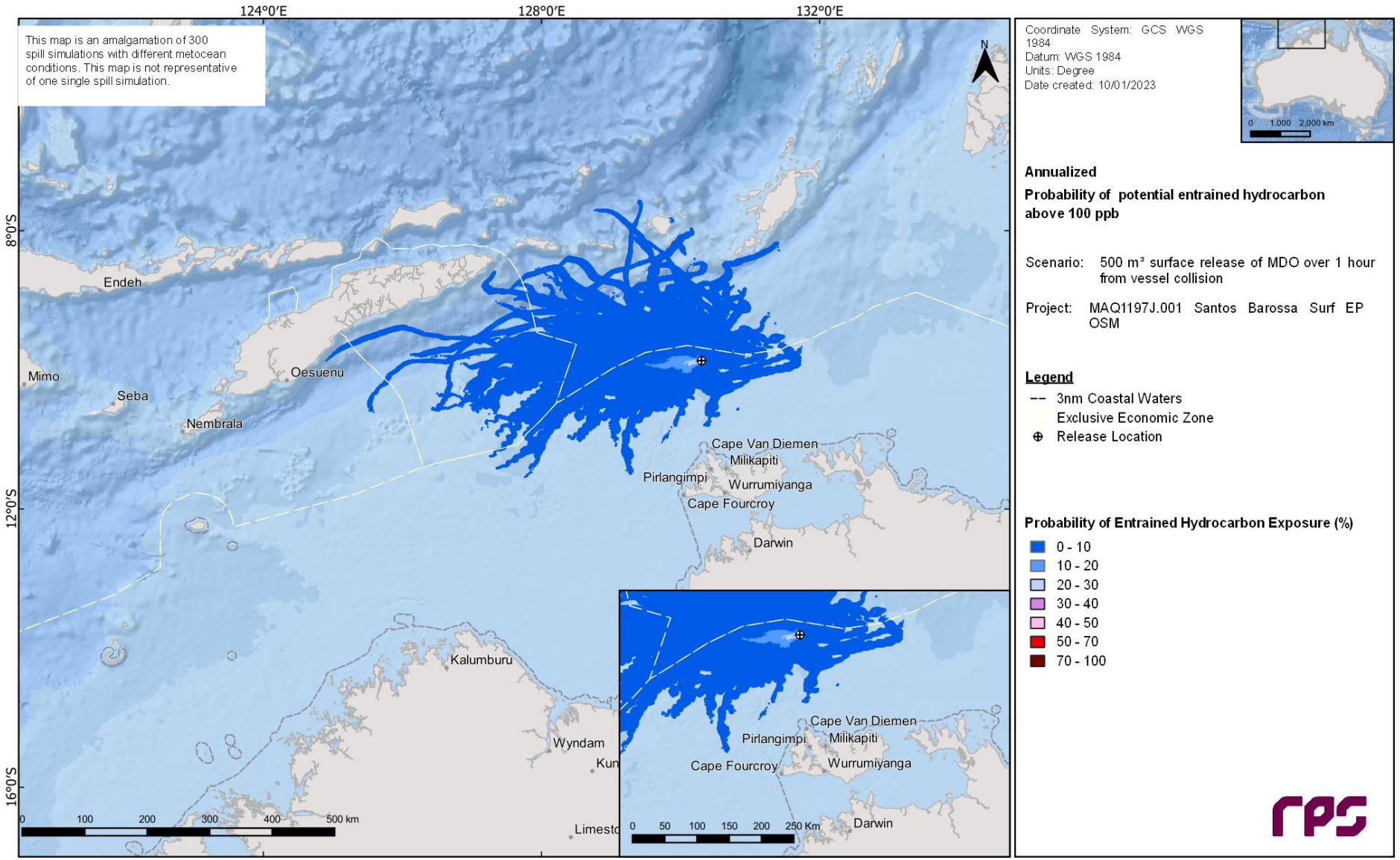

Figure 12.13 Predicted probability of entrained hydrocarbon exposure at or above 100 ppb during annual conditions from a vessel tank rupture. The results were calculated from all 300 spill simulations.

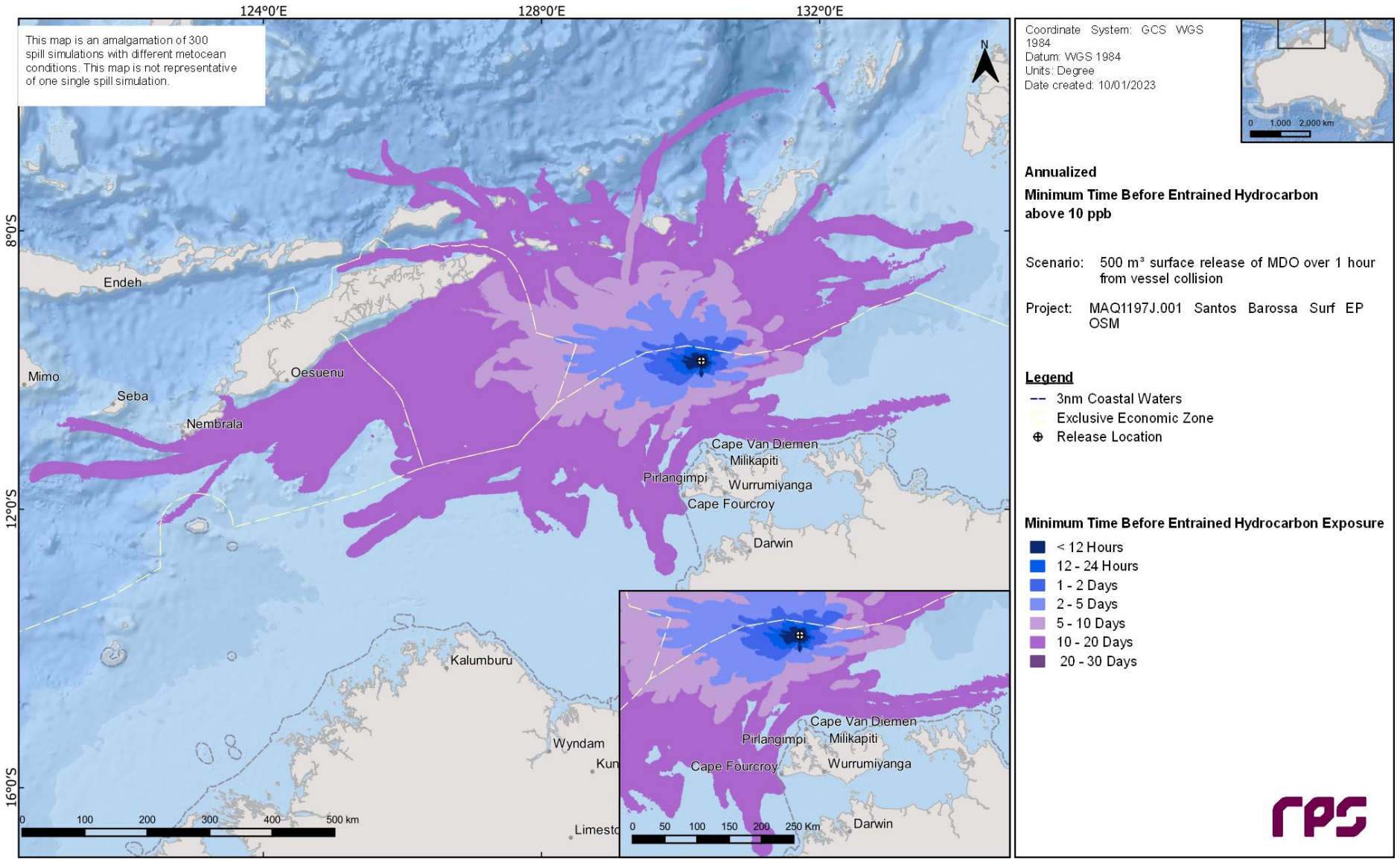

Figure 12.14 Predicted minimum times before entrained hydrocarbon exposure at or above 10 ppb during annual conditions from a vessel tank rupture. The results were calculated from all 300 spill simulations.

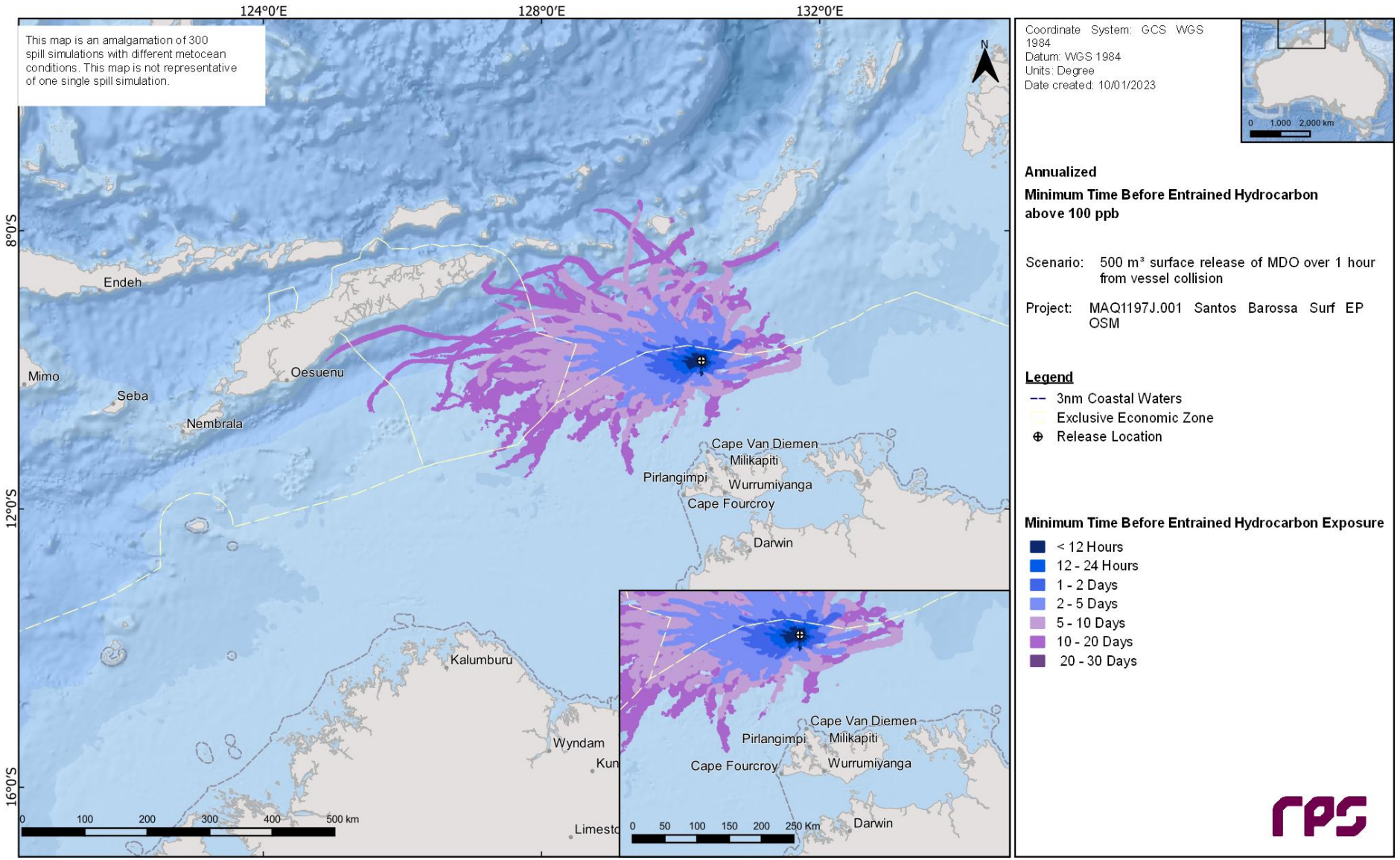

Figure 12.15 Predicted minimum times before entrained hydrocarbon exposure at or above 100 ppb during annual conditions from a vessel tank rupture. The results were calculated from all 300 spill simulations.

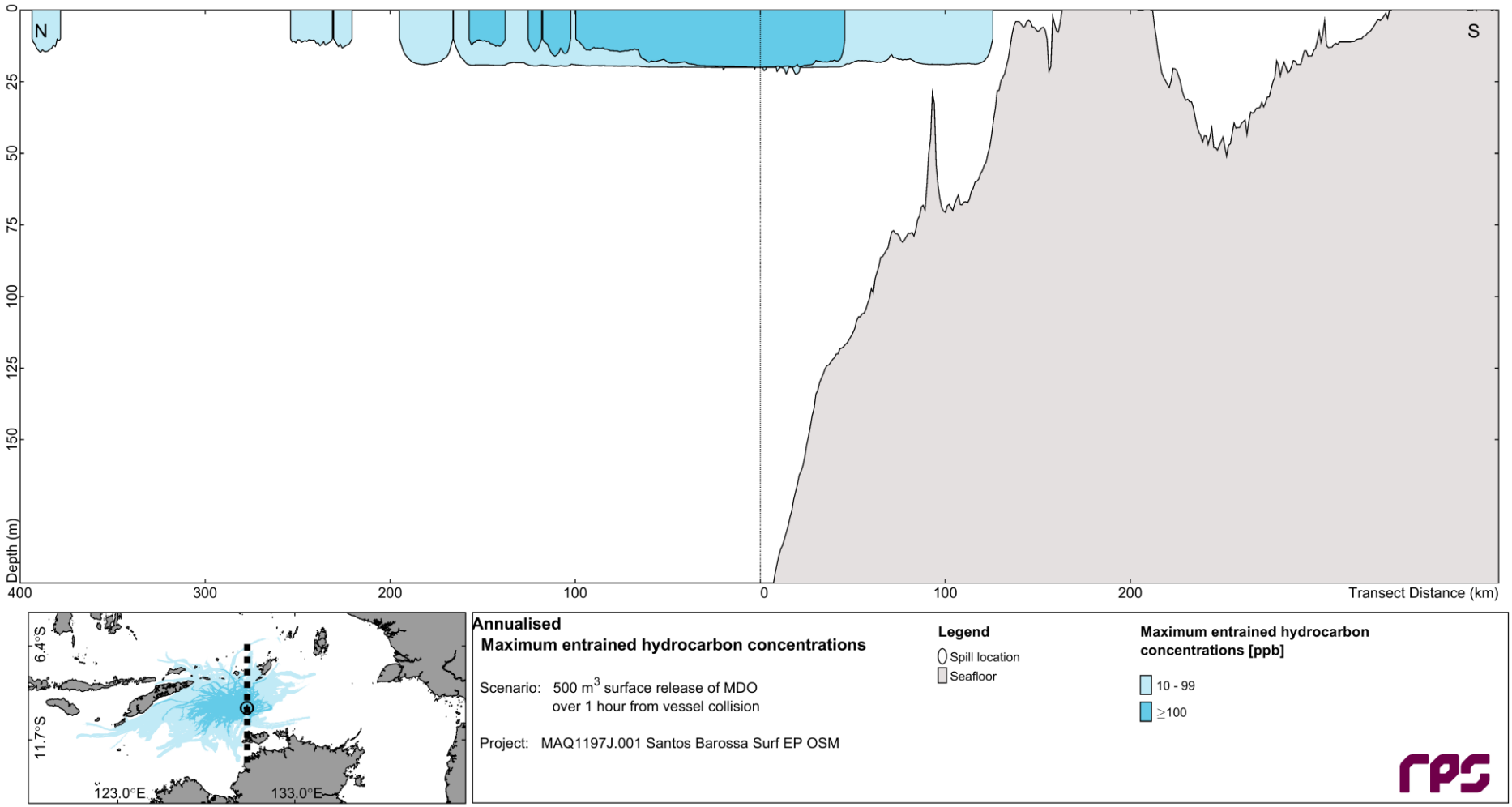

Figure 12.16 North-south cross-section transect of entrained hydrocarbon concentrations during annual conditions from a vessel tank rupture. The results were calculated from all 300 spill simulations.

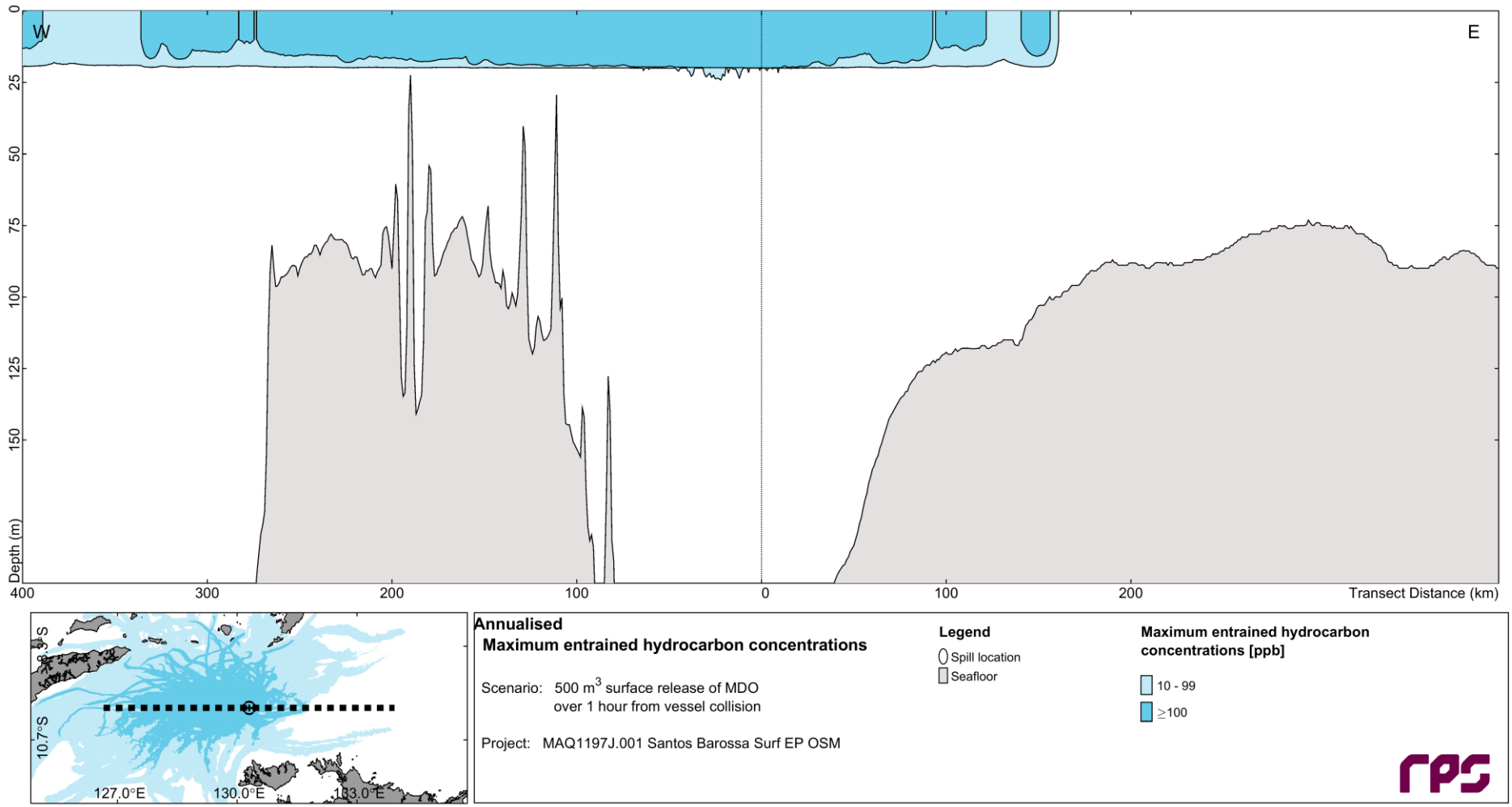

Figure 12.17 East-west cross-section transect of entrained hydrocarbon concentrations during annual conditions from a vessel tank rupture. The results were calculated from all 300 spill simulations.

12.1.4.2 Dissolved Hydrocarbons

Table 12.6 summarises the maximum distances from the release location to dissolved hydrocarbons exposure thresholds. Dissolved hydrocarbon concentrations exceeding 10 ppb may potentially occur 322 km from the release location with the distance reducing to 116 km as the exposure threshold increases to 50 ppb. There was no dissolved hydrocarbon concentrations exceeding 400 ppb.

Table 12.7 presents the predicted dissolved hydrocarbon exposure for EVAs. Only the results for receptors predicted to be exposed at or above the low threshold have been presented.

The probability of exposure at concentrations equal to or greater than 10 ppb is greatest at Sunrise Bank (1.67%), followed by the Outer Oceanic Shoals AMP (0.66%). The highest concentration is predicted at Sunrise Bank at 68 ppb.

Figure 12.18 presents the zones of dissolved hydrocarbon exposure, while the probabilities and minimum times before exposure are presented in Figure 12.19 to Figure 12.22, respectively.

Cross-sectional transects (north-south and east-west) of the maximum dissolved hydrocarbons in the vicinity of the release site are presented in Figure 12.23 and Figure 12.24.

Table 12.6 Maximum distances from the release location to dissolved hydrocarbon exposure thresholds for the annualised results following a vessel tank rupture. The results were calculated from 300 spill simulations.

Distance and direction travelled	Dissolved hydrocarbon exposure thresholds		
	10 ppb	50 ppb	400 ppb
Maximum distance travelled (km) by a spill simulation	322	116	–
Direction of maximum travel	West	West	–

Table 12.7 Predicted of predicted dissolved hydrocarbon exposure for environmental value areas following a following a vessel tank rupture based on annualised results. The results were calculated from 300 spill simulations.

Environmental Value Areas	Probability (%) of dissolved hydrocarbon exposure at			Minimum time (hours) before dissolved hydrocarbon exposure at			Maximum dissolved hydrocarbon concentrations (ppb)	
	≥ 10 ppb	≥ 50 ppb	≥ 400 ppb	≥ 10 ppb	≥ 50 ppb	≥ 400 ppb	averaged over all simulations	for the worst simulation
Margaret Harries Bank	0.33	<0.33	<0.33	212	NC	NC	<1	13
Outer Oceanic Shoals AMP	0.66	<0.33	<0.33	77	NC	NC	<1	24
Sunrise Bank	1.67	0.33	<0.33	44	58	NC	<1	68
The Boxers Area	0.33	<0.33	<0.33	180	NC	NC	<1	14

^: If exposure is predicted for a receptor at the low threshold but not at the moderate and/or high threshold, then the probability presented is <0.33%.

NC: No contact to receptor predicted for specified threshold.

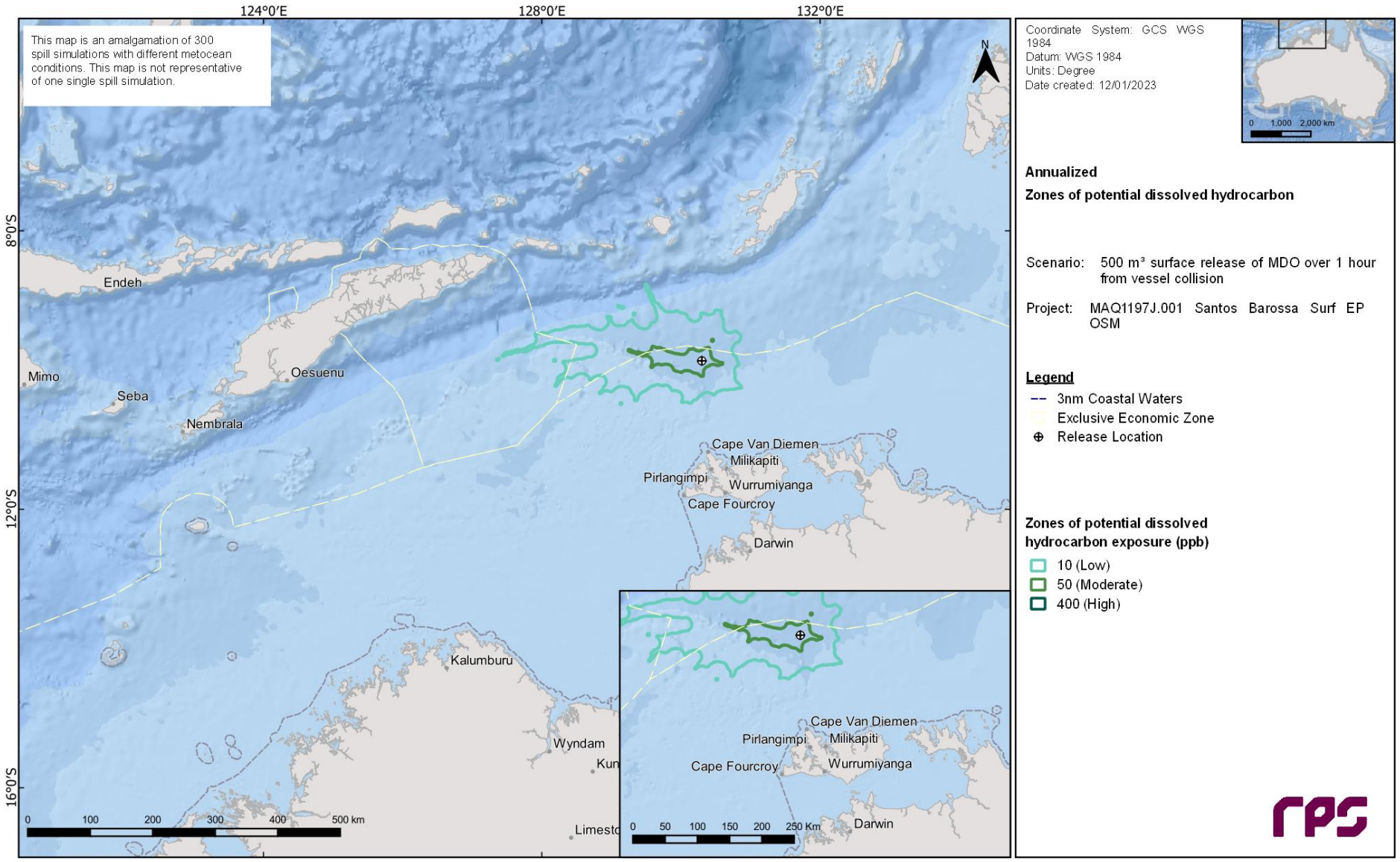

Figure 12.18 Predicted zones of dissolved hydrocarbon exposure during annual conditions from a vessel tank rupture. The results were calculated from all 300 spill simulations.

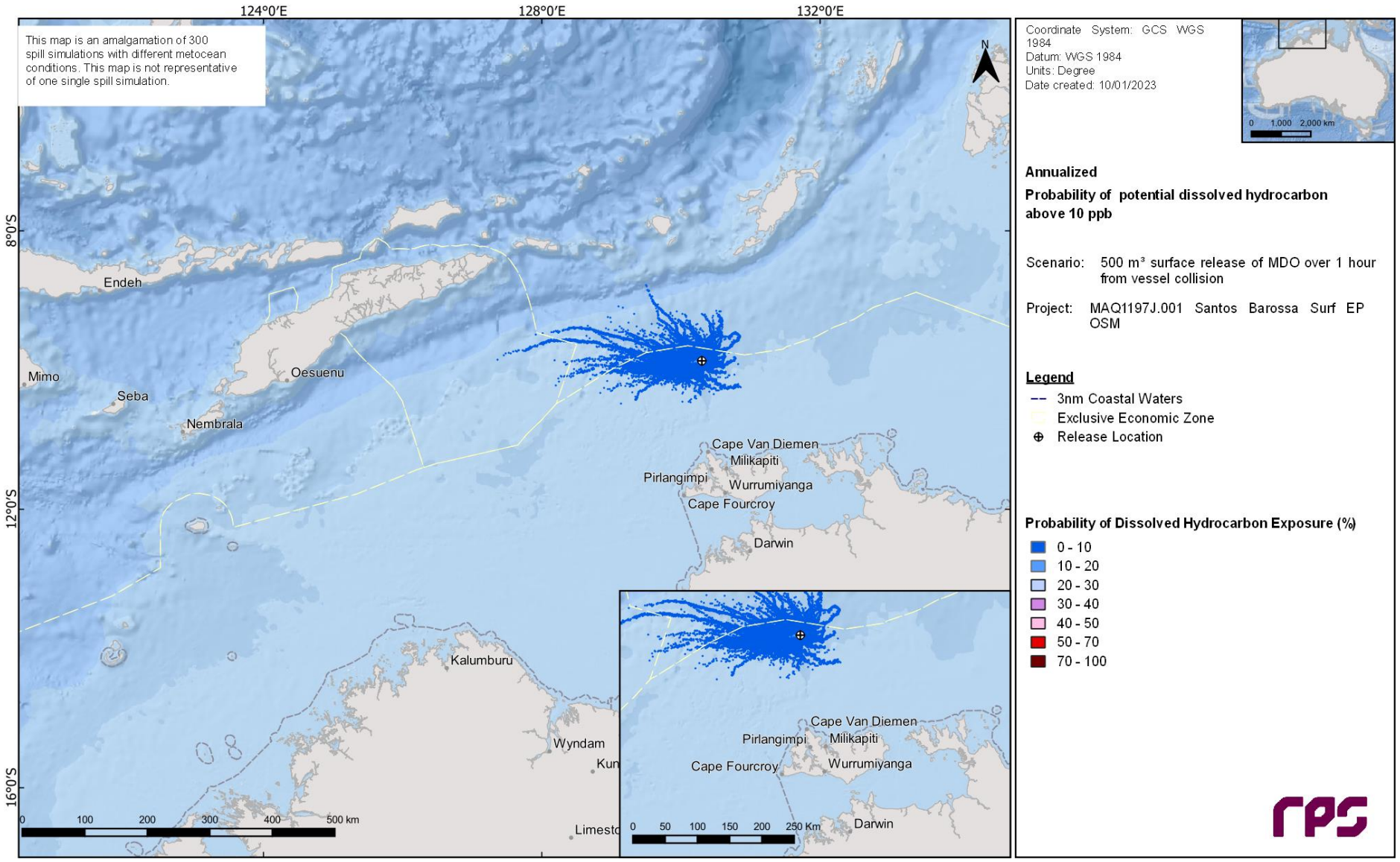

Figure 12.19 Predicted probability of dissolved hydrocarbon exposure at or above 10 ppb during annual conditions from a vessel tank rupture. The results were calculated from all 300 spill simulations.

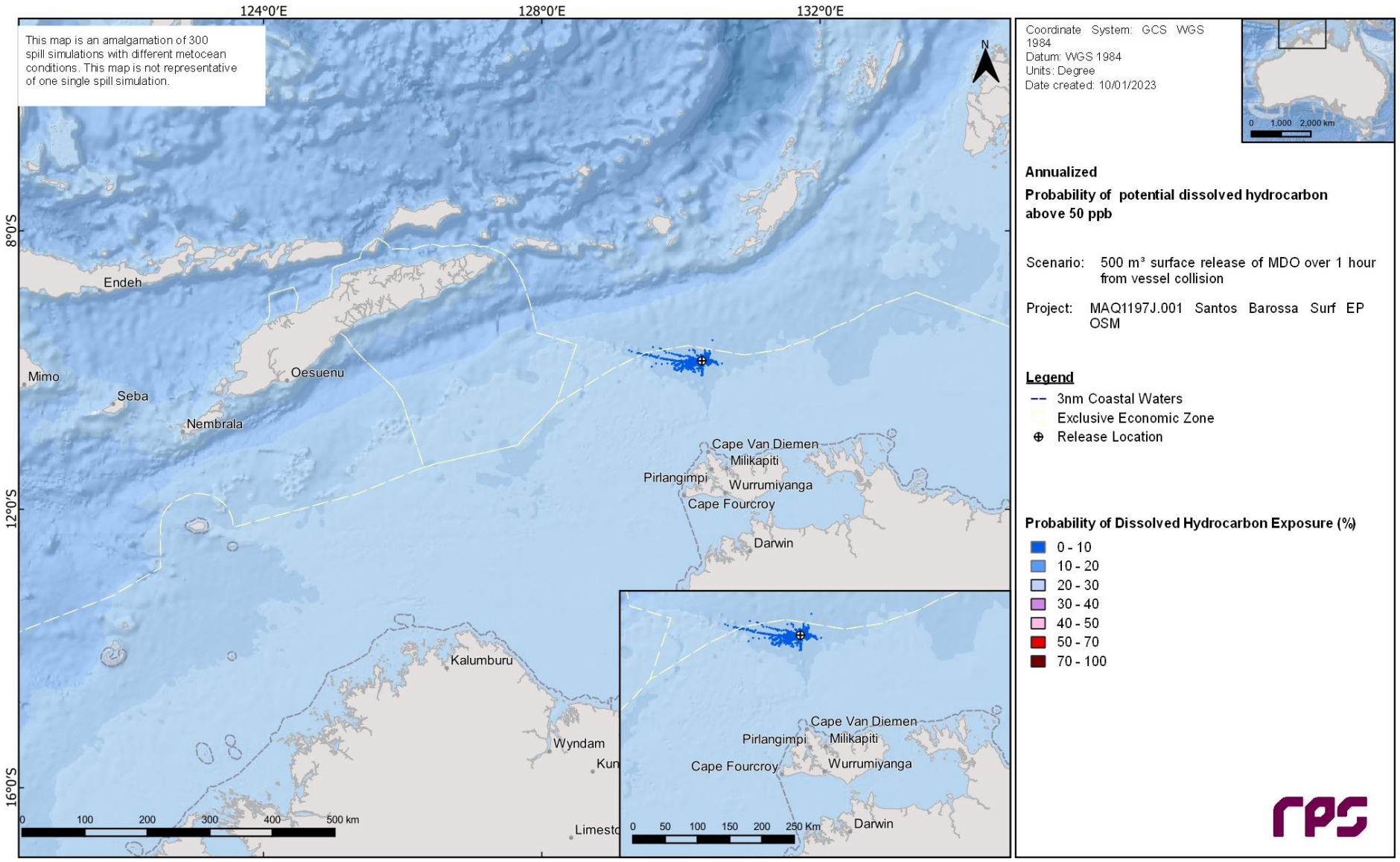

Figure 12.20 Predicted probability of dissolved hydrocarbon exposure at or above 50 ppb during annual conditions from a vessel tank rupture. The results were calculated from all 300 spill simulations.

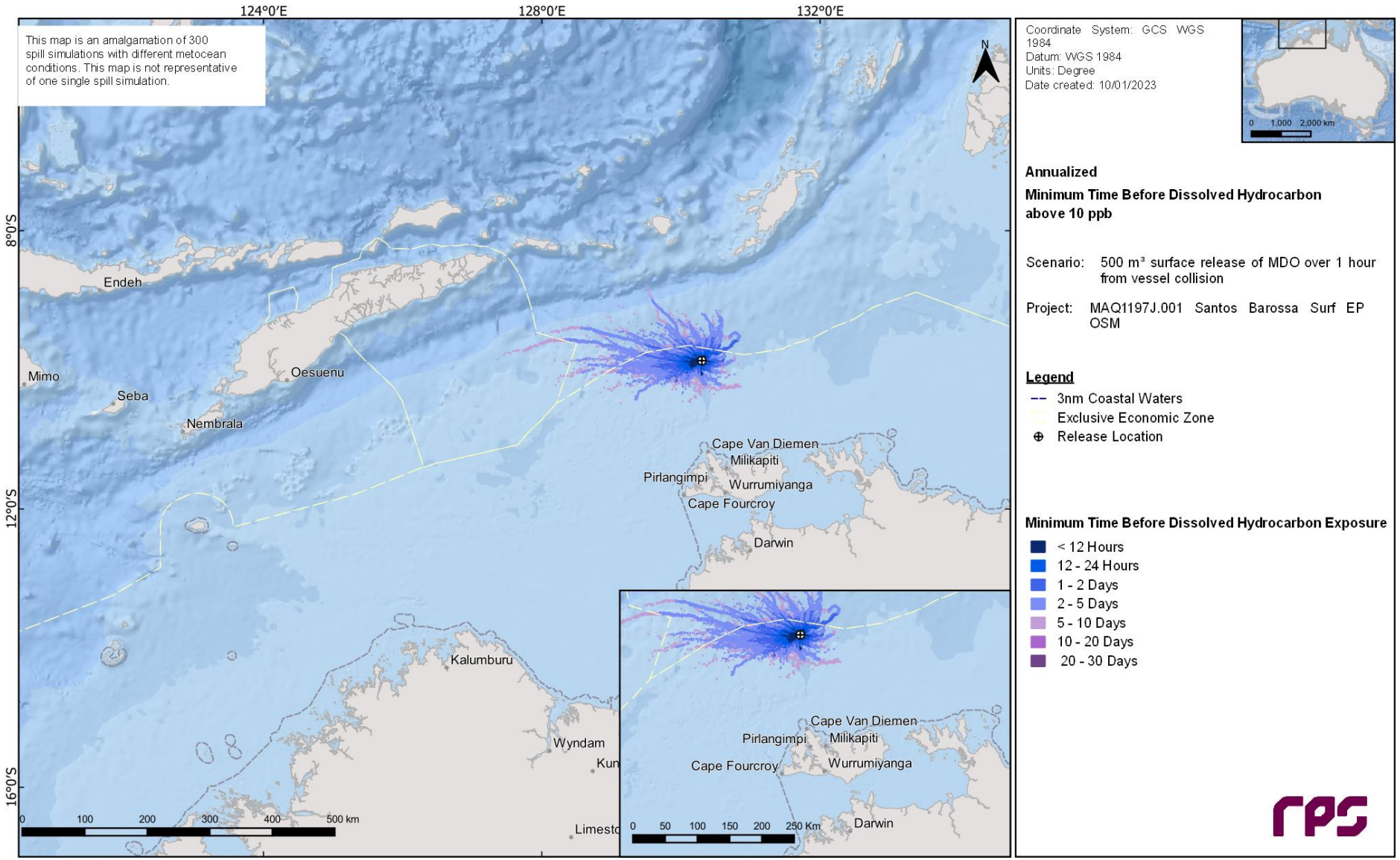

Figure 12.21 Predicted minimum times dissolved hydrocarbon exposure at or above 10 ppb during annual conditions from a vessel tank rupture. The results were calculated from all 300 spill simulations.

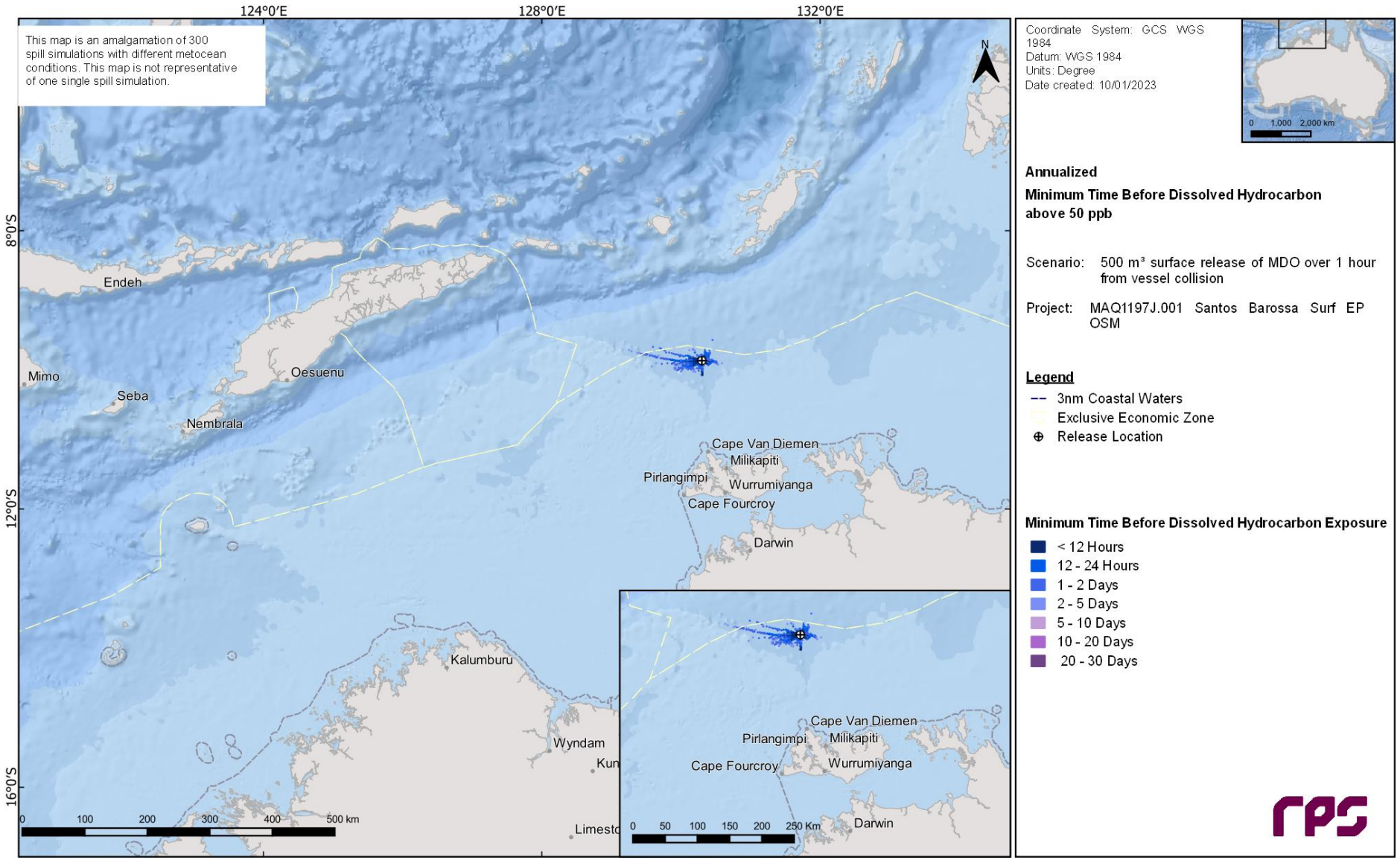

Figure 12.22 Predicted minimum times dissolved hydrocarbon exposure at or above 50 ppb during annual conditions from a vessel tank rupture. The results were calculated from all 300 spill simulations.

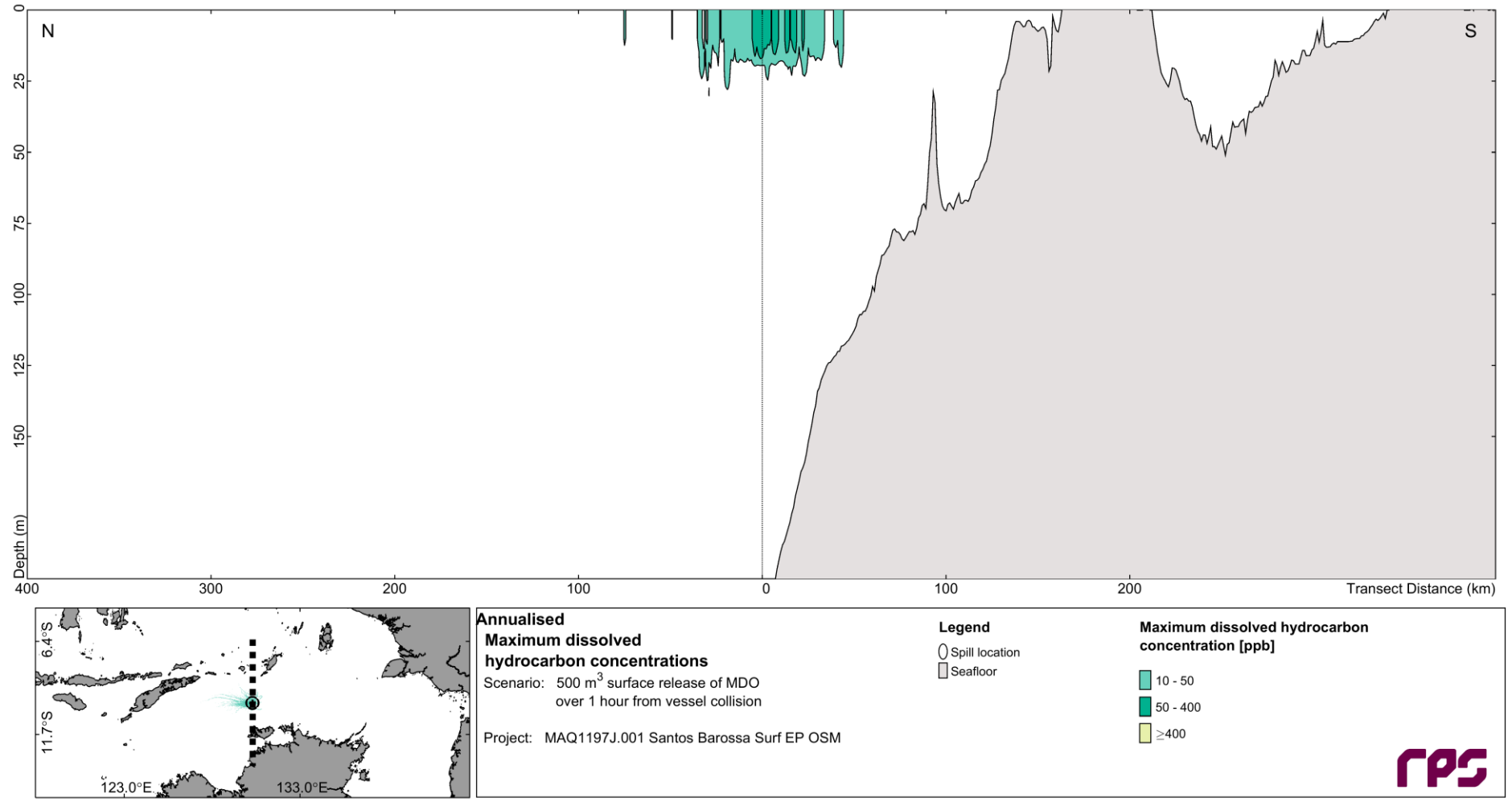

Figure 12.23 North-south cross-section transect of dissolved hydrocarbon concentrations during annual conditions from a vessel tank rupture. The results were calculated from all 300 spill simulations.

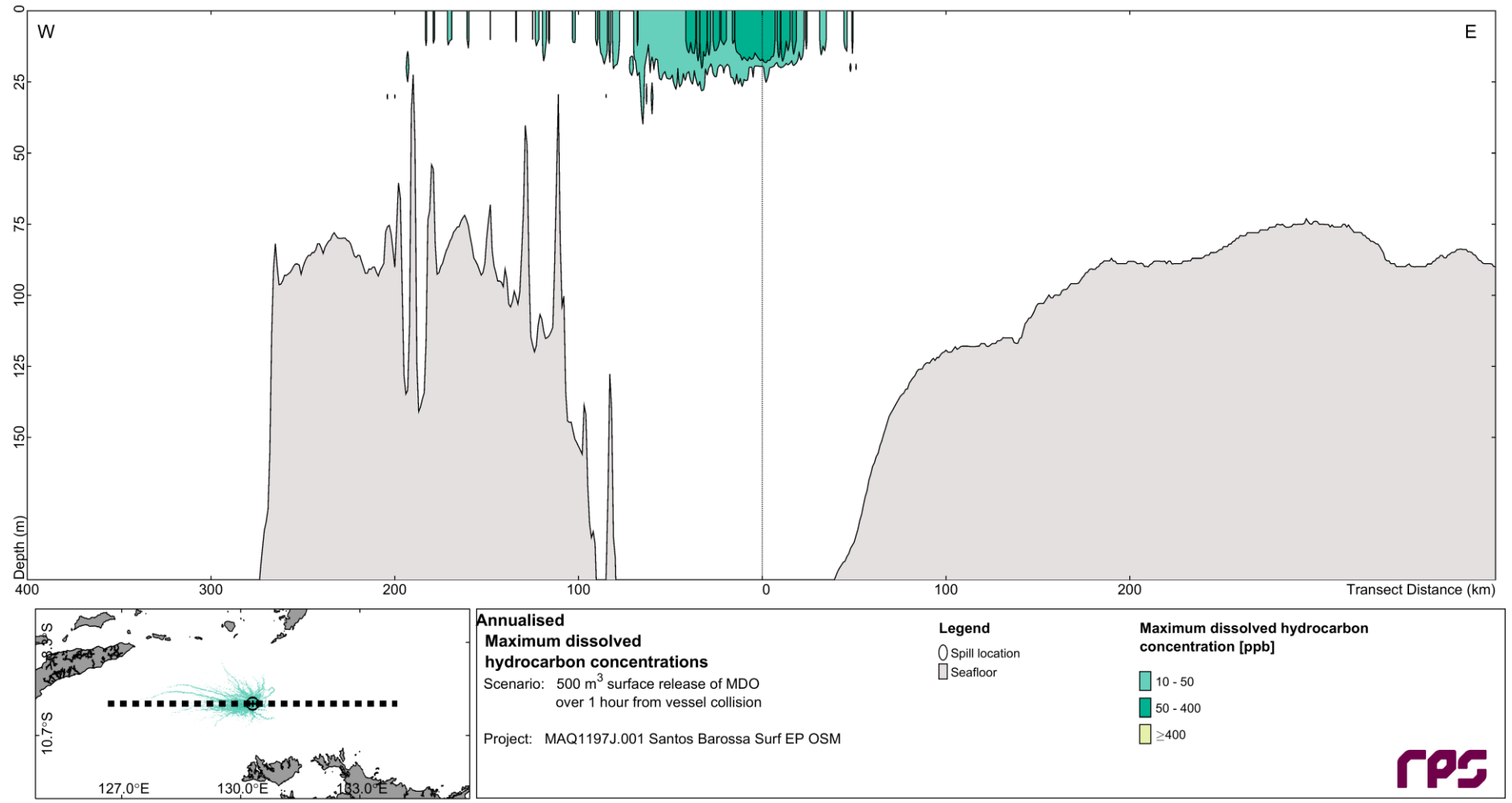

Figure 12.24 East-west cross-section transect of dissolved hydrocarbon concentrations during annual conditions from a vessel tank rupture. The results were calculated from all 300 spill simulations.

12.2 Deterministic Results

12.2.1 Largest Swept Area of Floating Oil ≥50g/m^2

A spill simulation commencing during transitional conditions (run 52) resulted in the greatest area of floating oil ≥50g/m^2.

Figure 12.25 shows the outer boundaries of the EMBA for the simulation. Figure 12.26 and Figure 12.27 show the floating oil exposure on the surface and in-water exposure (entrained only). No shoreline accumulation or dissolved hydrocarbon exposure above the reporting thresholds was predicted for this spill simulation.

Table 12.8 is a summary of the exposure to EVAs during the simulation. Only the results for receptors predicted to be exposed at or above the low threshold have been presented.

The maximum concentration of entrained hydrocarbons during this spill was 62 ppb predicted for the Margaret Harries Bank receptor.

Figure 12.28 shows time series snapshots of the predicted floating oil exposure (above 50 g/m^2) and volume ashore at intervals of 1 day, 1 week, 2 weeks and 4 weeks following the spill event. Although the snapshots show no area of exposure of floating oil ≥50g/m2 other than on day 1, floating oil exposure of ≥50g/m^2 was predicted before and following day 1 outside of these timeframes.

Table 12.8 Summary of exposure to environmental value areas for the vessel tank rupture deterministic simulation (transitional, run 52) which resulted in the greatest area of floating oil ≥50g/m^2.

Environmental Value Areas	Floating oil minimum time to receptor (hours) at			Shoreline accumulation minimum time to receptor (hours) at			Maximum local accumulated concentration (g/m²)	Maximum accumulated volume (m³) along this shoreline	Maximum length of shoreline (km) at			Entrained minimum time to receptor waters (hours) at		Maximum entrained hydrocarbon concentration (ppb)	Maximum dissolved aromatic hydrocarbon concentration (ppb)
	≥ 1 g/m²	≥ 10 g/m²	≥ 50 g/m²	≥ 10 g/m²	≥ 100 g/m²	≥ 1,000 g/m²			≥ 10 g/m²	≥ 100 g/m²	≥ 1,000 g/m²	≥ 10 ppb	≥ 100 ppb		
Outer Oceanic Shoals AMP	NC	NC	NC	NA	NA	NA	NA	NA	NA	NA	NA	194	NC	35	<1
The Boxers Area	NC	NC	NC	NA	NA	NA	NA	NA	NA	NA	NA	378	NC	11	<1
Margaret Harries Bank	121	NC	NC	NA	NA	NA	NA	NA	NA	NA	NA	122	NC	62	<1

NA: Not applicable for receptor; NC: No contact to receptor predicted for specified threshold.

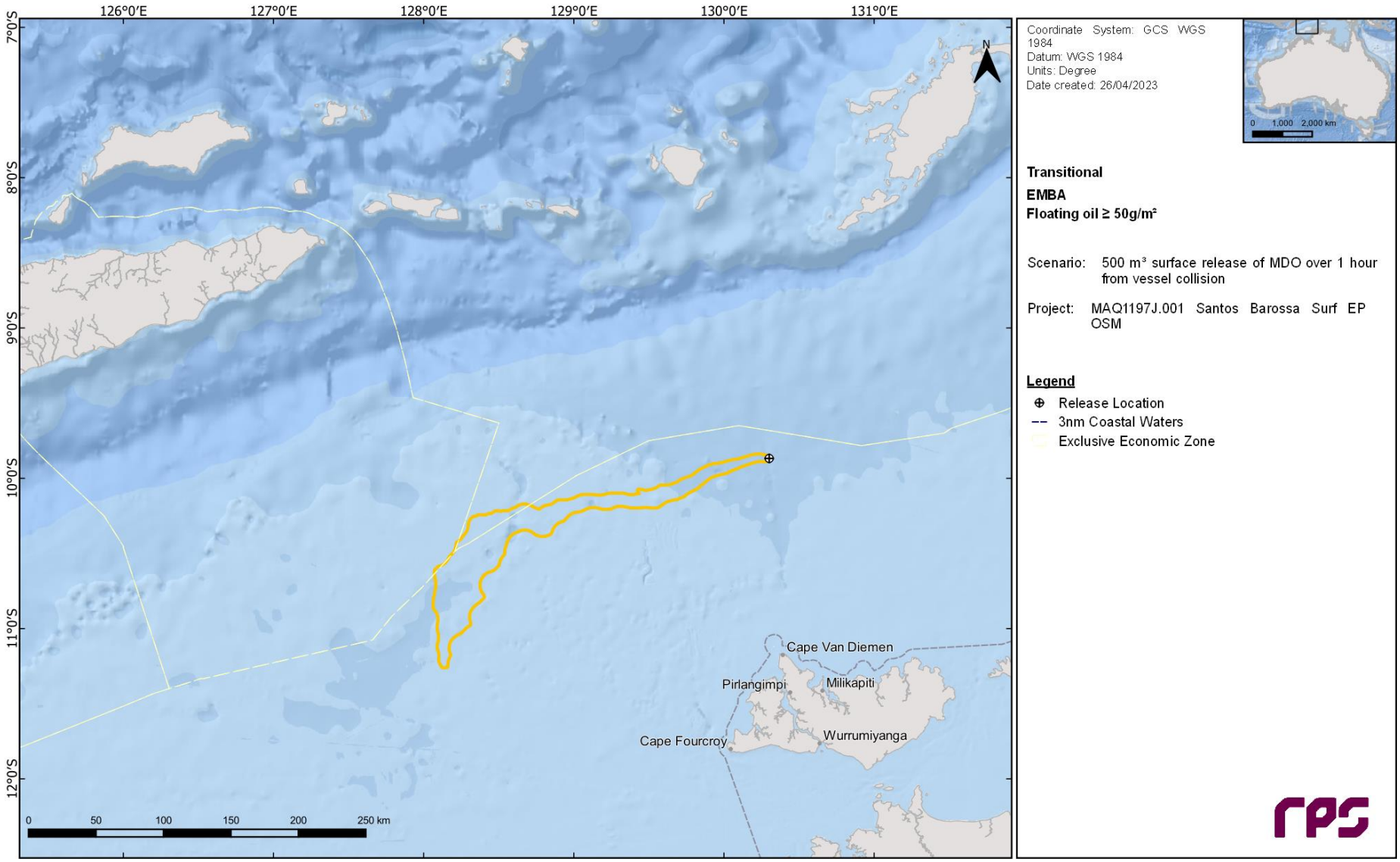

Figure 12.25 Predicted EMBA for the vessel tank rupture deterministic simulation (transitional, run 52) which resulted in the greatest area of floating oil ≥50g/m².

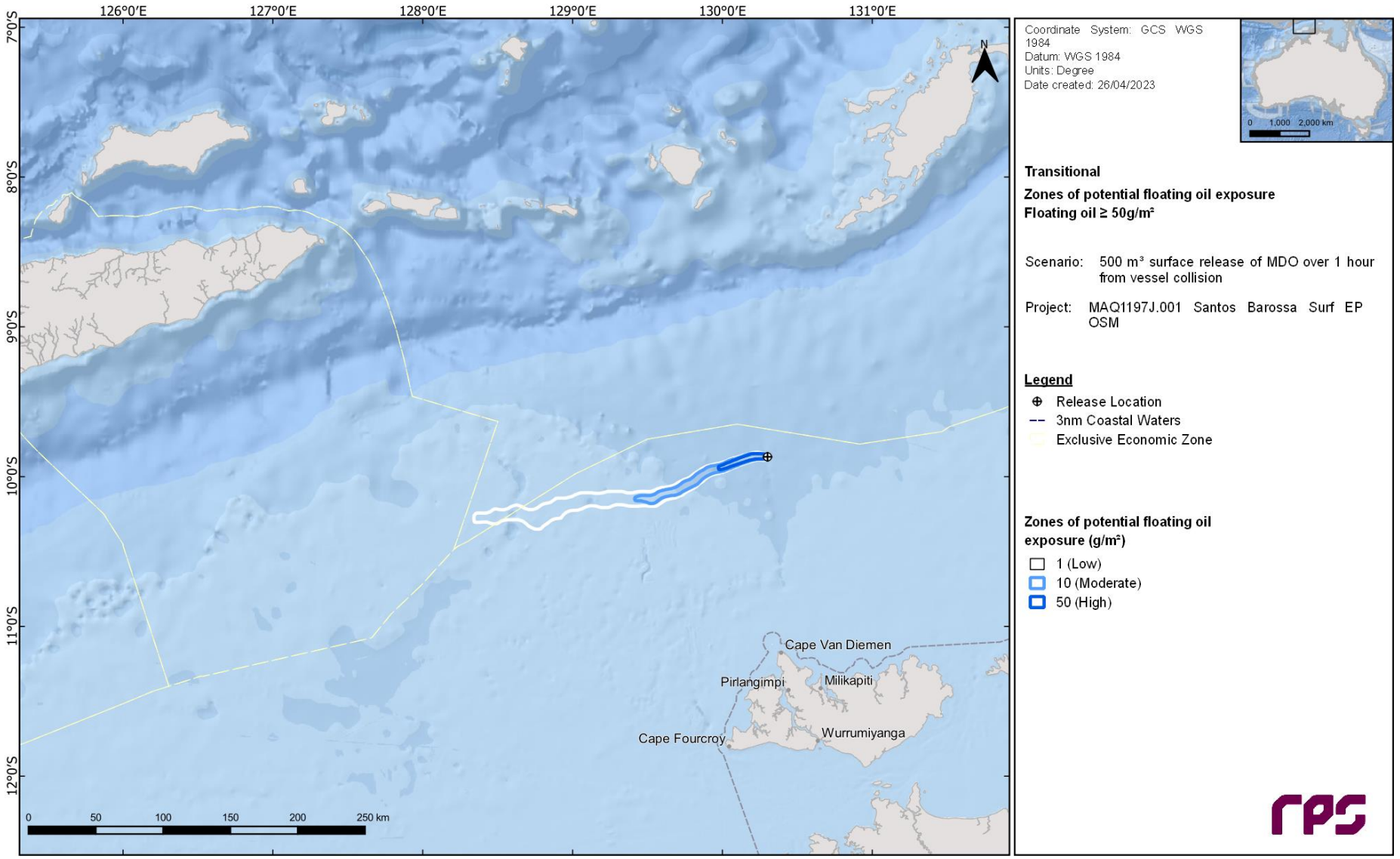

Figure 12.26 Predicted zones of floating oil exposure for the vessel tank rupture deterministic simulation (transitional, run 52) which resulted in the greatest area of floating oil ≥50g/m².

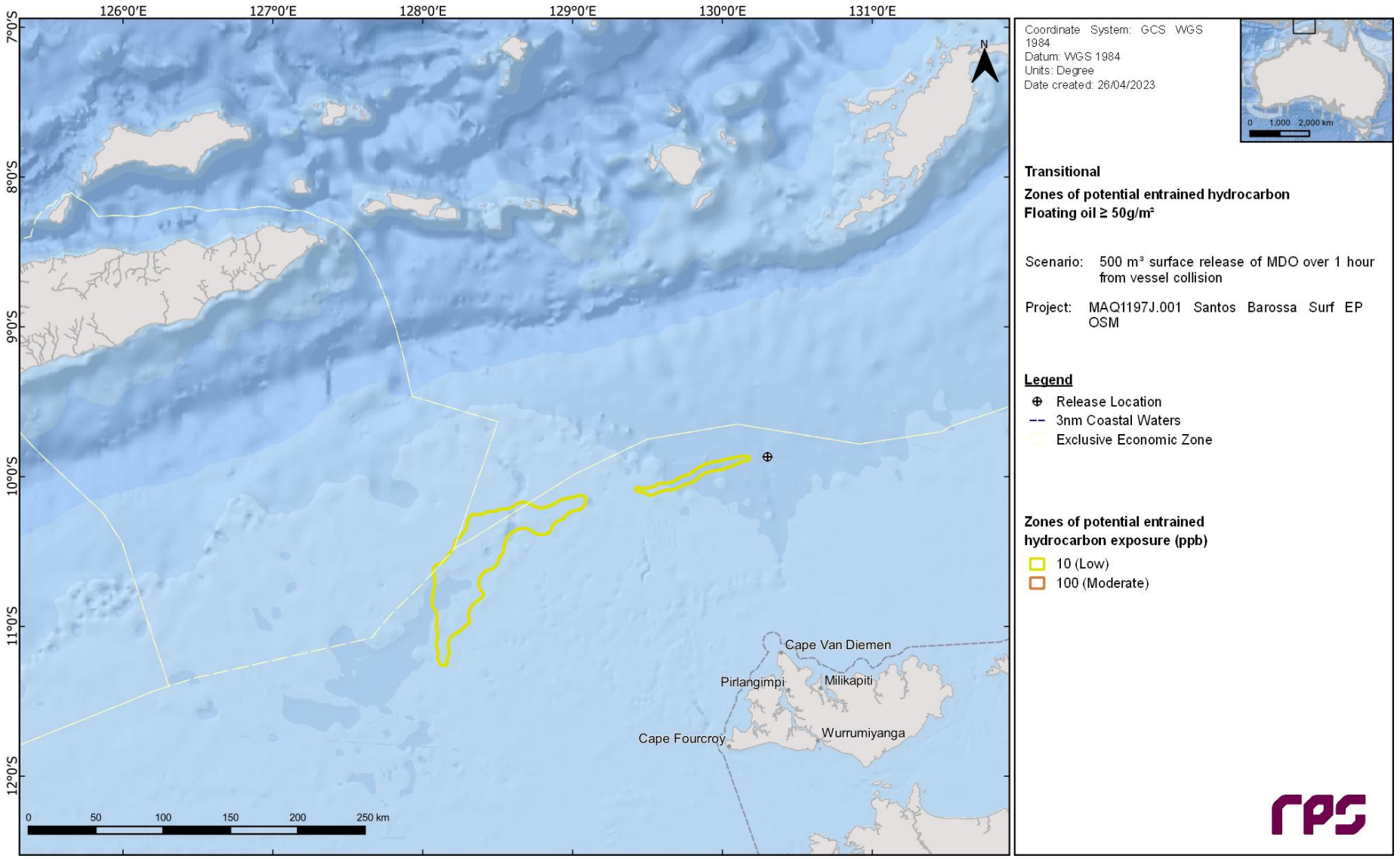

Figure 12.27 Predicted zones of entrained hydrocarbon exposure for the vessel tank rupture deterministic simulation (transitional, run 52) which resulted in the greatest area of floating oil ≥50g/m².

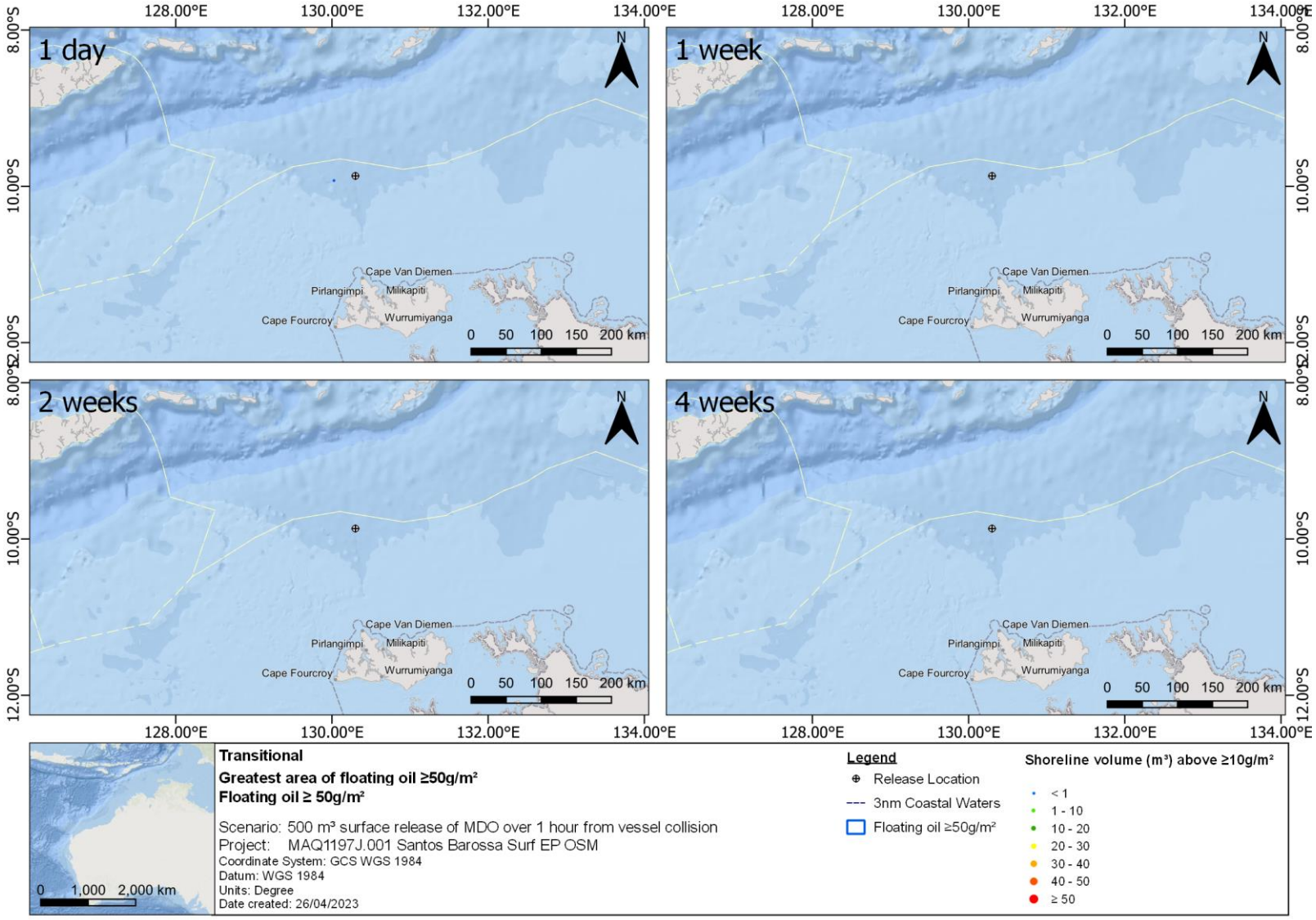

Figure 12.28 Snapshots of floating oil exposure (above 50 g/m^2) and volume ashore at intervals of 1 day, 1 week, 2 weeks and 4 weeks for the vessel tank rupture deterministic simulation (transitional, run 52) which resulted in the greatest area of floating oil ≥50g/m^2.

12.2.2 Maximum Volume of Oil Ashore ≥10g/m^2 for the Indonesia - East Receptor

A spill simulation commencing during transitional conditions (run 76) resulted in the maximum volume of oil ashore for the Indonesia - East receptor.

Figure 12.29 shows the outer boundaries of the EMBA for the simulation. Figure 12.30 to Figure 12.31 illustrate the floating oil exposure on the surface, in-water (entrained) and shoreline accumulation. No dissolved hydrocarbons exceeding 10 ppb was predicted.

Table 12.9 is a summary of the exposure to EVAs during the simulation. Only the results for receptors predicted to be exposed at or above the low threshold have been presented.

The greatest volume of oil ashore (at or above 10 g/m² threshold) was forecast for the Indonesia - East receptor at 8 m^3 with a predicted length of shoreline oiling of 16 km.

The maximum concentration of entrained hydrocarbons during this spill was 35 ppb also at the Indonesia - East receptor.

Figure 12.33 shows time series snapshots of the predicted floating oil exposure (above 50 g/m^2) and volume ashore at intervals of 1 day, 1 week, 2 weeks and 4 weeks following the spill event.

Table 12.9 Summary of exposure to environmental value areas resulting for the vessel tank rupture deterministic simulation (transitional, run 76) which resulted in the maximum volume of oil ashore for the Indonesia - East receptor.

Environmental Value Areas	Floating oil minimum time to receptor (hours) at			Shoreline accumulation minimum time to receptor (hours) at			Maximum local accumulated concentration (g/m²)	Maximum accumulated volume (m³) along this shoreline	Maximum length of shoreline (km) at			Entrained minimum time to receptor waters (hours) at		Maximum entrained hydrocarbon concentration (ppb)	Maximum dissolved aromatic hydrocarbon concentration (ppb)
	≥ 1 g/m²	≥ 10 g/m²	≥ 50 g/m²	≥ 10 g/m²	≥ 100 g/m²	≥ 1,000 g/m²			≥ 10 g/m²	≥ 100 g/m²	≥ 1,000 g/m²	≥ 10 ppb	≥ 100 ppb		
Indonesia - East*	NC	NC	NC	351	NC	NC	351	8	16	NC	NC	NC	NC	35	NC

* Indonesia - East encompasses Indonesia East and Timor Leste

NC: No contact to receptor predicted for specified threshold.

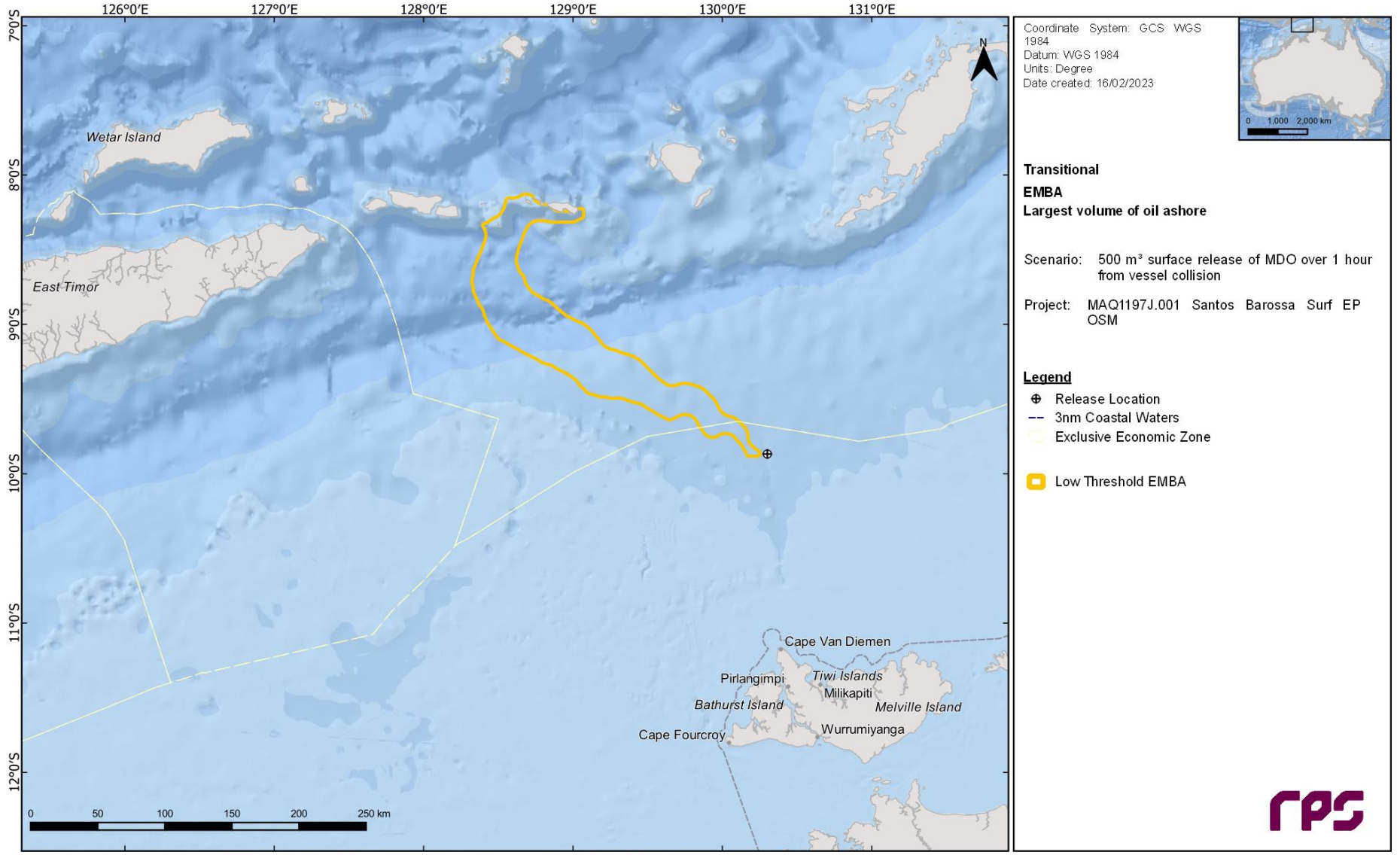

Figure 12.29 Predicted EMBA for the vessel tank rupture deterministic simulation (transitional, run 76) which resulted in the maximum volume of oil ashore for the Indonesia - East receptor.

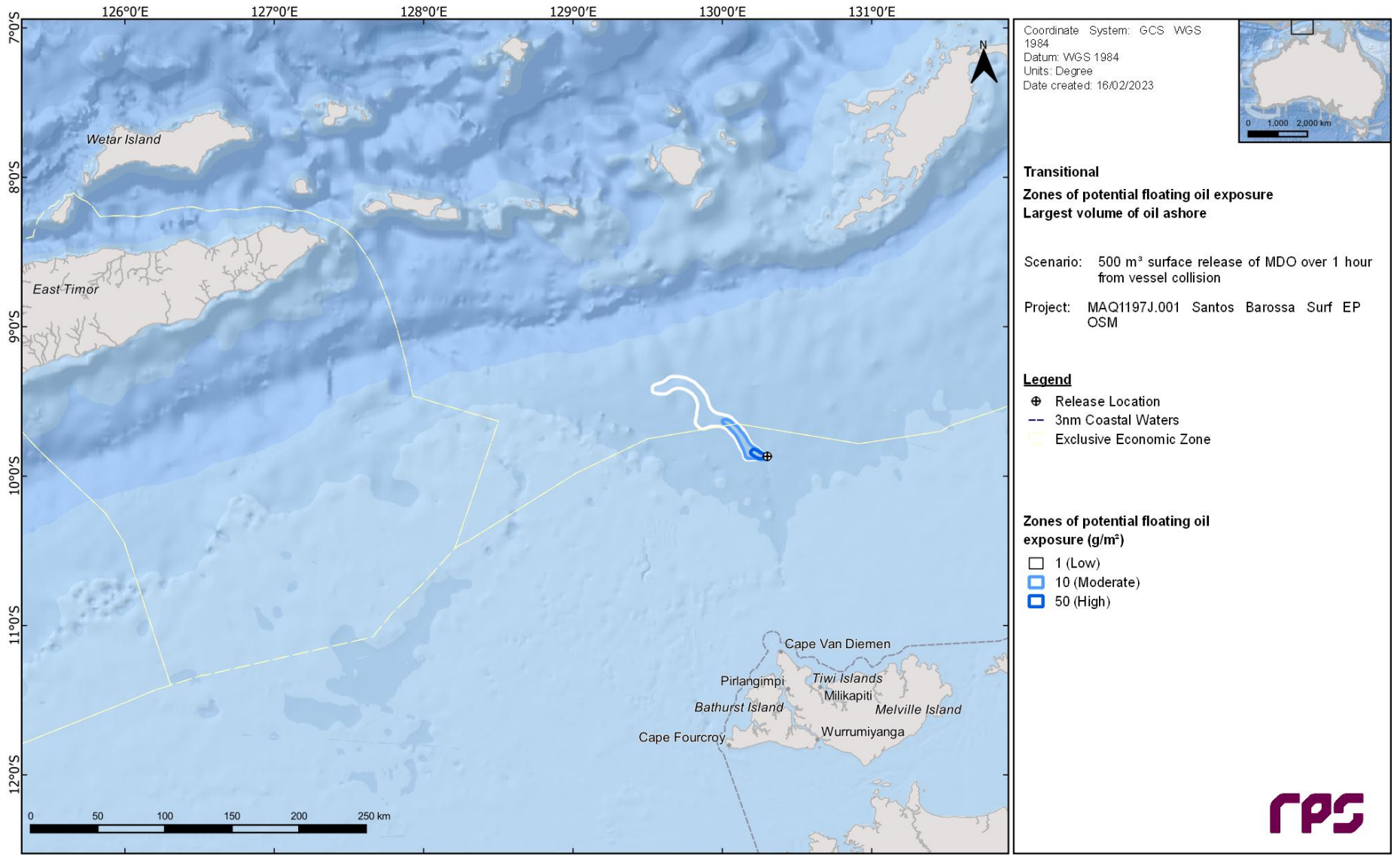

Figure 12.30 Predicted zones of floating oil exposure for the vessel tank rupture deterministic simulation (transitional, run 76) which resulted in the maximum volume of oil ashore for the Indonesia - East receptor.

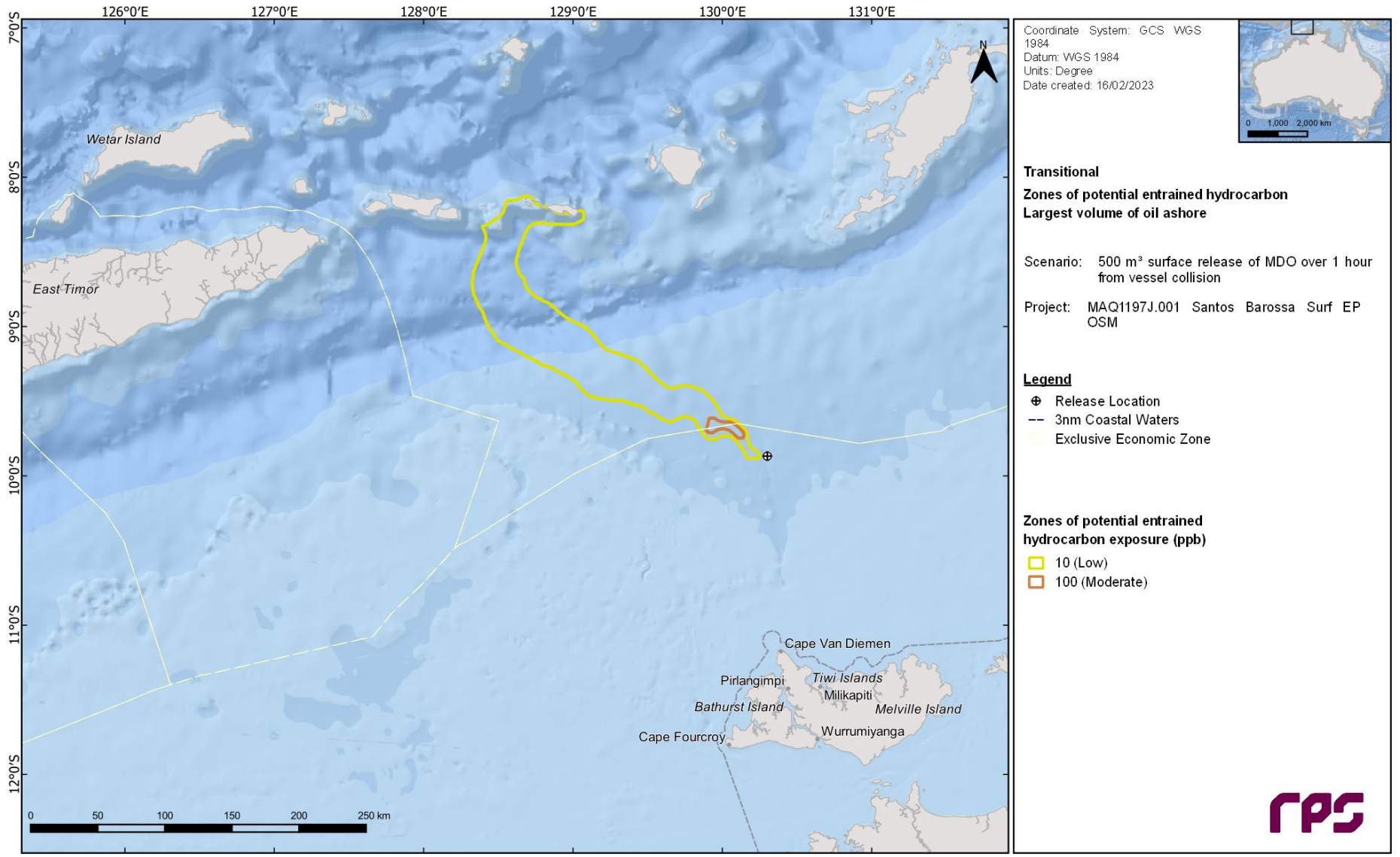

Figure 12.31 Predicted zones of entrained hydrocarbon exposure for the vessel tank rupture deterministic simulation (transitional, run 76) which resulted in the maximum volume of oil ashore for the Indonesia - East receptor.

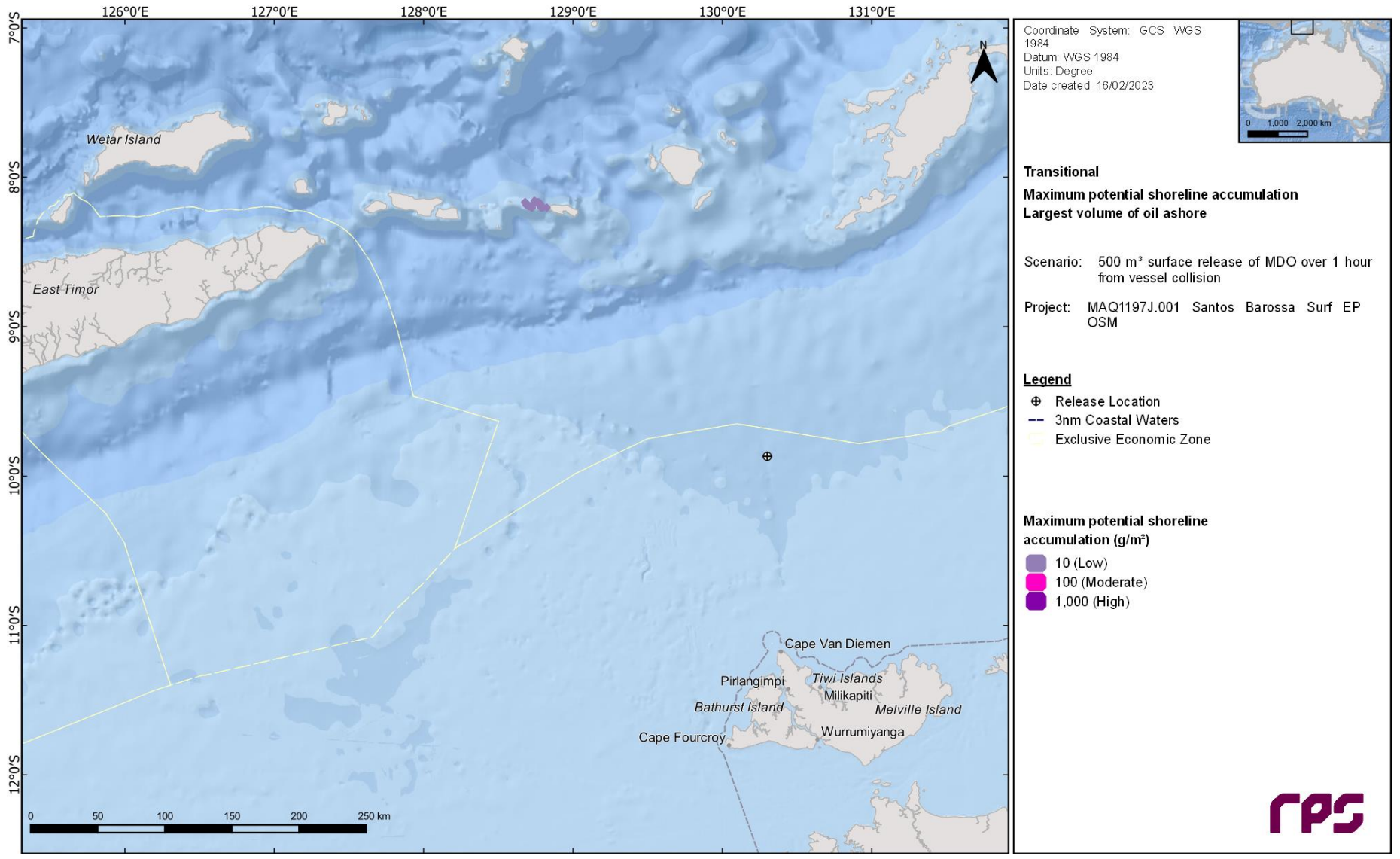

Figure 12.32 Predicted shoreline oil accumulation for the vessel tank rupture deterministic simulation (transitional, run 76) which resulted in the maximum volume of oil ashore for the Indonesia - East receptor.

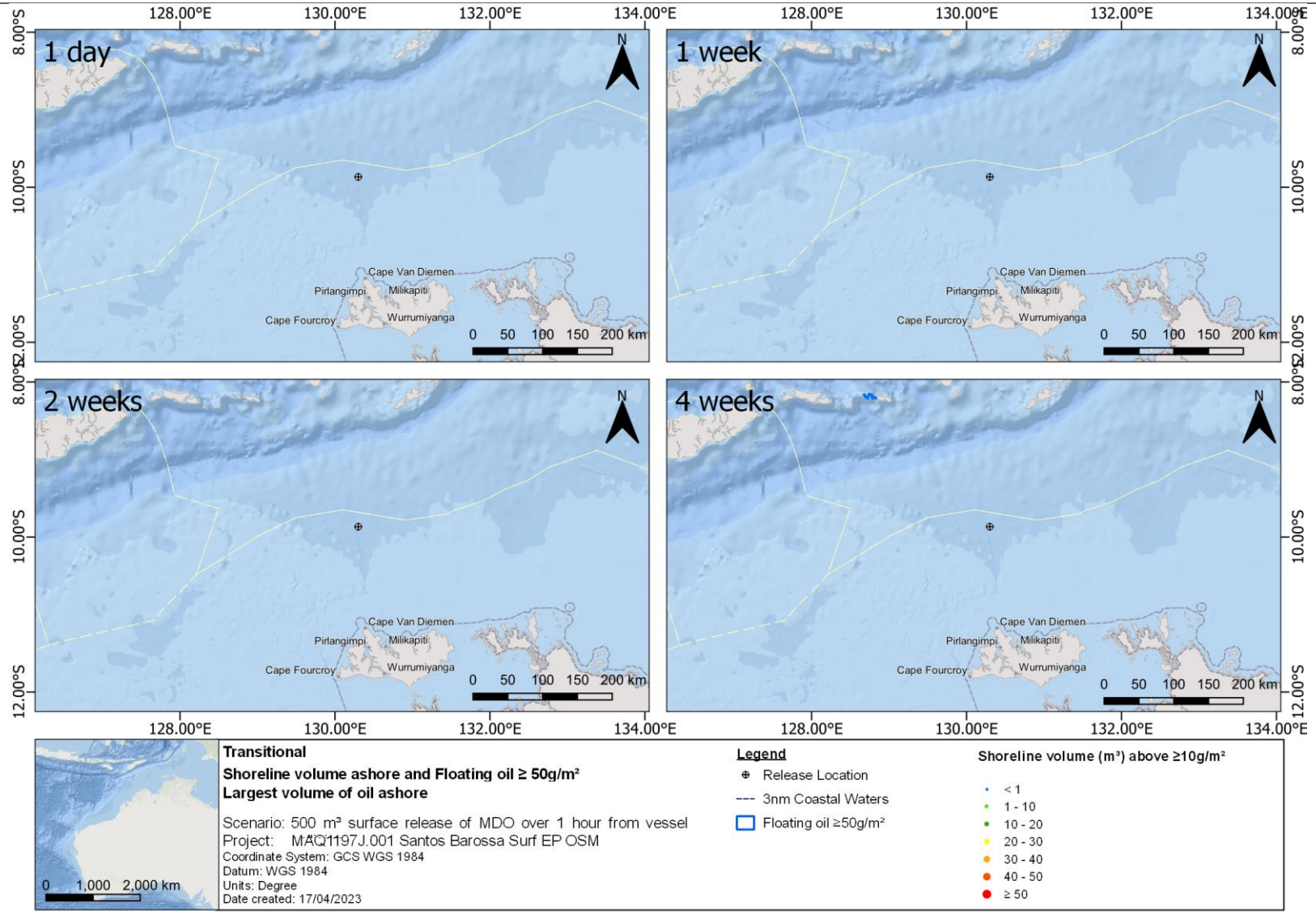

Figure 12.33 Snapshot of the predicted floating oil exposure (above 50 g/m^2) and volume ashore at intervals of 1 day, 1 week, 2 weeks and 4 weeks for the vessel tank rupture deterministic simulation (transitional, run 76) which resulted in the maximum volume of oil ashore for the Indonesia - East receptor.

12.2.3 Maximum Volume of Oil Ashore ≥10g/m^2 for the Tiwi Islands Receptor

A spill simulation commencing during transitional conditions (run 34) resulted in the maximum volume of oil ashore of 5 m^3 for the Tiwi Island receptor.

Figure 12.34 shows the outer boundaries of the EMBA for the simulation. Figure 12.35 to Figure 12.37 illustrate the floating oil exposure on the surface, in-water (entrained) and shoreline accumulation. No dissolved hydrocarbons exceeding 10 ppb was predicted.

Table 12.10 is a summary of the exposure to EVAs during the simulation. Only the results for receptors predicted to be exposed at or above the low threshold have been presented.

The greatest volume of oil ashore (at or above 10 g/m² threshold) was forecast for the Tiwi Islands receptor at 5 m^3 with a predicted length of shoreline oiling of 13 km.

The maximum concentration of entrained hydrocarbons during this spill was 19 ppb for the Outer Oceanic Shoals AMP receptor.

Figure 12.38 shows time series snapshots of the predicted floating oil exposure (above 50 g/m^2) and volume ashore at intervals of 1 day, 1 week, 2 weeks and 4 weeks following the spill event.

Note, this spill simulation was also remodelled with a reduced release volume of 450 m^3 to investigate whether a decrease in the fuel tank spill volume is likely to mitigate or reduce the risk of exposure to the Tiwi Islands (see Appendix A).

Table 12.10 Summary of exposure to environmental value areas resulting for the vessel tank rupture deterministic simulation (transitional, run 34) which resulted in the maximum volume of oil ashore for the Tiwi Islands receptor.

Environmental Value Areas	Floating oil minimum time to receptor (hours) at			Shoreline accumulation minimum time to receptor (hours) at			Maximum local accumulated concentration (g/m²)	Maximum accumulated volume (m³) along this shoreline	Maximum length of shoreline (km) at			Entrained minimum time to receptor waters (hours) at		Maximum entrained hydrocarbon concentration (ppb)	Maximum dissolved aromatic hydrocarbon concentration (ppb)
	≥ 1 g/m²	≥ 10 g/m²	≥ 50 g/m²	≥ 10 g/m²	≥ 100 g/m²	≥ 1,000 g/m²			≥ 10 g/m²	≥ 100 g/m²	≥ 1,000 g/m²	≥ 10 ppb	≥ 100 ppb		
Outer Oceanic Shoals AMP	163	NC	NC	NA	NA	NA	NA	NA	NA	NA	NA	262	NC	19	<1
The Boxers Area	NC	NC	NC	NA	NA	NA	NA	NA	NA	NA	NA	340	NC	15	<1
Tiwi Islands	NC	NC	NC	665	NC	NC	41	5	13	NC	NC	NC	NC	8	<1

NA: Not applicable for receptor; NC: No contact to receptor predicted for specified threshold.

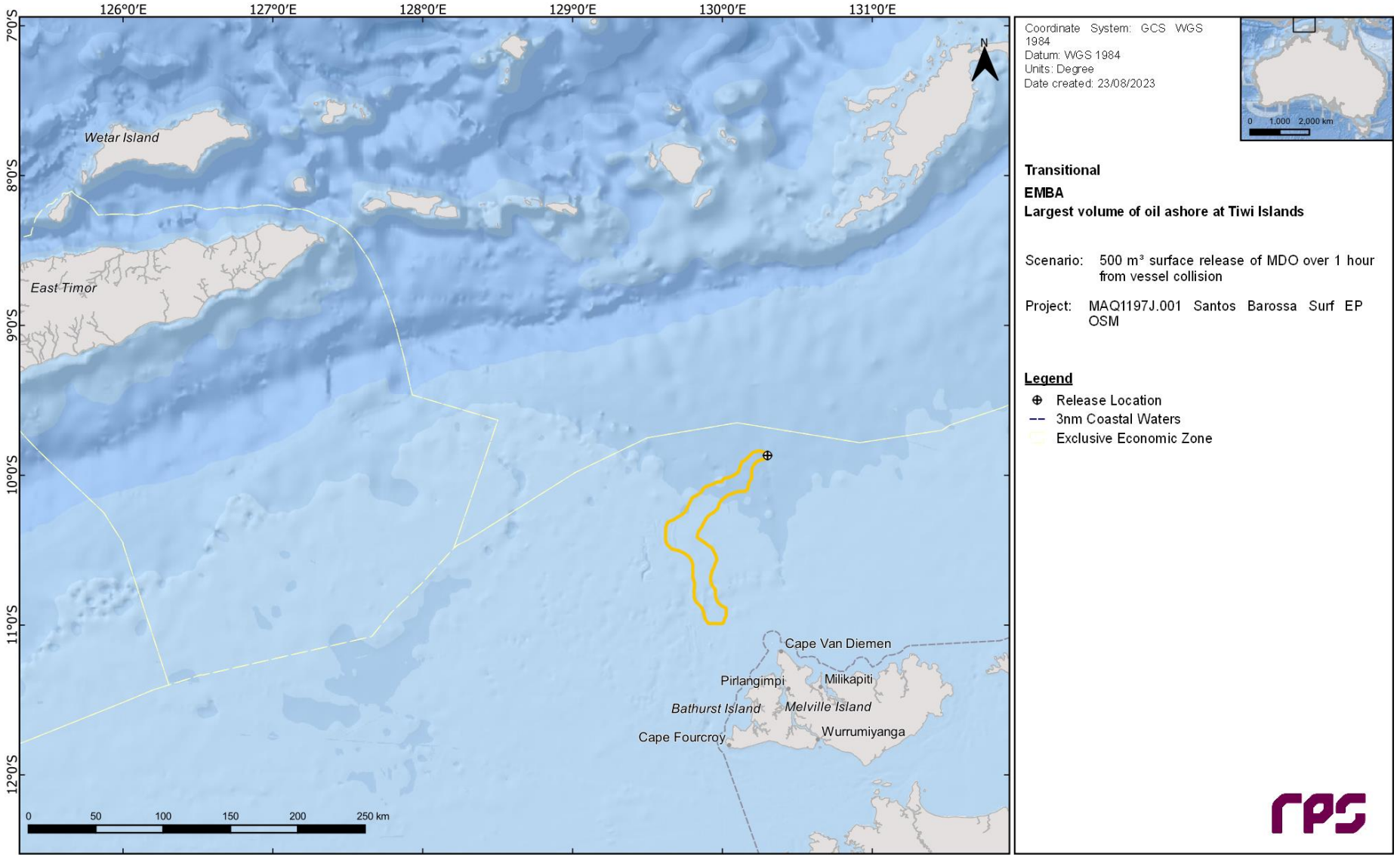

Figure 12.34 Predicted EMBA for the vessel tank rupture deterministic simulation (transitional, run 34) which resulted in the maximum volume of oil ashore for the Tiwi Islands receptor.

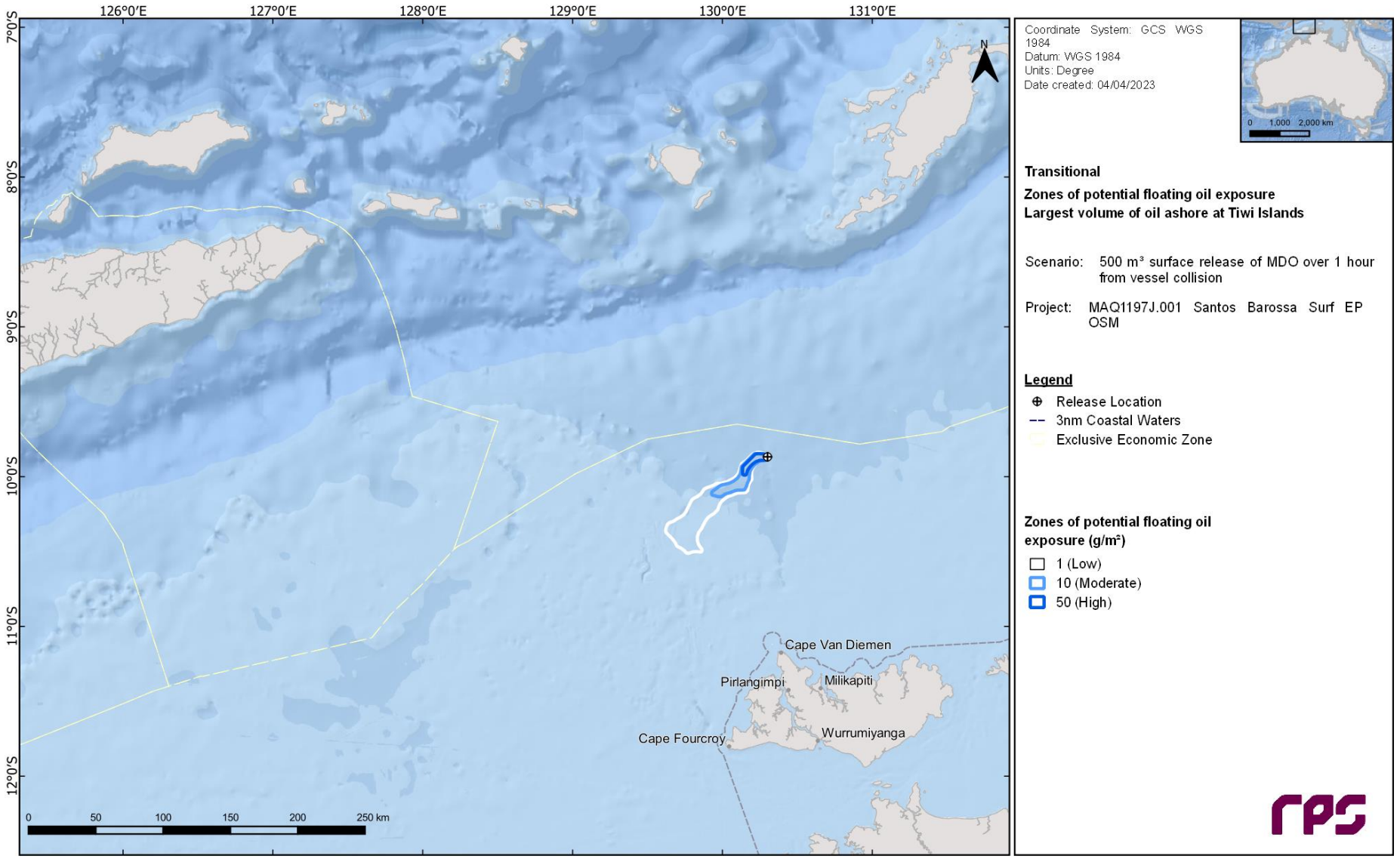

Figure 12.35 Predicted zones of floating oil exposure for the vessel tank rupture deterministic simulation (transitional, run 34) which resulted in the maximum volume of oil ashore for the Tiwi Islands receptor.

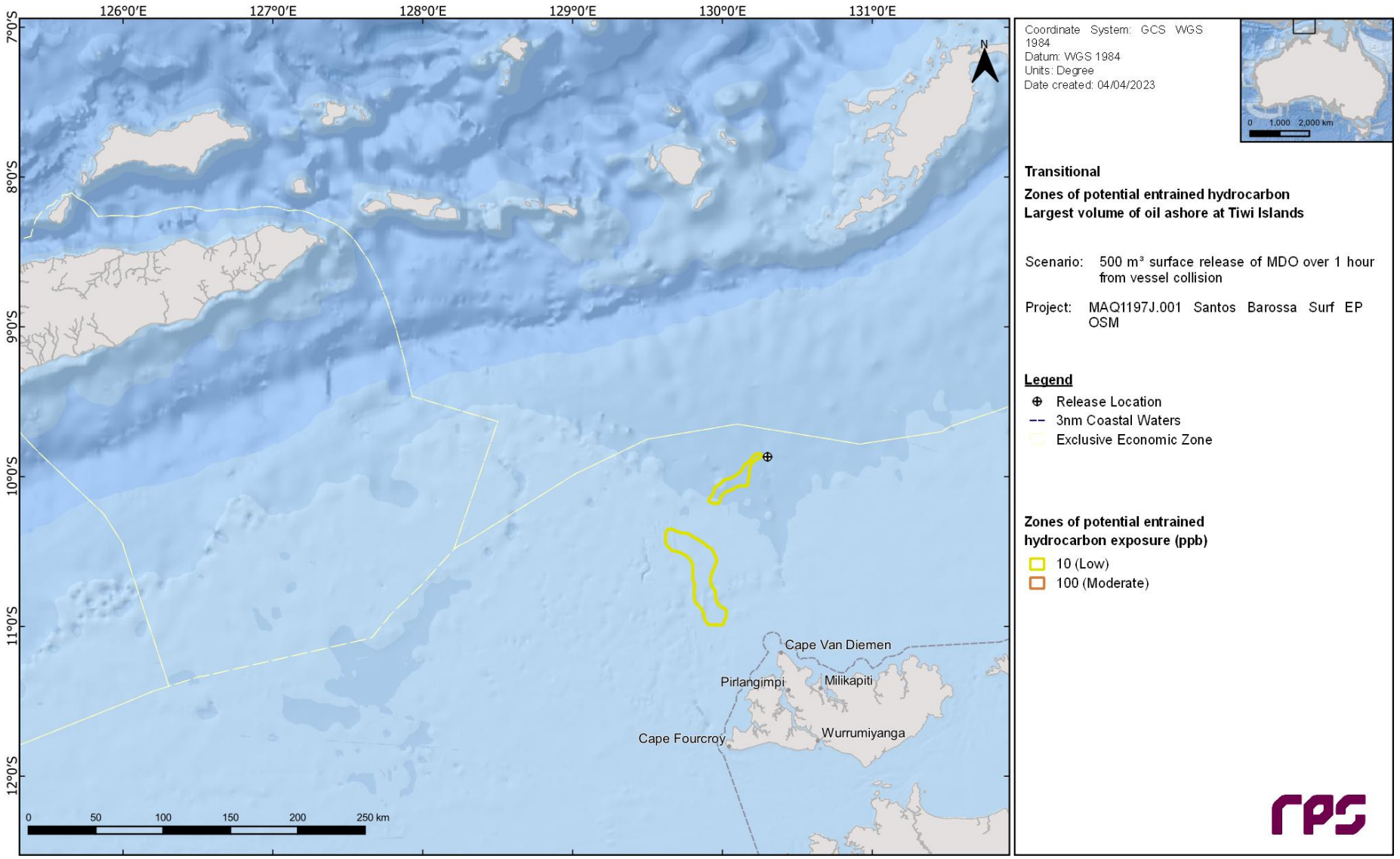

Figure 12.36 Predicted zones of entrained hydrocarbon exposure for the vessel tank rupture deterministic simulation (transitional, run 34) which resulted in the maximum volume of oil ashore for the Tiwi Islands receptor.

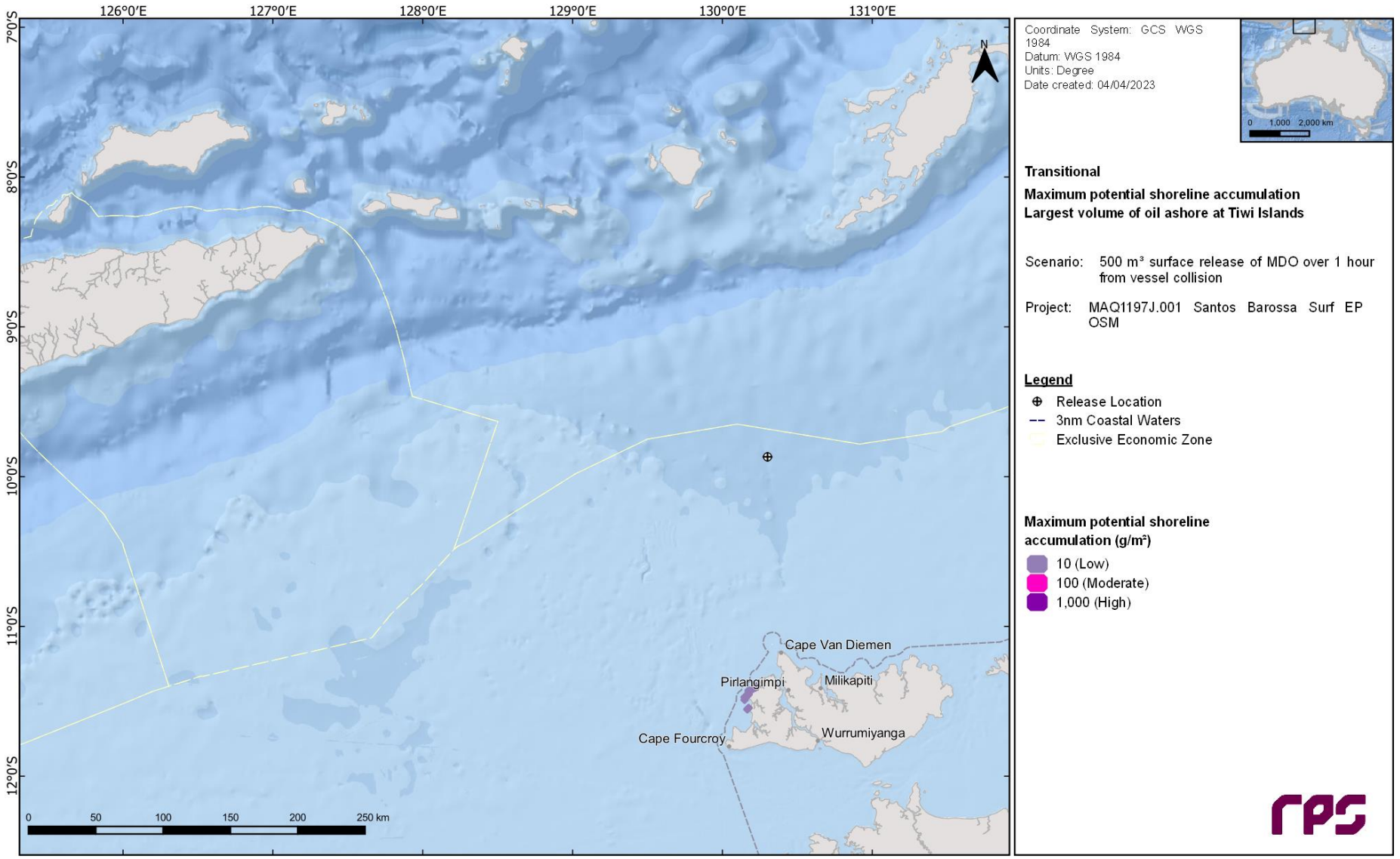

Figure 12.37 Predicted shoreline oil accumulation for the vessel tank rupture deterministic simulation (transitional, run 34) which resulted in the maximum volume of oil ashore for the Tiwi Islands receptor.

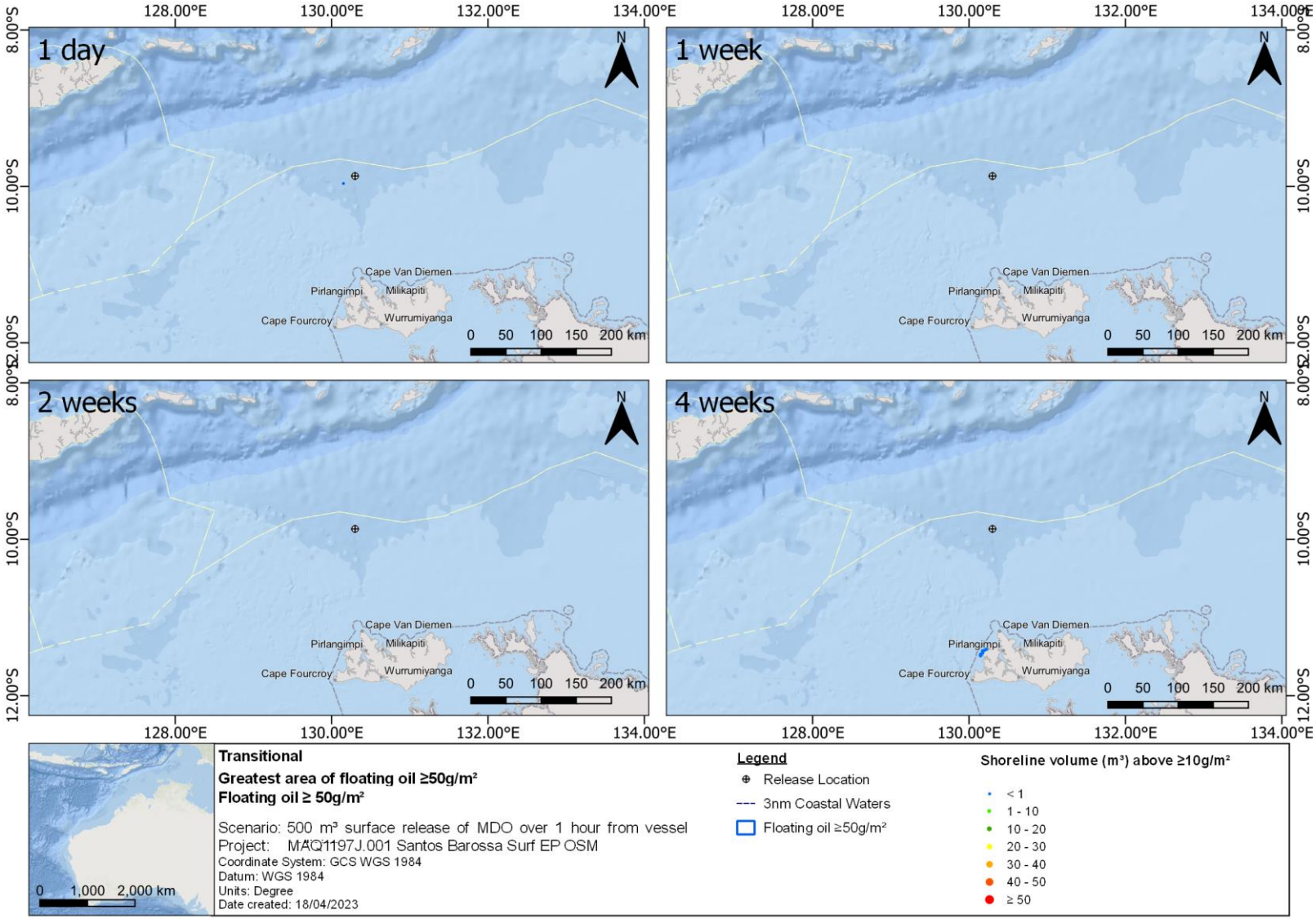

Figure 12.38 Snapshot of the predicted floating oil exposure (above 50 g/m^2) and volume ashore at intervals of 1 day, 1 week, 2 weeks and 4 weeks for the vessel tank rupture deterministic simulation (transitional, run 34) which resulted in the maximum volume of oil ashore for the Tiwi Islands receptor.

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14 APPENDIX A

A.1 Investigation into the Fuel Tank Spill Volume to reduce Potential Risk of Exposure to the Tiwi Islands

Santos requested that RPS investigate whether reducing the fuel tank spill volume by 10%, from 500 m^3 to 450 m^3, would further reduce the potential risk of exposure to the Tiwi Islands. The stochastic modelling results revealed that only 1 simulation out of 300 reached the Tiwi Islands shoreline and that this particular simulation which commenced during transitional conditions (run 34) resulted in 5 m^3 of oil ashore, as detailed Section 12.2.3.

The same simulation was subsequently remodelled using the same wind and current conditions and a release volume of 450 m^3. Figure 14.1 shows the outer boundaries of the EMBA for the remodelled simulation. While Figure 14.2 and Figure 14.3 illustrate the floating oil exposure on the surface and in-water (entrained), respectively. As with the original simulation with a 500 m^3 volume released, no dissolved hydrocarbons exceeding 10 ppb was predicted. However, it is important to note that based on the 450 m^3 volume released, no shoreline accumulation was predicted for this simulation.

Table 14.1 is a summary of the exposure to EVAs during the simulation. Only the results for receptors predicted to be exposed at or above the low threshold have been presented.

Table 14.1 Summary of exposure to environmental value areas for the reduced 450 m³ fuel tank spill simulation (transitional, run 34), used to investigate if a 10% reduction in volume would reduce the potential risk of exposure to the Tiwi Islands.

Environmental Value Areas	Floating oil minimum time to receptor (hours) at			Shoreline accumulation minimum time to receptor (hours) at			Maximum local accumulated concentration (g/m²)	Maximum accumulated volume (m³) along this shoreline	Maximum length of shoreline (km) at			Entrained minimum time to receptor waters (hours) at		Maximum entrained hydrocarbon concentration (ppb)	Maximum dissolved aromatic hydrocarbon concentration (ppb)
	≥ 1 g/m²	≥ 10 g/m²	≥ 50 g/m²	≥ 10 g/m²	≥ 100 g/m²	≥ 1,000 g/m²			≥ 10 g/m²	≥ 100 g/m²	≥ 1,000 g/m²	≥ 10 ppb	≥ 100 ppb		
Outer Oceanic Shoals AMP	164	NC	NC	NA	NA	NA	NA	NA	NA	NA	NA	262	NC	16	<1
The Boxers Area	NC	NC	NC	NA	NA	NA	NA	NA	NA	NA	NA	342	NC	14	<1
Tiwi Islands	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	5	<1

NA: Not applicable for receptor; NC: No contact to receptor predicted for specified threshold.

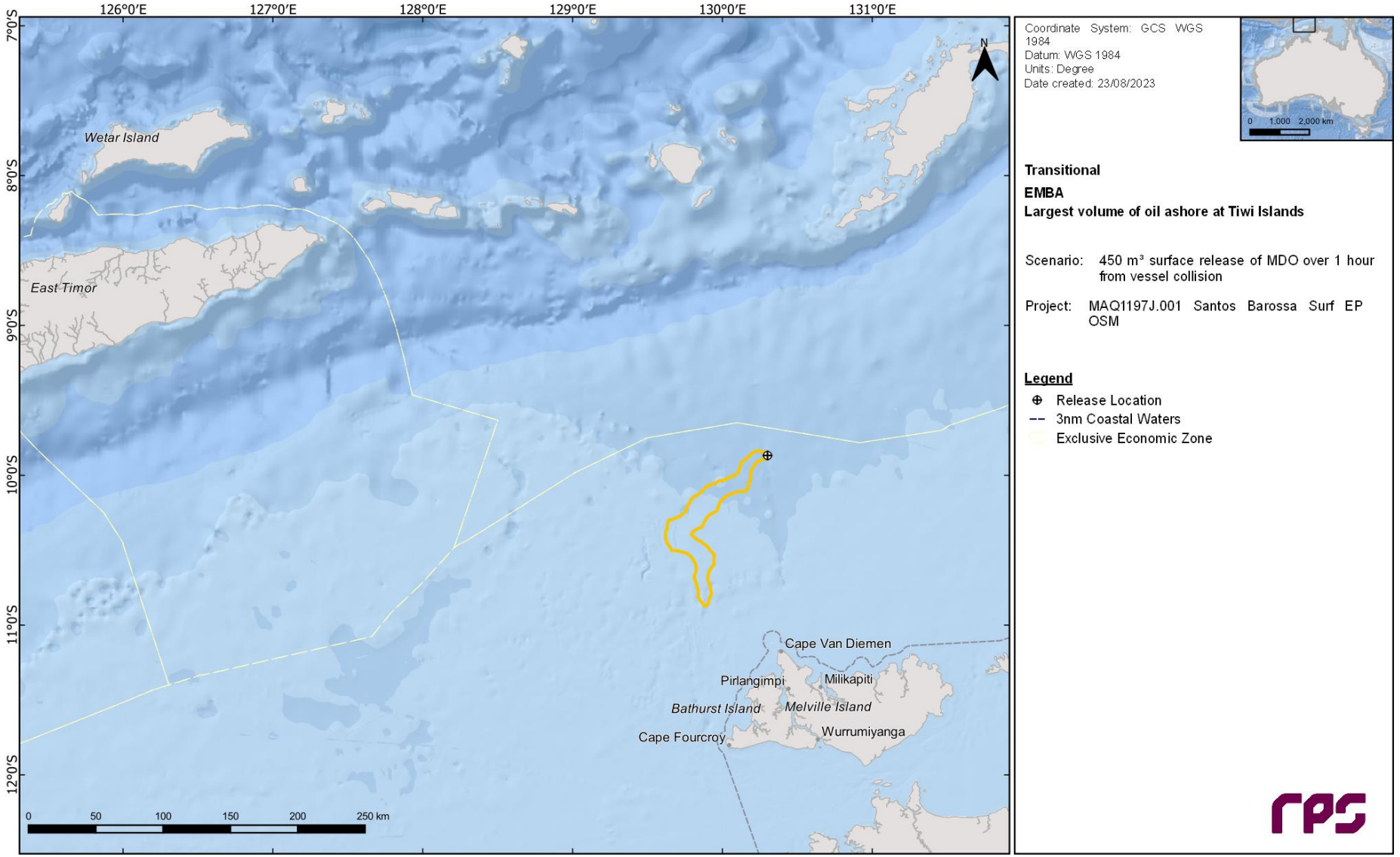

Figure 14.1 Predicted EMBA for the reduced 450 m³ fuel tank spill simulation (transitional, run 34), used to investigate if a 10% reduction in volume would reduce the potential risk of exposure to the Tiwi Islands.

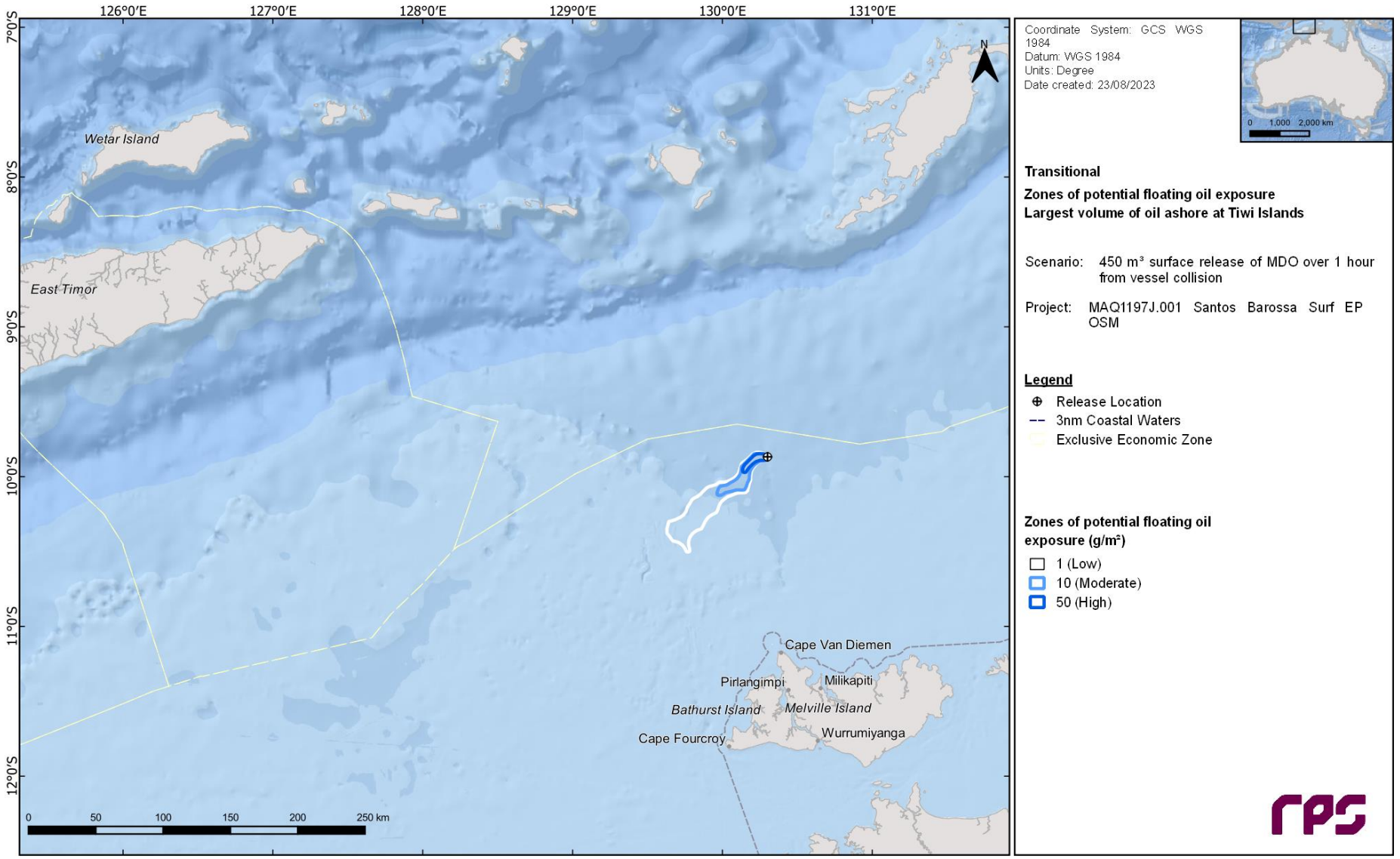

Figure 14.2 Predicted zones of floating oil exposure for the reduced 450 m³ fuel tank spill simulation (transitional, run 34), used to investigate if a 10% reduction in volume would reduce the potential risk of exposure to the Tiwi Islands.

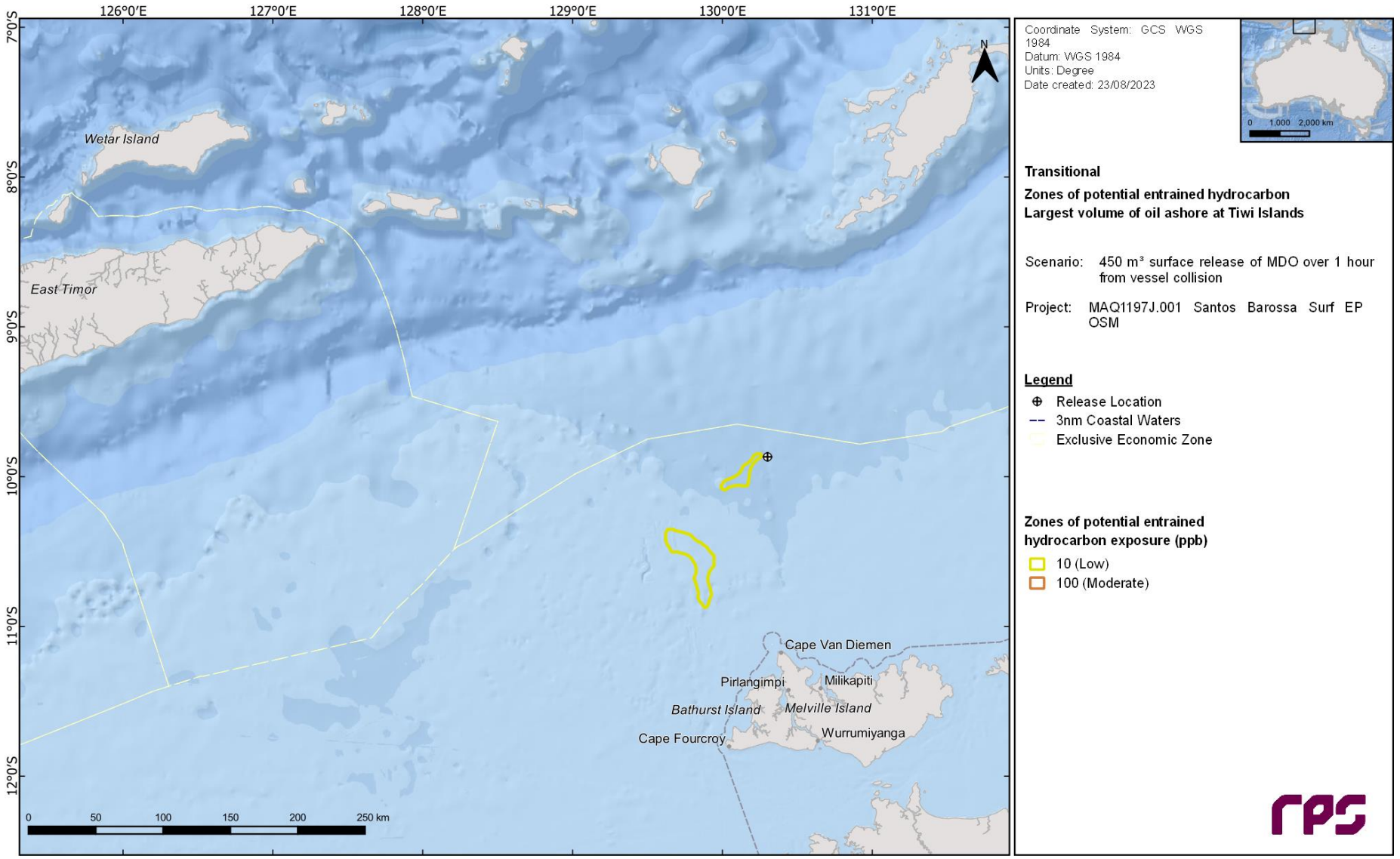

Figure 14.3 Predicted zones of entrained hydrocarbon exposure for the reduced 450 m³ fuel tank spill simulation (transitional, run 34), used to investigate if a 10% reduction in volume would reduce the potential risk of exposure to the Tiwi Islands

Appendix J Santos' environment consequence descriptors

Excerpt from Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004), Revision 5.

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. Widespread (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[35]; habitat within a protected area; habitats that include benthic primary producers[36] and/or epi-fauna[37]	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 widespread 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.
	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.

[35] As defined by the Department of Agriculture, Water and Environment
[36] Benthic photosynthetic organisms such as seagrass, algae, hard corals and mangroves
[37] Fauna attached to the substrate including sponges, soft corals and crinoids.