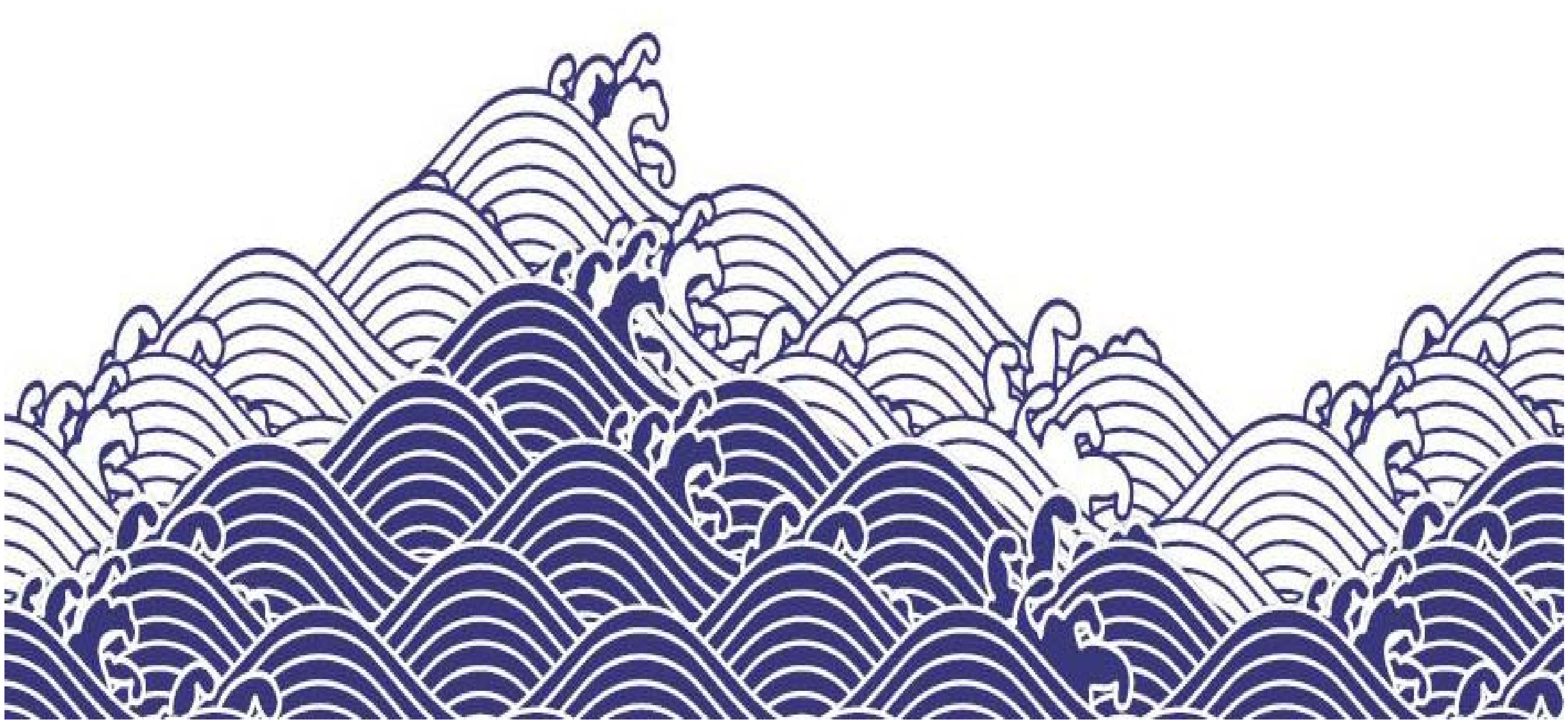
Ichthys Umbilicals, Risers and Flowlines and Subsea Production Systems Installation WA-50-L

Environment Plan



Environment plan summary

The WA-50-L environment plan summary has been prepared from material provided in this environment plan (EP). The summary consists of the following as required by Regulation 11(4) of the OPGGS (E) Regulations 2009:

EP summary and material requirement	Relevant section of EP containing EP summary material
The location of the activity	Section 3.1
A description of the receiving environment	Section 4
A description of the activity	Section 3
Details of the environmental impacts and risks	Sections 7 and 7.7
The control measures for the activity	Sections 7 and 7.7
The arrangements for ongoing monitoring of the titleholders environmental performance	Sections 9.11, 9.12 and 9.13
Response arrangements in the oil pollution emergency plan	Sections 8.5, 8.6 and Appendix D
Consultation already undertaken and plans for ongoing consultation	Sections 5 and 9.8.3
Details of the titleholders nominated liaison person for the activity	Section 1.5

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Terms, abbreviations and acronyms

Term, abbreviation or acronym	Meaning
°C	degrees Celsius
AFMA	Australian Fisheries Management Authority (Cwlth)
AHO	Australian Hydrographic Office
AICS	Australian Inventory of Chemical Substances
AIMS	Australian Institute of Marine Science
AIS	automatic identification system
ALARP	as low as reasonably practicable
AMOSC	Australian Marine Oil Spill Centre
AMP	Australian marine park
AMSA	Australian Maritime Safety Authority (Cwlth)
APASA	Asia-Pacific Applied Science Associates
APPEA	Australian Petroleum Production and Exploration Association
ARP	applied research program
AS/NZS	Australian/New Zealand Standard
BIA	Biologically Important Area
BoM	Bureau of Meteorology
BWM	ballast water management
CAMBA	China-Australia Migratory Bird Agreement
CASA	Civil Aviation Safety Authority
CMT	crisis management team
COLREGs	International Regulations for Preventing Collisions at Sea 1972
CPF	central processing facility
Cwlth	Commonwealth
DAWR	Department of Agriculture and Water Resources (Cwlth) (Now known as the Department of Agriculture, Water and the Environment)
dB	decibel

Term, abbreviation or acronym	Meaning
DBCA	Department of Biodiversity, Conservation and Attractions (WA)
DEE	Department of the Environment and Energy (Cwlth) (Now known as the Department of Agriculture, Water and the Environment)
DAWE	Department of Agriculture, Water and the Environment (Cwlth) (formerly the DEE and Department of Agriculture)
DJ	double joint
DMIRS	Department of Mines, Industry Regulation and Safety WA (formerly Department of Mines and Petroleum)
DP	dynamically positioned
DPaW	Department of Parks and Wildlife (WA) now known as DBCA
DPIR	Department of Primary Industry and Resources (NT)
DPIRD	Department of Primary Industries and Regional Development (WA)
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
EEZ	exclusive economic zone
EFL	electrical flying lead
EIAPP	Engine International Air Pollution Prevention
EIS	environmental impact statement
EMBA	environment that may be affected
ENVID	environmental impact identification
EP	environment plan
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Cwlth)
ERP	emergency response plan
ERT	emergency response team
ESD	ecological sustainable development
FCGT	flooding cleaning gauging and testing
FIS	filtered inhibited seawater
FLET	flowline end termination

Term, abbreviation or acronym	Meaning
FLNG	floating liquified natural gas
FPSO	floating production storage and offloading
FWAD	fixed wing aerial dispersant
g/m^2	grams per square metre
g/m^3	grams per cubic metre
GS	gathering system
GT	gross tonnes
ha	Hectare
HAZID	identification of operational risks and hazards
HFO	heavy fuel oil
HLV	heavy lift vessel
HSE	health, safety and environment
HSEQ-MS	health, safety, environment and quality management system
Hz	Hertz
IAP	incident action plan
IAPP	International Air Pollution Prevention
IBA	important bird area
IBC	intermediate bulk container
ILT	in-line tee
IMO	International Maritime Organization
IMR	inspection maintenance and repair
IMS	invasive marine species
IMT	incident management team
INPEX	INPEX Ichthys Pty Ltd
IOGP	International Association of Oil and Gas Producers
IOPP	International Oil Pollution Prevention
ISPPC	International Sewage Pollution Prevention Certificate

Term, abbreviation or acronym	Meaning
ISO	International Organization for Standardization
ITOPF	International Tanker Owners Pollution Federation Limited
IUCN	International Union for Conservation of Nature
KEF	key ecological feature
kg/m^3	kilograms per cubic metre
kHz	Kilohertz
km	kilometre(s)
L	litre(s)
LAT	lowest astronomical tide
licence area	WA-50-L
LLR	lower limits of reporting
LNG	liquefied natural gas
m^2	square metres
m^3	cubic metres
m^3/d	cubic metres per day
m/s	metres per second
MARPOL 73/78	International Convention for the Prevention of Pollution from Ships, 1973/1978
MBH	multi-bore hub
MEG	monoethlyene glycol
mg/L	milligrams per litre
MNES	Matters of National Environmental Significance
MNP	marine national park
MoC	management of change
MoU	memorandum of understanding
MP	marine park
MSI	Maritime Safety Information
NatPlan	National Plan for Maritime Environmental Emergencies

Term, abbreviation or acronym	Meaning
nm	nautical miles
NMR	north marine region
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NOPTA	National Offshore Petroleum Titles Administrator
NOx	mono-nitrogen oxides
NT DIPL	Northern Territory Department of Infrastructure, Planning and Logistics (NT)
NWMR	north-west marine region
ODS(s)	ozone-depleting substance(s)
OFL	optical flying lead
OEM	original equipment manufacturer
OIW	oil-in-water
OPEP	oil pollution emergency plan
OPGGS Act	Offshore Petroleum and Greenhouse Gas Storage Act 2006 (Cwlth)
OPGGS (E) Regulations	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cwlth)
OSMP	operational and scientific monitoring program
OSPAR	The 1992 OSPAR Convention ("Convention for the protection of the marine environment of the north-east Atlantic")
OSRL	Oil Spill Response Limited
OSTM	oil spill trajectory modelling
OWS	oil-water separator
PAH(s)	polycyclic aromatic hydrocarbon(s)
PDCA	plan, do check, act
PEZ	potential exposure zone
PLONOR	pose little or no risk (to the environment)
PM	production manifold
POLREP	(marine) pollution report

Term, abbreviation or acronym	Meaning
POTS Act	Protection of the Sea (Prevention of Pollution from Ships) Act 1983
ppb	parts per billion
PPE	personal protective equipment
ppm	parts per million
ppt	parts per thousand
PPRR	prevention, preparedness, response, and recovery
PRB	production riser base
PSV	platform supply vessel
PTS	permanent threshold shift
PTW	permit to work
QA/QC	quality assurance and quality control
Ramsar Convention	The Convention on Wetlands of International Importance, especially as Waterfowl Habitat (the Ramsar Convention)
RCC	rescue coordination centre
RO	reverse osmosis
ROKAMBA	Republic of Korea- Australia Migratory Bird Agreement
ROV	remotely operated (underwater) vehicle
RSS	riser support structure
SDH	subsea distribution hub
SDU	subsea distribution unit
SEEMP	Ship Energy Efficiency Management Plan
SIMA	spill impact mitigation assessment
SIMOPs	simultaneous operations
SITREP	situation report
SOLAS	International Convention for the Safety of Life at Sea
SOPEP	shipboard oil pollution emergency plan
SMPEP	shipboard marine pollution emergency plan
SPS	subsea production system

Term, abbreviation or acronym	Meaning
STFL	steel flying lead
STP	sewage treatment plant
T	tonne
t/d	tonnes per day
TTS	temporary threshold shift
UNEP	United Nations Environment Programme
URF	umbilical risers and flowlines
VOC(s)	volatile organic compound(s)
WA	Western Australia
WA-50-L	Production licence area within the Browse basin
WA DoT	Department of Transport (WA)
WA EPA	Western Australian Environmental Protection Authority
WAFIC	Western Australian Fishing Industry Council
XT	christmas tree
ZRB	zero radius bend
µg/L	micrograms per litre
µPa	micropascal

1 INTRODUCTION

1.1 Background

INPEX Ichthys Pty Ltd, on behalf of the Ichthys Upstream Unincorporated Joint Venture Participants, is developing the Ichthys Field in the Browse Basin off the north-west coast of Western Australia (WA). Initial development wells were drilled and the Ichthys LNG offshore facilities were installed and commissioned from 2014 through to 2019. The assets commenced production in July 2018 and now routinely ship cargoes of condensate from the FPSO to international customers and send gas to the onshore plant in Darwin via the gas export pipeline (GEP).

The existing facilities consist of a subsea production system (SPS) (e.g. xmas trees (XT), manifolds, subsea control systems and umbilicals, risers and flowlines (URF), and the gas export riser base, which connect the development wells to the central processing platform (CPF Explorer) and floating production storage offtake (FPSO Venturer).

The various scopes of work (or petroleum activities) occurring in WA-50-L under in force Environment Plans (EPs) including details of estimated schedules, are described in Table 1-1.

Table 1-1: INPEX Ichthys LNG Project environment plans

Title	Activities	Indicative timing
Ichthys Development Drilling Campaign WA-50-L Environment Plan (000-AD-PLN-60003) (Accepted)	• 12-15 well drilling program utilising semisubmersible drilling rigs • installation of well infrastructure and xmas trees (XTs) • well clean-up and completions • support activities, including equipment transfers, refuelling, crew transfers, and transfer of waste and general supplies to and from logistics support vessels • control and maintenance of well integrity.	Mar 2020 – Mar 2025
Ichthys Project Offshore Facility (Operations) Environment Plan (X075-AH-PLN-100015) (Accepted)	Operation of the interlinked facility including: • CPF (*Ichthys Explorer*) • FPSO (*Ichthys Venturer*) • SPS infrastructure.	Dec 2016 – Dec 2021

Title	Activities	Indicative timing
Ichthys Project Gas Export Pipeline (Operation) Environment Plan (F075-AH-PLN-10001) (Accepted)	• operation of the gas export pipeline from the gas export riser base to the boundary of Commonwealth waters adjacent to NT waters • inspection, maintenance and repair (IMR) of gas export pipeline infrastructure during the Operations stage • deployment of a pipeline repair system during a repair scenario • post-repair discharges of residual hydrocarbon, air, nitrogen gas, filtered inhibited seawater (FIS) or monoethylene glycol (MEG) to the environment.	Jan 2017 – Jan 2022

1.2 Scope

As titleholder and on behalf of its joint venture participants, INPEX Ichthys Pty Ltd. (INPEX) is proposing to undertake additional construction and installation activities within petroleum production licence WA-50-L, associated with the Ichthys Liquefied Natural Gas (LNG) Project (Figure 1-1). This further development of the Ichthys Field was approved under the Ichthys LNG Project Commonwealth approval decision EPBC 4208/2008.

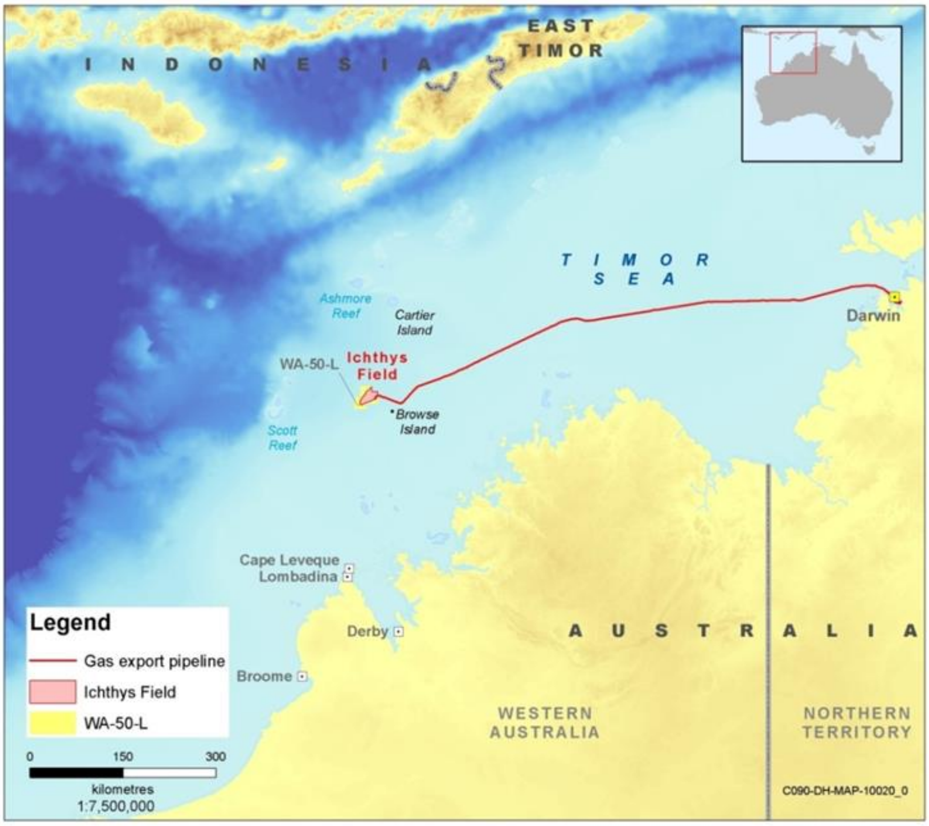

Figure 1-1: Location of the Ichthys LNG Project

Construction and installation of umbilical, risers and flowlines (URF) infrastructure associated with the first phase of the Ichthys LNG Project were addressed in the Ichthys URF Installation Environment Plan (EP) (E075-AH-PLN-10000) accepted in January 2014, under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS (E) Regulations), as administered by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA). The scope relating to the first phase has been completed and the EP was closed out in 2018.

The scope of this EP includes the construction and installation of URF infrastructure associated with the next stage of the Ichthys LNG Project. The subsea production system (SPS) will be expanded through the installation of a new gathering system and new infrastructure required to connect new production wells to the existing gathering systems. The scope also includes for the potential for inspection, maintenance and repair (IMR) of existing and proposed (SPS) infrastructure in WA-50-L.

Construction and installation activities are expected to commence in the first quarter (Q1) of 2021; however, the start date is subject to vessel availability, operational efficiencies and weather.

The scope of this EP does not include:

- the movement of vessels or helicopters outside of the production licence area (e.g. travel to and from WA-50-L). These activities will be undertaken in accordance with other relevant maritime and aviation legislation; most notably, the *Navigation Act 2012* (Cwlth) and *Civil Aviation Act 1988* (Cwlth).
- oil spill response activities in relation to a loss of containment from the SPS. Although the risks are assessed in this EP and preventive controls are described, any spill response activities and mitigative controls will be managed under the Ichthys Project Offshore Facility (Operation) EP (X075-AH-PLN-100015) and associated Oil Pollution Emergency Plan (X075-AH-PLN-10016).

1.3 Objectives

The objectives of this EP are to:

- demonstrate that the environmental impacts and risks associated with the petroleum activity have been reduced to 'as low as reasonably practicable' (ALARP) and are of an acceptable level
- establish appropriate environmental performance outcomes, environmental performance standards and measurement criteria in relation to the installation of URF and SPS infrastructure
- define an appropriate implementation strategy and monitoring, recording and reporting arrangements, whereby compliance with this EP, the OPGGS (E) Regulations, and other relevant legislative requirements, can be demonstrated
- demonstrate that INPEX has carried out the consultations required by the OPGGS (E) Regulations
- demonstrate that the measures adopted by INPEX, arising from the consultation process, are appropriate
- demonstrate that the petroleum activity complies with the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (OPGGS Act) and the OPGGS (E) Regulations.

1.4 Overview of activity description

Table 1-2 provides an overview of the URF and SPS installation activities to be undertaken under this EP.

Table 1-2: Overview of the activity description

Item	Description
Petroleum production licence area	WA-50-L
Basin	Browse
Gas field	Ichthys Field
Activity location	Wholly located within Commonwealth waters approximately 390 km north of Derby, Western Australia in the North West Marine Region (NWMR) of the Timor Sea.
Hydrocarbon type	Gas and condensate
Water depth	235–275 m at Lowest Astronomical Tide (LAT)
Vessels	Installation vessels, deep-water construction vessels, derrick lay vessels, construction support vessels, light construction vessels, support vessels, platform supply vessels, survey/metrology vessels, tugs, barges, dynamically positioned (DP) transport vessels, offshore construction vessels and HLVs.
Activities	The activities to be undertaken in WA-50-L production licence area including surveys; installation and mechanical completion, pre-commissioning and commissioning of URF infrastructure; connection of URF infrastructure and systems to the existing Ichthys SPS and offshore facility; pre-commissioning and commissioning of well head Christmas trees; work associated with installation, mechanical completion, pre-commissioning and commissioning; and support activities.
Activity commencement	Q1 2021
Duration	Multiple campaigns within a 5 year duration

1.5 Titleholder details

INPEX Ichthys Pty Ltd is a joint titleholder of production licence WA-50-L but has been nominated as the single titleholder for the purposes of taking eligible voluntary actions under subsection 775B of the OPGGS Act, such as making submissions.

In accordance with Regulation 15(1) of the OPGGS (E) Regulations, details of the titleholder are described in Table 1-3. INPEX will be responsible for ensuring that activities covered in this EP are carried out in accordance with the OPGGS (E) Regulations, this EP and other applicable Australian legislation.

In accordance with Regulation 15(2) of the OPGGS (E) Regulations, details of the titleholder's nominated liaison person are provided in Table 1-4.

Table 1-3: Titleholder details

Name	INPEX Ichthys Pty Ltd (INPEX)
Business address	Level 22, 100 St Georges Tce, Perth, WA 6000

Telephone number	+61 8 6213 6000
Fax number	+61 8 6213 6455
Email address	enquiries@inpex.com.au
ABN	46 150 217 253

Table 1-4: Titleholder nominated liaison officer

Name	Dawn MacInnes
Position	INPEX Environment Manager
Business address	Level 22, 100 St Georges Tce, Perth, WA 6000
Telephone number	+61 8 6213 6000
Email address	enquiries@inpex.com.au

1.5.1 Notification arrangements

In the event that the titleholder, nominated liaison person or contact details for the nominated liaison person change, INPEX will notify the regulator in accordance with Regulation 15(3) of the OPGGS (E) Regulations.

1.6 Financial assurance

Financial assurance for the titleholder's liabilities for cleaning up, remediating and monitoring the impact of a petroleum release has been calculated using the Australian Petroleum Production and Exploration Association (APPEA) methodology for estimating levels of financial assurance (2018), based on the maximum credible loss scenario from a loss of well containment.

Declarations of financial assurance will be provided in relation to title WA-50-L prior to acceptance of the Environment Plan by NOPSEMA.

2 ENVIRONMENTAL MANAGEMENT FRAMEWORK

In accordance with Regulation 13(4) of the OPGGS (E) Regulations 2009, the requirements, including legislative requirements that apply to the activity and are relevant to environmental management, are described in this section with reference to demonstration of how those requirements will be met.

2.1 Corporate framework

The INPEX Australia health safety, environment and quality management system (HSEQ-MS) is part of the INPEX's Business Management System, an integrated framework of policies, standards and procedures that describe how business activities at INPEX are governed and managed.

The INPEX Environmental Policy sets the direction and minimum expectations for environmental performance, and is implemented through the standards and procedures of the HSEQ-MS. This system and policy are further described in Section 9 in accordance with Regulation 16(a) of the OPGGS (E) Regulations.

2.2 Legislative framework

In accordance with Regulation 13(4) of the OPGGS (E) Regulations, the legislative framework relevant to the petroleum activity is listed in Table 2-1. A summary of applicable industry standards and guidelines is also presented in Table 2-2. Ongoing management of legislative and other requirements is described further in in Section 9.8.1.

Table 2-1: Summary of applicable legislation

Legislation	Description	Requirements	Demonstration of how requirements are met in EP
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act; Cwlth) and Environment Protection and Biodiversity Conservation Regulations 2000 (EPBC Regulations)	Provides for the protection and management of nationally and internationally important flora, fauna, ecological communities, and heritage places.	The OPGGS (E) Regulations were revised in February 2014 to include the requirement that matters protected under Part 3 of the EPBC Act are considered and any impacts are at acceptable levels. Part 8 of the EPBC Regulations outlines requirements for vessel when interacting with cetaceans. In accordance with Regulation 9 of the OPGGS (E) Regulations, the activities described in this EP were approved by the Commonwealth Environment Minister under Part 9 of the EPBC Act (EPBC Approval Decision 2008/4208). The EPBC Act provides for protection of 'matters of national environmental significance' including not only listed species but also heritage properties and Ramsar wetlands. There are exemptions covering provisions of Part 3 and 13 of the EPBC Act, for the undertaking of activities when responding to maritime environmental emergencies, in accordance with the National Plan (NatPlan). Australian Marine Parks (AMPs) are proclaimed under this Act and associated management plans are enacted under this legislation.	Relevant approval conditions within approval decision EPBC 2008/4208 have been addressed in this EP and are summarised in Appendix A. Section 4.3 – Australian marine parks Section 7.6.1 – Physical presence of vessels and Section 7.4.2 interaction with marine fauna. Section 8 – Emergency conditions. OPEP (Appendix D) A demonstration of how this EP addresses the relevant conservation management documents related to EPBC listed species has been presented in Appendix B.
OPGGS (E) Regulations (Cwlth)	The OPGGS (E) Regulations under the OPGGS Act require a titleholder to have an accepted plan in place for a petroleum activity.	The OPGGS (E) Regulations require that the petroleum activity is undertaken in an ecologically sustainable manner, and in accordance with an accepted EP.	Throughout this EP. Implementation of the HSEQ-MS.

Legislation	Description	Requirements	Demonstration of how requirements are met in EP
Navigation Act 2012 (Cwlth)	The primary legislation that regulates ship and seafarer safety, shipboard aspects of protection of the marine environment, and employment conditions for Australian seafarers.	The *Navigation Act 2012* includes specific requirements for safe navigation, including systems, equipment and practices consistent with the International Convention for the Safety of Life at Sea (SOLAS) and the International Regulations for Preventing Collisions at Sea (COLREGS), as implemented as maritime law in Australia through a series of Marine Orders, including Marine Orders – Part 21 – Safety of navigation and emergency procedures and Marine Orders – Part 30 – Prevention of collisions. The *Navigation Act 2012*, in conjunction with the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* and through legislative Marine Orders, also requires vessels to have pollution prevention certificates (see below).	Section 7.7.1 – Physical presence – disruption to other marine users Section 8.2 - Vessel collision Implementation of the HSEQ-MS.
Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (POTS Act; Cwlth)	The POTS Act provides for the prevention of pollution from vessels, including pollution by oil, noxious liquid substances, packaged harmful substances, sewage, garbage, and air pollution. In conjunction with Chapter 4 of the *Navigation Act 2012*, the POTS Act gives effect to relevant requirements of the International Convention for the Prevention of Pollution from Ships, 1973/1978 (MARPOL 73/78) in Australia.	The requirements of the POTS Act and the *Navigation Act 2012* are implemented as maritime law in Australia through a series of Marine Orders and legislative instruments, made and administered by the Australian Maritime Safety Authority (AMSA). The requirements of each Marine Order made under the POTS Act and the *Navigation Act 2012* and their relevance to the activity are outlined separately below.	Section 7 and Section 8 Implementation of the HSEQ-MS.

Legislation	Description	Requirements	Demonstration of how requirements are met in EP
Marine Orders Part 91 – Marine pollution prevention — oil	Marine Orders Part 91 implements Part II of the POTS Act, Chapter 4 of the *Navigation Act 2012*, and Annex I of MARPOL 73/78 (oil pollution). The Marine Orders provide standards for the discharge of certain oily mixtures or oily residues and associated equipment and include duties to manage bunkering and transfers of oil between vessels; to maintain Oil Record Books and Shipboard Oil Pollution Emergency Plans (SOPEPs); and to report oil pollution.	Vessels ≥400 gross tonnes (GT) are required to maintain: • International Oil Pollution Prevention (IOPP) certificates to demonstrate that the vessel or facility and onboard equipment comply with the requirements of Annex I of MARPOL 73/78 (as applicable to vessel size, type and class). • Oil Record Books to record activities, such as fuel/oil bunkering and discharges of oil, oily water, mixtures and residues. • SOPEPs outlining the procedures to be followed during an oil pollution incident. • Discharges must also comply with Annex I of MARPOL 73/78, and oil pollution incidents must also be reported to AMSA.	Section 7.1.3 – Routine discharges Section 7.4.1 – Accidental release Section 8 - Emergency Conditions OPEP (Appendix D) Implementation of the HSEQ-MS.
Marine Orders Part 93 – Marine pollution prevention – noxious liquid substances	Marine Orders Part 93 – Marine pollution prevention – noxious liquid substances (made under the *Navigation Act 2012* and the POTS Act and Annex II of MARPOL 73/78) specifies the requirements for the prevention of contaminating liquids and chemicals entering the marine environment. They set out the guidelines for developing a shipboard marine pollution emergency plan (SMPEP).	INPEX and vessel contractor will comply with the Marine Orders – Part 93: Marine Pollution Prevention– noxious liquid substances (as appropriate to vessel class) in relation to the discharge to sea of any noxious liquid substances. Marine vessels >150 GT will carry SMPEPs approved under MARPOL 73/78 Annex II, Regulation 17 if the vessel is carrying noxious liquid substances in bulk. (noting that the vessels SOPEP and SMPEP may be combined into a single document).	Section 7.4.1 – Accidental release Implementation of the HSEQ-MS.

Legislation	**Description**	**Requirements**	**Demonstration of how requirements are met in EP**
Marine Orders Part 94 – Marine pollution prevention — packaged harmful substances	Marine Orders Part 94, – Marine pollution prevention — packaged harmful substances, and the POTS Act relating to packaged harmful substances as defined by Annex III of MARPOL 73/78.	INPEX and vessel contractor will comply with the *Navigation Act 2012* – Marine Orders – Part 94: Marine Pollution Prevention– Packaged Harmful Substances (as appropriate to vessel class), through reporting the loss or discharge to sea of any harmful materials.	Section 7.2 – Waste management
Marine Orders Part 95 – Marine pollution prevention — garbage	Marine Orders Part 95 – Marine pollution prevention — garbage implements Part IIIC of the POTS Act, Chapter 4 of the *Navigation Act 2012*, and Annex V of MARPOL 73/78 (garbage). The Marine Orders provide for the discharge of certain types of garbage at sea, waste storage, waste incineration, and the comminution and discharge of food waste. They also set out requirements for garbage management and recording.	Vessels ≥100 GT, or vessels certified to carry 15 persons or more, are required to maintain a Garbage Management Plan. Vessels ≥400 GT are required to maintain a Garbage Record Book. The requirements will apply to vessels (as appropriate to their size, type and class) at all times.	Section 7.2 – Waste Management. Implementation of the HSEQ-MS.
Marine Orders Part 96 – Marine pollution prevention — sewage	Marine Orders Part 96 – Marine pollution prevention — sewage implements Part IIIB of the POTS Act, Chapter 4 of the *Navigation Act 2012*, and Annex IV of MARPOL 73/78 (sewage).	Vessels ≥400 GT are required to maintain International Sewage Pollution Prevention (ISPP) certificates to demonstrate that vessels and their onboard sewage systems comply with the requirements of Annex IV of MARPOL 73/78. Discharges of sewage must also comply with Annex I of MARPOL 73/78, and oil pollution incidents must also be reported to AMSA.	Section 7.1.3 – Routine discharges Implementation of the HSEQ-MS.

Legislation	Description	Requirements	Demonstration of how requirements are met in EP
	The Marine Orders include requirements for the treatment, storage and discharge of sewage and associated sewage systems, and for an International Sewage Pollution Prevention (ISPP) certificate to be maintained on board.		
Marine Orders Part 97 – Marine pollution prevention — air pollution	Marine Orders Part 97 – Marine pollution prevention — air pollution implements Part IIID of the POTS Act, Chapter 4 of the *Navigation Act 2012*, and Annex VI of MARPOL 73/78 (air pollution). The Marine Orders set requirements for marine diesel engines and associated emissions, waste incineration on board vessels, engine fuel quality, and equipment and systems containing ozone-depleting substances (ODS).	Vessels ≥400 GT are required to have International Air Pollution Prevention (IAPP) certificates and Engine International Air Pollution Prevention (EIAPP) certificates to demonstrate that the vessel or facility and onboard marine diesel engines comply with the requirements of Annex VI of MARPOL 73/78. Low-sulphur fuel oil / marine diesel with 0.5% mass-for-mass (m/m) sulphur content is required to be used in engines after 31 December 2019. In accordance with Annex VI of MARPOL 73/78, the requirements do not apply to the following: • emissions resulting from the incineration of substances that are solely and directly the result of the exploitation and offshore processing of seabed mineral resources (i.e. hydrocarbons), including but not limited to flaring during well completion and testing operations and flaring arising from upset conditions • emissions associated solely and directly with the treatment, handling, or storage of seabed minerals (i.e. hydrocarbons) • emissions from marine diesel engines that are solely dedicated to the exploration, exploitation and associated offshore processing of seabed mineral resources (i.e. hydrocarbons).	Section 7.1.2 – Atmospheric emissions. Implementation of the HSEQ-MS.

Legislation	**Description**	**Requirements**	**Demonstration of how requirements are met in EP**
		• vessels ≥400 GT are required to have an International Maritime Organization (IMO)-approved waste incinerator, as confirmed by the IAPP certificate. • vessels ≥400 GT with rechargeable systems containing ODS to maintain an ODS Record Book. • vessels ≥400 GT to have an International Energy Efficiency (IEE) certificate (as applicable to the vessel and engine size, type and class). • vessels ≥400 GT to have a Ship Energy Efficiency Management Plan (SEEMP) (as applicable to the vessel and engine size, type and class).	
Biosecurity Act 2015 (Cwlth)	The Act and its supporting legislation are the primary legislative means for managing risk of pests and diseases entering into Australian territory and causing harm to animal, plant and human health, the environment and/or the economy.	Of specific relevance to this EP, the Act requires that ballast is managed within Australian seas; as such the Biosecurity Act now defines Australian seas as: • for domestic and international vessels whose Flag State Administration is party to the BWM Convention - the waters (including the internal waters of Australia) that are within the outer limits of the exclusive economic zone (EEZ) of Australia (all waters within 200 nm); or • for all other international vessels – the Australian territorial seas (all waters within 12 nm).	Section 7.5.1 - Invasive marine species Implementation of the HSEQ-MS.
Biodiversity Conservation Act 2018 (WA) *Animal Welfare Act 2002* (WA)	Ensures the protection of biodiversity and humane treatment of native fauna. Ensures appropriate treatment and management of wildlife in the event of a potential hydrocarbon spill and response activities.	Consult with WA Department of Biodiversity, Conservation and Attractions (DBCA) and obtain relevant permit(s) before a wildlife hazing and post contact wildlife response.	Section 8 – Emergency conditions OPEP (Appendix D)

Legislation	Description	Requirements	Demonstration of how requirements are met in EP
Fish Resources Management Act 1994 (WA)	The *Fish Resources Management Act* is administered by the WA Department of Primary Industry and Regional Development (DPIRD) that has powers to deal with incursions of marine pests.	INPEX will manage its operations in accordance with the Act and the associated Fish Resources Management Regulations (1995) with respect to managing potential invasive marine species (IMS) risks.	Section 7.5.1 - Invasive marine species Implementation of the HSEQ-MS.
Aquatic Resources Management Act 2016 (ARMA) WA	The *Aquatic Resources Management Act 2016* (ARMA) will become the primary legislation used to manage fishing, aquaculture, pearling and aquatic resources in WA.	At the time of submission of this EP, only certain sections of the ARMA have taken effect, with most Sections not yet commenced. While this is the case, the *Fish Resources Management Act 1994* (WA) remains in effect until the transitional provisions for the ARMA are in operation. Once in operation the ARMA will provide new management methods in a flexible framework. This EP will be updated to reflect this once the ARMA comes into effect, expected within the duration of this EP.	-

Table 2-2: Summary of applicable industry standards and guidelines

Guideline	Description
Australian and New Zealand guidelines for fresh and marine water quality (ANZG 2018)	These guidelines provide a framework for water resource management and state specific water quality guidelines for environmental values, and the context within which they should be applied.
International Convention for the Prevention of Pollution from Ships, 1973/1978 (MARPOL 73/78)	This convention is designed to reduce pollution of the seas, including dumping, oil and exhaust pollution. MARPOL 73/78 currently includes six technical annexes. Special areas with strict controls on operational discharges are included in most annexes.
International Convention on the Control of Harmful Anti-fouling Systems	This convention prohibits the use of harmful organotins in anti-fouling paints used on ships and establishes a mechanism to prevent the potential future use of other harmful substances in anti-fouling systems.
International Convention for the Safety of Life at Sea (SOLAS) 1974	In the event of an offshore emergency event that endangers the life of personnel, the International Convention for the Safety of Life at Sea (SOLAS) 1974 may take precedence over environmental management.
Bonn Agreement for Cooperation in Dealing with Pollution of the North Sea by Oil and other harmful substances (Bonn Agreement)	The Bonn Agreement is the mechanism by which the North Sea states, and the European Union (the Contracting Parties), work together to help each other in combating pollution in the North Sea area from maritime disasters and chronic pollution from ships and offshore installations; and to carry out surveillance as an aid to detecting and combating pollution at sea. The Bonn Agreement Oil Appearance Code may be used during spill response activities.
The Australian Petroleum Production and Exploration Association *Code of Environmental Practice* (APPEA 2008)	Recognising the need to avoid or minimise and manage impacts to the environment, this code of environmental practice includes four basic recommendations to APPEA members undertaking activities: • Assess the risks to, and impacts on, the environment as an integral part of the planning process. • Reduce the impact of operations on the environment, public health and safety to as low as reasonably practicable (ALARP) and to an acceptable level by using the best available technology and management practices. • Consult with stakeholders regarding industry activities. • Develop and maintain a corporate culture of environmental awareness and commitment that supports the necessary management practices and technology, and their continuous improvement.
Australian Ballast Water Requirements, Version 7 (DAWR 2017)	Australian Ballast Water Management Requirements outline the mandatory ballast water management requirements to reduce the risk of introducing harmful aquatic organisms into Australia's marine environment through ballast water from international vessels. These requirements are enforceable under the *Biosecurity Act 2015*.

Guideline	Description
National Biofouling Management Guidelines for the Petroleum Production and Exploration Industry (Marine Pest Sectoral Committee 2018)	A voluntary biofouling management guidance document developed under the National System for the Prevention and management of Marine Pest Incursions. Its purpose is to provide tools to operators to minimise the amount of biofouling accumulating on their vessels, infrastructure and submersible equipment and thereby to minimise the risk of spreading marine pests.
International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention) (IMO 2009)	All vessels are required to manage their ballast water and sediments in accordance with the Convention and *Biosecurity Act 2015*. The convention came into force on 8 September 2017 and Australia's ballast water policy and legislation align with the convention.
Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species (IMO 2012)	The guidelines provide a globally consistent approach to the management of biofouling. They aim to reduce the risk of translocation of marine pests from biofouling present on immersed areas of vessels. It was adopted by IMO marine environment committee in the form of Resolution MEPC.207 (62) in 2011.

3 ACTIVITY DESCRIPTION

3.1 Location, timing and schedule

Production licence, WA-50-L, is located within the Browse Basin in Commonwealth waters within Western Australia (Figure 3-1). It is approximately 230 km north-west of the Kimberley coastline, at its closest point. Water depths at the proposed installation locations range between 235 m and 275 m at lowest astronomical tide (LAT). The closest major town is Derby, located approximately 390 km south of the southern boundary of the licence area.

INPEX is preparing to expand capacity with further development of the Ichthys Field. The expansion of the URF and SPS includes installation of a new gathering system and new infrastructure required to connect new production wells to existing gathering systems.

The proposed activities will be undertaken in WA-50-L over a period of five years. The commencement date is expected to be in Q1 2021, noting that the exact timing for commencement and completion will be dependent upon approvals, vessel availability, operational efficiencies and weather conditions.

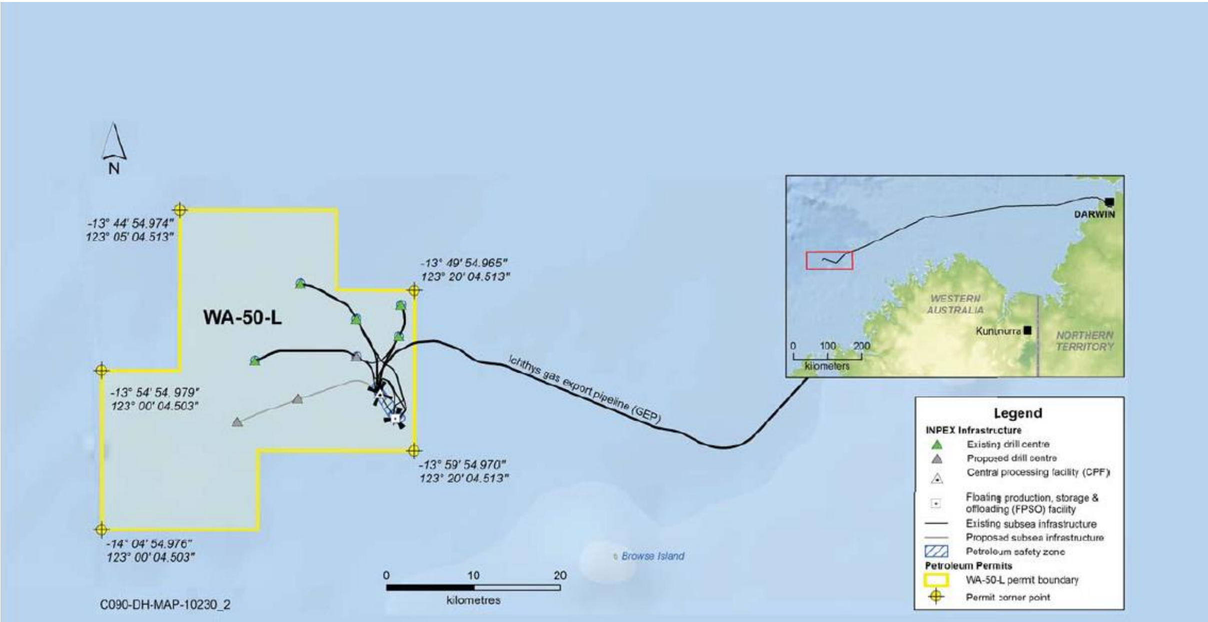

Figure 3-1: Location and coordinates of WA-50-L including existing and proposed subsea infrastructure

Figure 3-2 shows a schematic drawing of the URF and SPS infrastructure including the Ichthys LNG offshore facility (i.e. the central processing facility (CPF) and floating production, storage and offloading (FPSO) facility) that are illustrated in black. The areas marked yellow identify additions to existing gathering systems (GS 1-3) and the area in blue shows the new gathering system (GS4).

Offshore installation vessels will be used to perform the various installation activities that may take days to weeks to complete and are typically conducted in specific campaigns using specialist vessels.

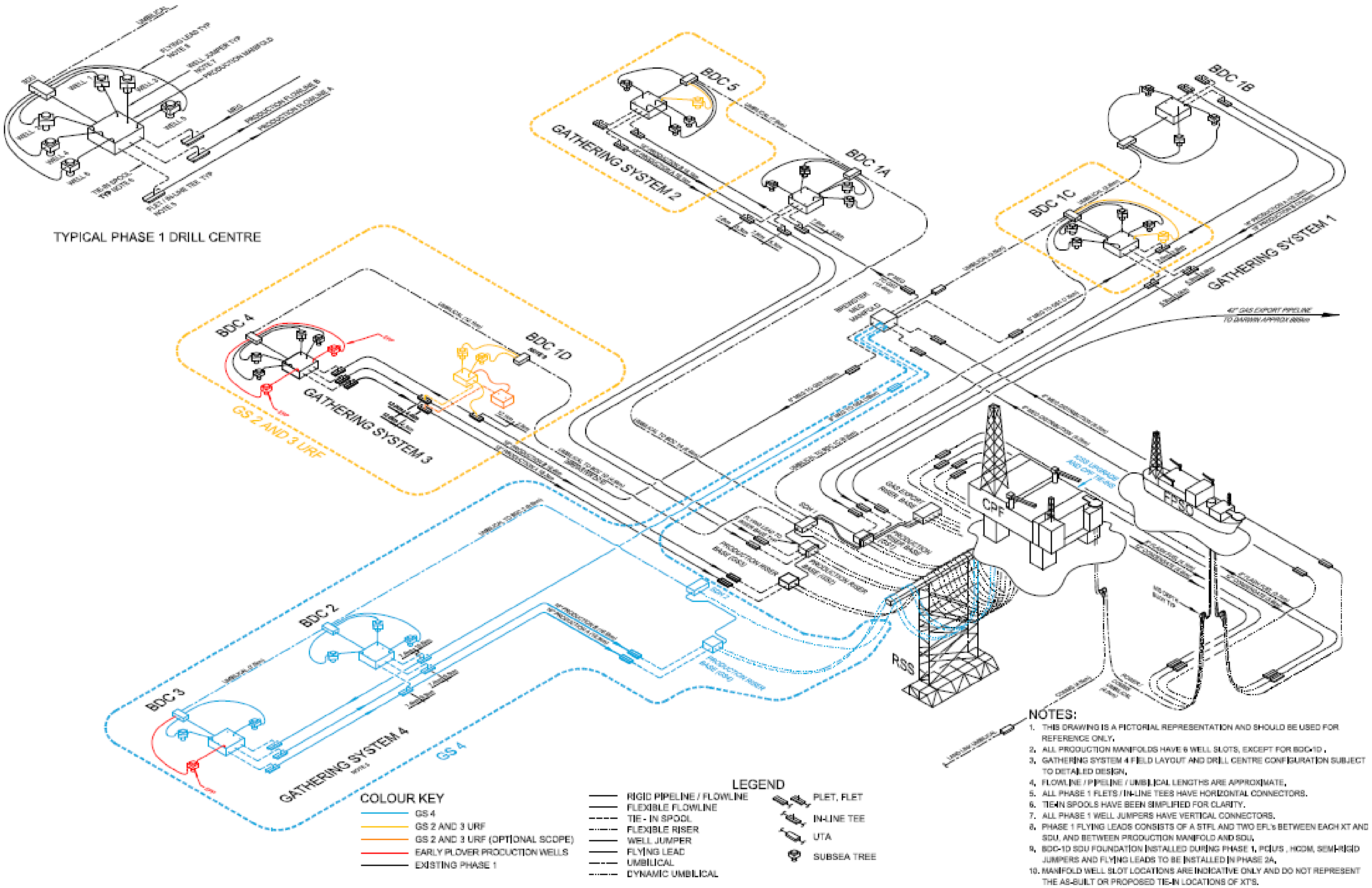

Figure 3-2: Indicative representation of Ichthys LNG infield installations

3.2 Summary of activities

Expansion of the SPS includes the installation of an additional gathering system (GS4), including umbilicals, risers, flowlines and related seabed infrastructure. It further includes installation of new infrastructure on existing gathering systems required to connect new production wells to the existing gathering system already in production. Offshore vessels will be used to perform the installations and link the subsea infrastructure to the offshore facility. They will be supported by various supply vessels, including PSVs, DP transport vessels, tugs and barges.

The activities to be undertaken under this EP include the following:

- survey activities comprising:
  - installation of temporary subsea positioning systems
  - pre-installation, as-laid and as constructed surveys
  - metrology surveys
- installation, mechanical completion, pre-commissioning and commissioning of URF infrastructure including:
  - umbilicals
  - risers
  - flowlines (two 16" production flowlines 16.9 km length and an 8" MEG line 18 km in length)
  - subsea structures including two production manifolds (PMs) and a production riser base (PRB)
  - smaller miscellaneous subsea structures such as zero radius bends (ZRBs), crossings, spool supports, mattresses and scour protection equipment
  - manifolds
  - control systems
- the connection of URF infrastructure and systems to the existing subsea infrastructure and offshore facility including:
  - tie-ins between subsea equipment
  - tie-ins to the well head Christmas trees at drill centres
  - installation of spools, jumpers, power cables and communication cables
  - subsea connection of umbilicals (electric and hydraulic control cables) and flying leads
- pre-commissioning and commissioning of the well head Christmas trees at drill centres
- work associated with installation, mechanical completion, pre-commissioning and commissioning (including seabed rectification activities such as jetting for freespan correction and seabed levelling)
- support activities in WA-50-L including
  - equipment transfers
  - refuelling
  - bulk transfer of MEG, hydrocarbons and other chemicals
  - crew transfers

  - transfer of waste
  - transfer of general supplies.
- potential for IMR of existing and proposed SPS infrastructure in WA-50-L.

All subsea activities will involve remotely operated underwater vehicles (ROVs) with onboard cameras to monitor and perform the installation activities. Due to the water depth, all deep-water connections between components will be guided and actuated by the ROVs. However, there will be contingency plans to allow for saturation diving to support seabed installation activities, and air diving at shallow water depths to support the connection of components at the CPF and FPSO (collectively termed the floating facilities).

Three moorings may be established in WA-50-L to assist in vessel logistics and reduce fuel use. The moorings will comprise of one or two anchors with chains on the seabed and wire rope to a buoy at the surface. The moorings will be located approximately 1 km from any subsea asset or facility and used to lay-off vessels and barges awaiting installation activities.

3.3 Surveys

Pre-installation and metrology surveys of the seabed along route alignments for the flowlines and umbilicals and at the locations of structures will take place prior to installation activities and will continue throughout the installation program to support accurate and safe placement of equipment. A network of subsea sensors and acoustic 'pingers' will be installed as a long baseline array. The system will use high frequency sound signals to communicate the positioning of the vessels, the ROVs and various subsea infrastructure components. The system will be periodically maintained using a ROV.

For positioning and tracking of ROVs and other subsea items, all deployed items will have ultra-short baseline (USBL) transducers attached to them, as this practice has become an industry standard. The purpose of the USBL is to ensure adequate accuracy in the positioning and real-time navigation during offshore operations, and to minimise the risk of accidental collisions and damage.

Post-installation, as-laid and as-constructed surveys will be conducted to confirm the as-laid position of equipment and will be performed throughout the installation period.

Multibeam echo-sounder (MBES) for hydrographic surveys of the seabed may be used along the flowline alignments. The MBES system will operate in the frequency range of 70–400 kHz with a sound source output of between 200 dB and 225 dB re 1µPa @ 1m peak level.

3.4 Flowlines and risers

3.4.1 Flowlines

Flowlines will transport production fluids from the wells to the CPF. Flowlines are rigid where they traverse the seabed. Between the seabed and the CPF they will be flexible and are known as flexible 'risers'. Flowlines and risers will be brought by vessels either directly to the WA-50-L from international destinations or via Australian ports.

The two 16" corrosion resistant alloy (CRA) production flowlines and the 8" Carbon Steel MEG flowline will be prefabricated into double joints before being loaded out and transported to site where the pipelay vessel shall weld the double joints together, complete non-destructive testing to ensure the quality of the welds and field joint coating before being lowered to the seabed.

The first end of the flowline will be fitted with a flowline end termination (FLET) which will exclude the seawater. The FLET will be secured to the end of the flowline on the vessel before being lowered to the seabed, where it will be fixed into place by either suction start-up pile or start-up anchor to restrict longitudinal movement of the flowline when laying away. The final end of the flowline will also be fitted with a FLET which will prevent ingress of water before mechanical completion and pre-commissioning.

In-line tees (ILTs) are required for the production flowlines. Each ILT will be fixed between a leading and trailing section of the flowline.

Flowlines are protected from external corrosion through a combination of high integrity coating and the installation of aluminium sacrificial anodes. The anodes are attached to select flowline pipe joints prior to pipelay.

3.4.2 Risers

Risers will be laid over the riser support structure (RSS). The first end of each riser will be deployed from reels on a vessel to a subsurface riser guide tube on the CPF, where they will be secured in place above the waterline. The vessel will then 'lay away' the riser from the CPF and drape it over the corresponding gutter on the RSS. Once in place, a collar on the riser will locate and lock with a receptacle on the gutter.

The risers will be filled with filtered inhibited seawater (FIS) or filled with MEG. The second end will be connected at the subsea structure of the relevant system.

3.4.3 Flowline installation contingency procedure

Contingency procedures will be initiated in the event that a buckle forms in a flowline during installation. Two types of buckles may occur: dry buckles, where the flowline is not ruptured; and wet buckles, where the flowline is ruptured and filled with seawater. Conditions of all flowlines will be monitored during installation to detect changes in tension, shape and air content – all of which can indicate either a wet or dry buckle. A flowline can be repaired on certain vessels or on the seabed, depending on the type, extent and location of the buckle.

Other unplanned events such as detachment of pressurisation hoses may also lead to ingress of seawater into flowlines. Such events would need to be managed in the same way as a wet buckle to prevent corrosion of the flowline.

Flowlines are subject to limits on the duration that they may be exposed to untreated seawater as a result of a wet buckle. Flooding of the flowline with FIS to prevent corrosion must be completed within a specified period following unplanned raw seawater ingress.

During a dry buckle or other contingency remediation action that can only be repaired at the seabed, it will be necessary to flood the flowline with treated seawater to prevent corrosion. This may result in additional discharges of treated seawater, most likely near the seabed.

In the event flowline lay is to be temporarily abandoned (e.g. in the case of an emergency, such as an approaching cyclone), the flowline will be mechanically capped and laid on the seabed to await recovery and recommencement of the activity. Recovered flowlines may require additional flooding and cleaning.

During contingency activities, such as the repair of a flowline buckle or seized connection pins, there may be a need to cut structures in the marine environment to enact a repair. Cutting activities will be conducted with the most appropriate tool available and controlled via a ROV. Cutting activities may result in fine particles of the cut material similar to saw dust. Any materials generated during these activities may be released to sea in circumstances where it is not possible to collect and retain them. Materials disposed this way could include small fragments of metals, paints, plastic cladding or lining materials.

3.5 Subsea structures

3.5.1 Production and control system structures

Subsea structures in the new and existing gathering systems comprise a series of pipes, valves and controls, with each structure housed in a steel protective frame. Structure foundations are skirted mudmats to support the weight of the structures on the seabed. The foundations will be installed separately prior to structure installation or installed with the structure. The various subsea structures include:

- production riser base (PRB)
- production manifolds (PMs)
- subsea distribution hubs/units (SDHs/SDUs)
- flowline end terminations (FLETs)
- in-line tees (ILTs).

The structures are either laid with the flowline (e.g. FLETs and ILTs) or lowered using construction vessel cranes. For structures that are lifted off a vessel via a crane and lowered to their final positions on the seabed, ROVs will monitor and assist with the set-down. Hydraulic shackles may be used to release the structures from the lifting tackle and on each occasion, a small amount of hydraulic fluid will be released to sea.

Control system components will also be installed on subsea structures and will connect them with the various components.

Similar to flowlines, the structures are protected from external corrosion through a combination of high integrity coating and the installation of aluminium sacrificial anodes. The anodes are attached to the structure during fabrication.

3.5.2 Structural supports

Zero radius bend counteract piles (ZRBs) will be pre-installed along the production flowlines route to control flowline buckling that occurs via thermal expansion during shutdown and re-start cycles. ZRBs will consist of a vertical steel pile that penetrates to depth using a gravity-based clump weight - or as a contingency, the use of vibro-driving to drive in the piles. Either a steel or concrete mattress will be used for support. Preliminary estimates suggest that 20 ZRBs are needed per production flowline.

If required, it is anticipated that there may be around 75 piles in total. If required, the installation is expected to last for approximately 2 hours per pile, with breaks of approximately 6 hours between each installation, while the vessel moves to the next location. The installation depths may range from 9 - 11 m. Like the ZRB’s, piles may be installed for other structural foundations, such as the subsea heat exchanger that will be secured to the seabed using a single pile.

Vibro-driving is one of the most common pile driving methods where rotating eccentric weights create an alternating force on the pile, vibrating it into the ground (Government of South Australia, 2012). Vibro-driving is continuous in character and usually of a much lower level than impact piling (Government of South Australia, 2012). Sound generated from vibro-driving of piles is continuous in character and sound levels are typically much lower than impact driving sound levels. Most of the sound energy occurs between 100 Hz and 2kHz, with strong tones and associated harmonics potentially occurring with the driving frequency, typically ranging between 10 and 60 Hz (Government of South Australia 2012). Sound levels from vibro-driving operations vary depending upon the dimensions of the piles and the substrate into which they were driven. Source levels typically range from approximately 160 dB re 1µPa to a maximum of 180 dB re 1µPa at 10 m from the source for piles driven into gravel, sand and clay sediments (similar to the shallow sedimentary geology in WA-50-L) and for steel pipe piles with a significantly larger diameter than those proposed for the URF installation activities (Bueler et al. 2015; URS 2007; Warner 2014; David Evans and Associates 2011).

Each pile may be supplemented with a low friction concrete mattress to provide the flowline with a sliding surface and vertical imperfection to initiate the buckle. These mattresses will be installed using installation vessel crane and lowered into place using an ROV to monitor the descent and final placement.

Flowline walking mitigation structures will be used to provide support to flowlines, in the form of gravity structure holdback or concrete mattresses installed over the top of the production flowlines.

The GS4 MEG flowline will cross over existing production flowlines and umbilicals. The MEG flowline will be separated above the existing flowlines and umbilical by laying the pipeline over concrete or steel mattresses/supports. Installation will involve lowering the structures onto the seabed with support from an ROV

Freespan mitigation will be performed using an ROV-mounted jetting tool inserted into the seabed adjacent to the flowline. The jetting tool will enable the flowlines to self-bury thereby removing adjacent freespans.

Rectification of flowline spans and structure scour protection may use inflatable grout bags. The grout bags are made from heavy-duty polypropylene fabric that are inflated in-situ by the injection of a neat cement and seawater grout slurry. The slurry is mixed in tanks on the construction vessel and injected into the bags via a downline. Prior to recovering the downline back to the vessel, the line is flushed from the vessel to subsea by pumping seawater through the line.

3.5.3 Miscellaneous subsea structures

Spool support frames

Small support frames will be installed on the seabed to support the tie-in spools and/or allow crossing of the spools over flowlines.

Scour protection mattresses, grout bags and sand bags

Grout bags and sand bags will be used for various purposes including to fill uneven areas of the seabed, act as support to structures on the seabed, for stability, and as turning bollards if required.

Grout bags and scour protections mattresses, as required, will form part of the permanent URF infrastructure and will remain on the seabed.

Metocean wave rider buoy

A metocean wave rider buoy may be installed to assist with the safe installation by providing real-time wave and current information. The buoy will be located at the surface and will be connected by a chain/cable to a weight deployed on the seabed. This weight will be up to 2 m x 2 m in size. Up to 15 m of chain is also expected to be in contact with the seabed. The buoy may be re-positioned within WA-50-L several times and will be removed once URF activities are completed.

3.6 Tie-ins (spools and jumpers)

Tie-in spools are sections of flowline which connect between a flowline and a structure laid on the seabed. Jumpers connect wellheads with production manifolds. Tie-in spools will be supported above the seabed on pre-installed supports such as concrete mattresses or fabricated structures. Well jumpers are suspended above the seabed without seabed supports.

A subsea heat exchanger well jumper is required to cool the production fluid from one well at BDC-3. This well jumper contains additional piping coiled within a structure. The structure requires a pre-lay foundation which will be a fabricated mud mat or piled similar to the ZRB counteracts (see Section 3.5.2).

Tie-in spools and jumpers will either be filled with treated water, chemical stick, MEG/MEG gel or preservation fluid, either before load-out or immediately before subsea deployment. Chemical sticks are dissolvable PVA tubes (typically dissolve within 2 hours), filled with neat liquid chemical at manufacturers recommended dosage rate for the desired preservation/protection, which may be inserted into each structure, spool or any cavity that requires preservation and protection.

Manoeuvring of the spool or jumpers into position on structures will be achieved using a crane or winch systems on a vessel with ROV support.

All subsea connections will be performed by ROVs. When in position, the spools and jumpers will be tied in to the seabed structures. During tie-in operations, end caps will be removed, and it is expected that small volumes of preservative fluid will be lost/flushed from each of the spool and jumper ends as well as the manifolds into which they are being connected.

3.7 Umbilicals and flying leads

Umbilicals and flying leads form part of the control system and convey hydraulic production control system fluids and electrical signals between the CPF and the control structures within the seabed infrastructure. They are laid from reels and carousels and are pre-filled with preservation or hydraulic fluids before being placed on the seabed.

The three main types of flying leads are steel flying leads (STFLs), electrical flying leads (EFLs) and optical flying leads (OFLs).

Umbilical risers will be tied back to the CPF in a similar way to risers and laid away over the RSS. The connection of the umbilical and flying leads will be achieved by connecting into the required control structures with a multi-bore hub (MBH) operated by an ROV. A small amount of hydraulic fluid will be lost to sea during each connection.

3.8 Mechanical completion, pre-commissioning and commissioning

Once the URF infrastructure is installed, the structural integrity of the flowlines, spools, jumpers, risers and SPS equipment will be verified, and all lines will be prepared to ensure they are suitable for operations. The principal activities are:

- mechanical completion: This involves flooding, cleaning, gauging and hydrotesting (FCGT) and final system leak testing
- pre-commissioning: This involves dewatering and MEG/nitrogen first filling which leaves the infrastructure in a state ready for the start of commissioning or start-up
- commissioning: This involves final system verifications and safety testing and preparations, for commencement of hydrocarbon production.

These are described in further detail in the following sections.

3.8.1 Mechanical completion

Flooding, Cleaning, Gauging and Testing (FCGT)

The purpose of FCGT is to:

- to clean the flowlines/risers and remove any mobile debris generated during construction
- flood the flowlines/risers in readiness for hydrotesting
- to confirm the flowlines are free from dents and ovalisation
- confirm the mechanical integrity of flowline prior to lay vessel demobilisation.

For flooding the flowlines, seawater will be recovered from just below the surface and filtered to remove particles. Following filtration, the seawater will undergo treatment with a chemical combination consisting of the following:

- oxygen scavenger – to remove dissolved oxygen from the sea water
- biocide – to kill micro-organisms and bacteria
- fluorescein dye (up to 80 ppm) – to help detect subsea leaks.

Both oxygen scavenger and biocide act to inhibit corrosion of the flowlines and provide a period of preservation, subject to chemical dosage rates. Typical preservation is for 24 months at a dosage rate of 500 ppm. When mixed with seawater, the combined fluid is termed filtered inhibited seawater (FIS). The fluorescein dye aids in leak detection. A description of the chemical selection process is presented in Section 9.6.1.

During flooding, cleaning and gauging (FGC), each flowline is cleaned and filled with filtered and treated seawater using a process called ‘pigging’. Pipeline internal gauges (‘pigs’) are cylindrical plugs that are pushed along the inside of flowlines to remove any foreign objects and mobile debris that may have been introduced during fabrication and transport. Pigs are launched from a subsea structure called a pig launcher, which is temporarily fixed in position on one of the subsea structures (e.g. FLET). During the pigging process, pressurised FIS will be delivered to the pig launcher via a hose from the vessel. When the pigging is complete, the pigs are received in a pig receiver at the receiving end of the flowline and brought to the surface. The flooding medium is discharged to sea along with any mobile debris in the fluid. Gauge plates on the pigs will be inspected at this time to determine if any defects occurred during flowline laying activities.

The risers will initially be flooded with FIS followed by MEG injection so as to minimise chloride contamination of the lean duplex carcass material. Pigs are pushed from the subsea end and received on the CPF via temporary pig receivers. FIS preceding the pig will be discharged via a spare riser guide tube (or other means) below the sea surface.

Hydrotesting

Once FCG has been completed, the flowlines will be pressurised above the maximum defined working pressure for each system by further injection of FIS. The pressure will then be stabilised and monitored to verify flowline integrity.

Once verified, the pressure will be released by venting the injected FIS to sea. Depressurisation discharges of the risers will occur subsea, or in the case where discharges originate from the CPF, this will occur via a discharge pipe.

The integrated infield flowline systems will be sequentially leak tested to verify system integrity, including verifying connections. The connections within the newly connected system will be monitored for leaks using an ROV black light, which will screen for the fluorescein dye which has been added to the FIS.

Once leak testing has been completed, the flowlines will be left full of FIS until the pre-commissioning phase and risers will be left full of MEG.

Hydrotest contingency plan

In the event that leaks are detected, flowlines or structures may be brought to the surface for inspection and repair, or replacement subject to the identified cause for the leak.

3.8.2 Pre-commissioning

Pre-commissioning of the flowlines and risers will involve dewatering the lines and replacing the water with nitrogen gas or MEG to make them ready for transporting gas or MEG.

When each flowline/riser is dewatered, FIS will be discharged to sea either near the seabed or at the surface. Whereas the risers will discharge treated potable water or FIS at the CPF location, via a spare riser guide tube. When the pigs arrive at the pig receiver, small quantities of MEG may be discharged to sea.

3.8.3 Commissioning

Commissioning of the SPS and URF infrastructure consists of the final preparations performed on the well head Christmas trees, subsea structures and control system prior to the commencement of hydrocarbon production. The preparations include confirming the correct functionality of each element of equipment via dynamic verification (i.e. valve cycling and profiling and verifying sensor feedback).

The commissioning scope also includes the performance of defined operational tests, safety/shutdown tests and the introduction of in-service / ready for start-up fluids (where these were not previously completed during pre-commissioning).

3.9 Additional contingent activities

3.9.1 Marine growth removal

The mating faces of connections may require cleaning to remove calcium formed through biological fouling. Initially, physical removal with high pressure or cavitation jets may be used to remove as much marine growth or calcium deposits as possible. If physical removal is unsuccessful (i.e. due to access issues) weak acids such as acetic or sulfamic acid may be used to remove residual marine growth / calcium deposits. This will be achieved by putting a cap over the connection sealing surfaces and injecting a weak acid solution. After the acid has dissolved the calcium deposits, the cap will be removed, and the remaining acid and salts will be discharged to sea.

3.10 Vessels

URF and SPS installation activities will involve several vessels, including installation vessels, deep-water construction vessels, derrick lay vessels, construction support vessels, light construction vessels, support vessels, DP transport vessels, platform supply vessels, survey/metrology vessels, tugs, barges and Heavy Lift Vessels (HLVs). Vessels may arrive directly from international destinations and/or may transit to and from Australian ports.

The specific vessels to be used during the activities are yet to be confirmed. However, the fuel type used by vessels will be either marine diesel (Group II hydrocarbon) or intermediate fuel oil/heavy fuel oil (IFO/HFO; Group IV hydrocarbons).

Support vessels will be used to transport equipment, materials and fuel between vessels and the port of Broome or Darwin. Supply vessel runs will be required each week; however, these supply vessels in transit are outside the scope of this EP.

Aviation support will be based at Broome International Airport. Helicopters based in Broome will be used to transfer personnel to and from vessels. This may occurseveral times per week. The transfer frequency will vary depending on vessel manning, operational activities and the specification (capacity) of the helicopters contracted.

Vessels and helicopters may be refuelled in WA-50-L as operationally required.

3.11 Summary of emissions, discharges and wastes

A summary of emissions, discharges and wastes resulting from the URF and SPS installation activities, including indicative volumes and expected location (subsea/sea surface), are presented in Table 3-1. Generic vessel related emissions, discharges and wastes are described in Table 3-2.

Table 3-1: Emissions, discharges and wastes generated during the installation activity

Component	Discharge activity	Emissions, discharges and wastes	Maximum volumes (indicative only)	Expected discharge location
Production flowlines (two 16" diameter flowlines)	Flood, clean and gauge operations	FIS (includes fluorescein dye, max concentration of 80 ppm)	260 m^3 per flowline	Subsea
	Hydrotesting (depressurisation of individual flowlines)	FIS	180 m^3 per flowline	Subsea
	Tie-ins between flowlines and control structures	FIS	1 m^3 for each connection	Subsea
	Leak testing	FIS (includes fluorescein dye, max concentration of 80 ppm)	450 m^3 per flowline	Subsea
	Dewatering operations	FIS	4280 m^3 per flowline	Subsea
	Dewatering operations	Chemically treated potable water	300 m^3 per flowline	Subsea
	Dewatering operations	MEG	100 m^3 per flowline	Subsea
	In the event of repair work	MEG	200 m^3	Subsea
MEG flowline (one 8" diameter line)	Flood, clean and gauge operations	FIS	30 m^3	Subsea
	Hydrotesting (depressurisation)	FIS	180 m^3 per flowline	Subsea
	Tie-ins between flowline and control structures	MEG	10 m^3	Subsea
	Tie-ins between flowline and control structures	MEG	10 m^3	Subsea

Component	Discharge activity	Emissions, discharges and wastes	Maximum volumes (indicative only)	Expected discharge location
	Tie-ins between flowline and control structures	MEG	10 m^3	Subsea
	Leak testing	FIS (includes fluorescein dye, max concentration of 80 ppm)	30 m^3	Subsea
	Dewatering operations	FIS	520 m^3	Subsea
	Dewatering operations	MEG	10 m^3	Subsea
Production Risers	Flood operations	Treated potable water	260 m^3 per riser	CPF
	Leak testing	MEG	15 m^3 per riser	Subsea
	Tie-ins between riser and structures	MEG	0.5 m^3 per connection	Subsea
	Dewatering operations	MEG	10 m^3 per riser	CPF
	In the event of repair work	MEG	100 m^3 per riser	Sea surface
Flushing spools with five times the volume of FIS	Spool flushing	FIS	90m^3 for each spool	Subsea
Well Jumper	Dewatering operations	MEG	5 m^3 per well jumper	Subsea
	Commissioning	MEG	10 m^3 per well jumper	Subsea
Umbilicals	Marine growth cleaning	Marine growth chemicals	5 L used on up to 24 individual applications.	Subsea
Flow-control module	Installation	Release of MEG, potentially containing trace hydrocarbons	2250 L per activity	Subsea
Damaged ILT and adjacent flowline	In the event of repair work	FIS Potable water	6.5 m^3 90 m^3	Subsea

Component	**Discharge activity**	**Emissions, discharges and wastes**	**Maximum volumes (indicative only)**	**Expected discharge location**
FCGT spread	Flood, Clean and Gauge operations	Waste treated seawater	10 L	Surface
Retrieval of downlines used to flood and pressurise the flowlines	Leak testing	FIS	10 m^3	Subsea and sea surface
Connection of MBH with the SDH, and other incidental loss of hydraulic media during installation of infrastructure	Preservation fluid bypasses poppets	Hydraulic media - similar to MacDermid HW740R (100L) 50% MEG / 50% water (100 L)	200 L per connection/disconnection (total of ~15), resulting in a total loss of approx. 3,000 L or 3 m^3	Subsea and surface
Unplanned events – wet buckle	Flooding flowline with FIS to prevent corrosion	FIS	30 m^3 (assumed slug before 1st pig) rest of FIS will stay in flowline until FCGT	Subsea
Unplanned events – stuck pig, failed gauge run, or issue with flowline cleanliness	Re-run of FCG for production flowlines	FIS (includes fluorescein dye, max concentration of 80 ppm)	260 m^3 per flowline	Subsea
	Re-run of FCG for MEG flowline	FIS (includes fluorescein dye, max concentration of 80 ppm)	30 m^3	Subsea
Detachment of pressurisation hoses	Unplanned event	FIS	2 m^3	Subsea and sea surface
Chemical sticks	To treat seawater that may ingress into flowlines and subsea structures during remedial works or when tying into subsea structures and when flooding with treated seawater	FIS (similar to Aquasweep)	383 mL per stick. A max of two sticks will be used in any one deployment.	Subsea

Component	Discharge activity	Emissions, discharges and wastes	Maximum volumes (indicative only)	Expected discharge location
Scour protection is not planned to be grouted – but it may be used as a contingency	If freespan is not successful, grouting (as per Phase 1) will be used	Grout	100 m^3	Subsea and sea surface
Use of grout bags	Overspill during filling of grout bags	Grout	Grout bags will range in size, up to 20 m^3. Minor spills may occur (less than 0.5 m^3) during filling of each bag.	Subsea and sea surface
Installation of the large subsea structures	Released from large subsea structures	Hydraulic media – MacDermid Oceanic HW540 or similar water/MEG mix	Up to 350 L of hydraulic media (McDermid Oceanic HW540 or similar water/MEG mix). This will be controlled by ROV via a one-way hydraulic system and when actuated.	Subsea
	Released from the installation shackles during the installation subsea structures such as PRBs and MEG manifolds	Hydraulic media	200 L	Subsea
Installation aids that may be left behind (i.e. cable ties, sacrificial slings, rigging etc.)	Discarded material	Plastic, fabric	Approximately 3 m^3	Subsea
Contingency activities – cutting of a flowline	Released when cutting a flowline in the event of a flowline buckle or seized connection pin	CRA liner Steel Plastic coating	1.0 kg 3.0 kg 1.0 kg	Subsea
	Unplanned event - Discarded material during contingency activities	Metals, paints, plastic cladding or lining materials	25 kg	Subsea

Component	Discharge activity	Emissions, discharges and wastes	Maximum volumes (indicative only)	Expected discharge location
Grease and wax	Incidental smearing of grease and wax found on infrastructure being installed (i.e. control structures)	Grease and wax	10 kg	Subsea and sea surface
Spill from bulk transfer of non-hydrocarbon fluid	Released from IBC during bulk transfer	MEG, FIS	24 m^3	Sea surface
IMR - marine growth removal	Released during cleaning	Acetic or sulfamic acid	<1 m^3 per activity	Subsea

Table 3-2: Generic vessel associated emissions (E), discharges (D) and wastes (W) generated during the activity

Source	E, D, W	Description
Power generation	E	Combustion gas emissions from diesel-powered engines are emitted to the atmosphere via an exhaust stack.
	E	Acoustic emissions from vessel engines and propulsion systems (such as DP thrusters).
Survey vessel and equipment	E	Acoustic emissions from survey vessel engines and equipment
Seawater cooling	D	Seawater used as heat-exchange medium for machinery engines. Return seawater containing residual heat and residual sodium hypochlorite is returned to sea.
Vessel deck drainage	D	Vessel deck drainage water may be discharged to sea.
Bilge system	D	Treated contaminated bilge water with <15 ppm (v) oil-in-water (OIW) is discharged to sea.
Sewage, grey water and macerated food waste effluent	D	Treated effluent produced by vessel sewage treatment plants and macerated food waste is discharged to sea.
Ballast system	D	Return ballast from vessels is discharged to sea.
Foam fire-extinguishing	D	Firefighting foam is routed to the open-drains/ deck drainage system and may be released to sea in the event of system deployment. Minor quantities of wind-blown foam may also be released. (Note no planned discharges from system testing will occur during the activity)
Deck wash	D	Deck wash used to clean vessel decks is discharged to sea.
Desalination brine	D	Brine produced from the Reverse Osmosis (RO) process will be diluted and discharged to sea.
Fresh/potable water	D	Saline reject-water stream will be discharged to sea.

Waste incineration	E	Combustion gas emissions from on board incineration of permitted wastes.
	W	Ash from incinerators will be stored as waste for disposal on the mainland.
ROV operations	D	Routine subsea discharges of water-based hydraulic fluids and subsea control fluids (< 1 m^3).
Sundries / miscellaneous	E	Combustion gas emissions from diesel-powered equipment engines (e.g. crane engines, temporary generators).
	E	Light emissions from deck and navigation lights on facility topsides and vessels.
	W	Solid and liquid wastes from general maintenance operations, equipment replacement, etc., and domestic wastes are transported to the mainland for disposal.

4 EXISTING ENVIRONMENT

4.1 Regional setting

Production licence area, WA-50-L is situated in the northern Browse Basin, approximately 390 km north of Derby, Western Australia. In the event of a worst-case unplanned oil spill, the area potentially exposed to hydrocarbons, hereafter referred to as the potential exposure zone (PEZ), covers a considerably larger area than the licence area where planned activities will occur.

The spatial extent of the PEZ was determined from stochastic spill modelling using the low hydrocarbon exposure thresholds described in NOPSEMA Bulletin #1 (NOPSEMA 2019a). This considered the worst-case credible hydrocarbon scenarios identified for the activity (refer Section 7.7, Table 7-15) for surface hydrocarbons, shoreline accumulations of oil, and entrained oil and dissolved aromatic hydrocarbons in the water column. The PEZ has been used to identify relevant values and sensitivities that may be affected and has been used as the basis for the EPBC Protected Matters Database search (Appendix B).

The low thresholds that have been used to inform the extent of the PEZ are useful for oil spill response planning and scientific monitoring (water quality) purposes but may not be ecologically significant (NOPSEMA 2019a). Therefore, in addition to the PEZ, an environment that may be affected (EMBA) has also been established from stochastic spill modelling using hydrocarbon exposure thresholds identified as having the potential to cause impacts to receptors such as fauna and habitats (refer Section 8, Table 8-2).

The resulting PEZ and EMBA from the oil spill modelling are the sum of overlaid stochastic modelling runs for worst-case spill scenarios, during all seasons (wet, transitional and dry) and under different hydrodynamic conditions (e.g. currents, winds, tides, etc.). As such, the actual area that may be affected from any single spill event would be considerably smaller than represented by the PEZ or EMBA. The PEZ and EMBA are both geographically represented in the figures throughout this section of the EP.

4.1.1 Australian waters

Australia's offshore waters have been divided into six marine regions in order to facilitate their management by the Australian Government under the EPBC Act. The production licence area is located entirely within the North-west Marine Region (NWMR). The PEZ intersects with the NWMR and the North Marine Region (NMR). The relevant key features of the NWMR and NMR in the context of WA-50-L and PEZ are further described in subsequent sections of this EP.

North-west Marine Region

The NWMR comprises Commonwealth waters, from the WA–NT border in the north, to Kalbarri in the south. The NWMR encompasses a number of regionally important marine communities and habitats which support a high biodiversity of marine life and feeding and breeding aggregations (DSEWPaC 2012a).

North Marine Region

The NMR comprises Commonwealth waters from the WA–NT border to West Cape York Peninsula. This region is highly influenced by tidal flows and less by ocean currents. The marine environment of the NMR is known for its high diversity of tropical species but relatively low endemism, in contrast to other bioregions (DSEWPaC 2012b).

4.1.2 International waters

The PEZ extends into the international waters of the Savu Sea and locations along the Indonesian shoreline including Sumba, Sawu and Rote Islands. The Indonesian archipelago lies between the Pacific and Indian oceans and bridges the continents of Asia and Australia and comprises of over 17,000 islands (Huffard et al. 2012). The archipelago is divided into several shallow shelves and deep-sea basins (ABD 2014). Indonesian waters, especially the eastern part of the archipelago, play an important role in the global water mass transport system, in which warm water at the surface conveys heat to deeper cold waters. The water mass transport from the Pacific to the Indian Ocean through various channels in Indonesia is known as the Indonesian Throughflow (described in Section 4.7.2).

The Lesser Sunda Ecoregion, located at the southern end of the Coral Triangle, encompasses the chain of islands and surrounding waters from Bali, Indonesia to Timor-Leste including East Nusa Tenggara (Indonesia's southernmost province). This region contains suitable habitat for corals and is considered important for coral endemism, particularly the areas of Bali-Lombok, Komodo and East Flores. The Indonesian coastline is rich in tropical marine ecosystems such as sandy beaches, mangroves, coral reefs and seagrasses (Hutomo & Moosa 2005). The majority of the West Timor coastline features a narrow fringing coral reef community with four dense areas of mangrove communities occurring primarily along the south coast (Allen & Erdmann 2013). The Timor-Leste coastline also features mangrove communities surrounding entrances to rivers primarily on the south coast, whilst the north and eastern coasts comprise a higher degree of coral reef communities (Allen & Erdmann 2013).

4.2 Key ecological features

The Australian Government has identified parts of the marine ecosystem that are of importance for a marine region's biodiversity or ecosystem function and integrity, referred to as key ecological features (KEFs). The north-western corner of WA-50-L overlaps one KEF, and a further 10 are located within the PEZ (Figure 4-2) as follows:

WA-50-L:

- Continental slope demersal fish communities

PEZ:

- Ancient coastline at 125 m depth contour
- Ashmore Reef and Cartier Island and surrounding Commonwealth waters
- Canyons linking the Argo Abyssal Plain with Scott Plateau
- Carbonate bank and terrace system of the Sahul Shelf
- Mermaid Reef and Commonwealth waters surrounding the Rowley Shoals
- Pinnacles of the Bonaparte Basin
- Seringapatam Reef and Commonwealth waters in the Scott Reef complex
- Carbonate bank and terrace system of the Van Diemen Rise
- Shelf break and slope of the Arafura Shelf
- Tributary Canyons of the Arafura Depression.

4.2.1 Continental slope demersal fish communities

The north-western corner of WA-50-L overlaps a small portion of the continental slope demersal fish community KEF. The level of endemism of demersal fish species in this community is the highest among Australian continental slope environments.

The demersal fish species occupy two distinct demersal community types associated with the upper slope (water depth of 225–500 m) and the mid-slope (750–1,000 m) (DEE 2020a). Although poorly studied, it is suggested that the demersal-slope communities rely on bacteria and detritus-based systems comprised of infauna and epifauna, which in turn become prey for a range of teleost fish, molluscs and crustaceans (Brewer et al. 2007). Higher-order consumers may include carnivorous fish, deepwater sharks, large squid and toothed whales (Brewer et al. 2007). Pelagic production is phytoplankton based, with hot spots around oceanic reefs and islands (Brewer et al 2007).

Bacteria and fauna present on the continental slope are the basis of the food web for demersal fish and higher-order consumers in this system. Therefore, loss of benthic habitat along the continental slope at depths known to support demersal fish communities could lead to a decline in species richness, diversity and endemism associated with this feature (DSEWPaC 2012a). Other potential concerns with regard to pressure on this KEF include climate change (increasing sea temperature/ocean acidification), habitat modification due to fishing gear and commercial fishing by-catch resulting in the potential to diminish the species richness and diversity of these communities (DEE 2020a).

4.2.2 Ancient coastline at 125 m depth contour

The ancient coastline at 125 m depth contour KEF runs diagonally in a north-easterly direction, approximately 20 km south of WA-50-L, at its closest point. Parts of the ancient coastline, particularly where it exists as a rocky escarpment, are thought to provide biologically important habitats in areas otherwise dominated by soft sediments. The topographic complexity of the escarpments may facilitate vertical mixing of the water column, providing relatively nutrient-rich local environments. The ancient coastline is an area of enhanced productivity, attracting baitfish which, in turn, supplies food for migrating species (DSEWPaC 2012a).

While there is little information available on the fauna associated with the hard substrate of the escarpment, it is likely to include sponges, corals, crinoids, molluscs, echinoderms and other benthic invertebrates representative of hard substrate fauna in the NWMR (DSEWPaC 2012a).

4.2.3 Ashmore Reef and Cartier Island and surrounding Commonwealth waters

The Ashmore Reef and Cartier Island and surrounding Commonwealth waters KEF is located approximately 132 km north of WA-50-L, at its closest point. The KEF is recognised for its ecological functioning and integrity (high productivity), and biodiversity (aggregations of marine life) values, which apply to both the benthic and pelagic habitats within the feature.

Ashmore Reef is the largest of only three emergent oceanic reefs in the north-eastern Indian Ocean and is the only oceanic reef in the region with vegetated islands. The waters surrounding Ashmore Reef and Cartier Island are important because they are areas of enhanced productivity in relatively unproductive waters (DSEWPaC 2012a).

Further details regarding this KEF are provided in Section 4.3 which describes Australian marine parks.

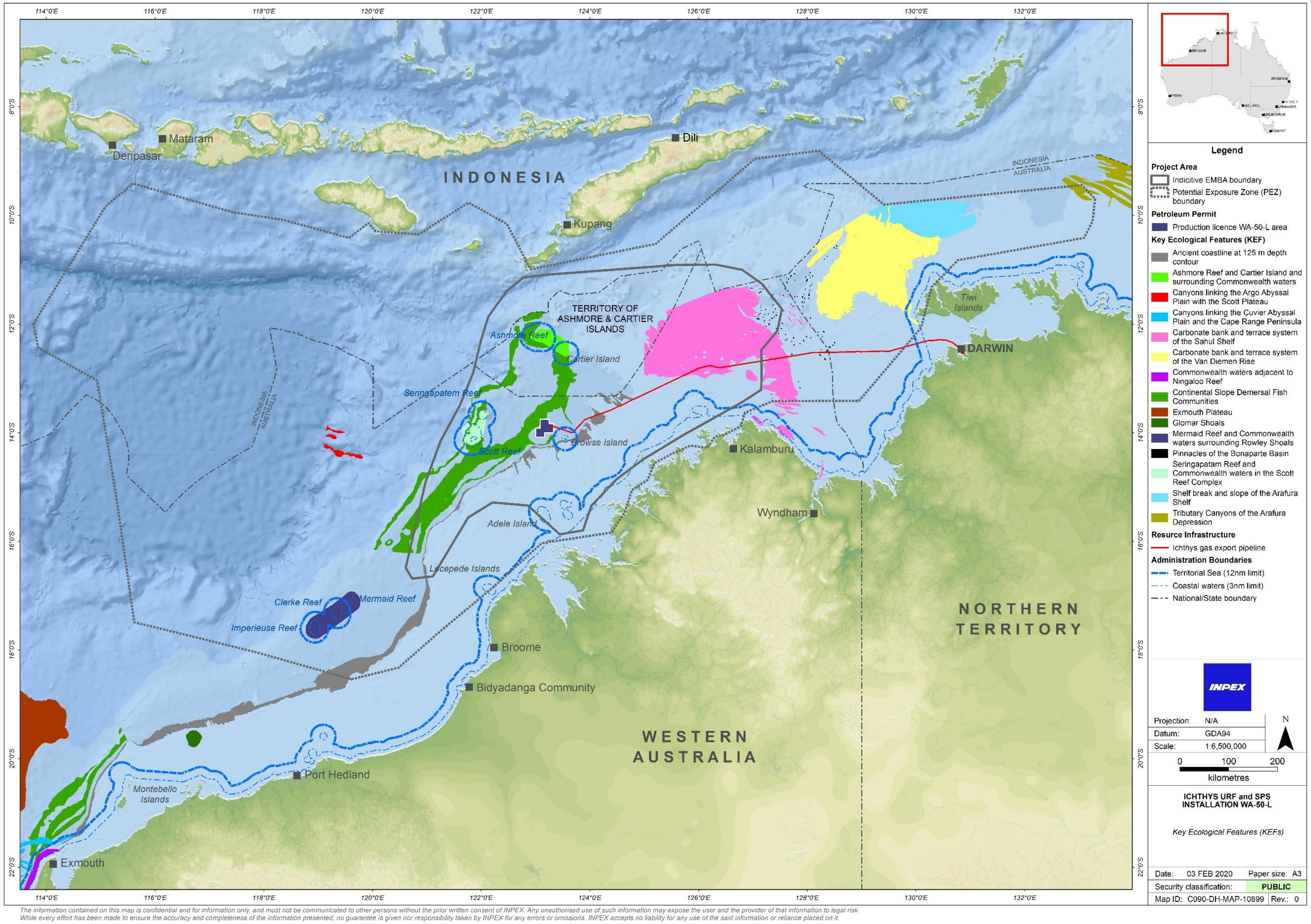

Figure 4-1: Key ecological features in north-west Australia (showing PEZ and EMBA)

4.2.4 Canyons linking the Argo Abyssal Plain with the Scott Plateau

The canyons linking the Argo Abyssal Plain with the Scott Plateau KEF is located approximately 345 km west of WA-50-L, at its closest point. The Bowers and Oats canyons are major canyons on the slope between the Argo Abyssal Plain and Scott Plateau. The canyons cut deeply into the south-west margin of the Scott Plateau at a depth of approximately 2,000–3,000 m, and act as conduits for transport of sediments to depths of more than 5,500 m on the Argo Abyssal Plain. Benthic communities at these depths are likely to be dependent on particulate matter falling from the pelagic zone to the seafloor. The ocean above the canyons may be an area of moderately enhanced productivity, attracting aggregations of fish and higher order consumers, such as large predatory fish, sharks, toothed whales and dolphins. The canyons linking the Argo Abyssal Plain and Scott Plateau are likely to be important features due to their historical association with sperm whale aggregations (DSEWPaC 2012a).

4.2.5 Carbonate Bank and Terrace System of the Sahul Shelf

The carbonate bank and terrace system of the Sahul Shelf KEF is located in the western Joseph Bonaparte Gulf, approximately 207 km north-east of WA-50-L, at its closest point. The KEF is recognised for its biodiversity values (a unique seafloor feature with ecological properties of regional significance), which apply to both its benthic and pelagic habitats. The banks consist of a hard substrate with flat tops. 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 (DSEWPaC 2012a).

Although little is known about the bank and terrace system of the Sahul Shelf, it is considered to be regionally important due to its continuous and large expanse, as well as the ecological role it is likely to play in the biodiversity and productivity of the Sahul Shelf (DSEWPaC 2012a). The banks support a high diversity of organisms, including reef fish, sponges, soft and hard corals, gorgonians, bryozoans, ascidians and other sessile filter-feeders (Brewer et al. 2007). They are foraging areas for loggerhead, olive ridley and flatback turtles. Humpback whales and green and freshwater sawfish are also likely to occur in the KEF (Donovan et al. 2008). However, due to their ecology, sawfish (generally estuarine rather than open-ocean species), are not expected to be present within open-ocean environments.

4.2.6 Mermaid Reef and Commonwealth waters surrounding Rowley Shoals

The Mermaid Reef and the Commonwealth waters surrounding Rowley Shoals KEF is located approximately 476 km south-west of WA-50-L, at its closest point. The Rowley Shoals are a collection of three atoll reefs, Clerke, Imperieuse and Mermaid, which are located approximately 300 km north-west of Broome. The KEF is regionally important in supporting high species richness, higher productivity and aggregations of marine life associated with the adjoining reefs themselves (Done et al. 1994; DSEWPaC 2012a).

The reefs provide a distinctive biophysical environment in the region as there are few offshore reefs in the north-west. They have steep and distinct reef slopes and associated fish communities. Enhanced productivity contributes to species richness due to the mixing and resuspension of nutrients from water depths of 500-700 m into the photic zone (DSEWPaC 2012a). In evolutionary terms, the reefs may play a role in supplying coral and fish larvae to reefs further south via the southward flowing Indonesian Throughflow. Both coral communities and fish assemblages differ from similar habitats in eastern Australia (Done et al. 1994).

4.2.7 Pinnacles of the Bonaparte Basin

The Pinnacles of the Bonaparte Basin KEF is located approximately 457 km east of WA-50-L, at its closest point. This KEF consists of an area containing limestone pinnacles, up to 50 m high (above the surrounding seabed) and is located in the western Joseph Bonaparte Gulf on the mid-to-outer edge of the shelf (DSEWPaC 2012a & 2012b). They represent 61% of the limestone pinnacles in the NWMR and 8% of limestone pinnacles in the Australian EEZ (Baker et al. 2008).

The pinnacles of the Bonaparte Basin are thought to be the eroded remnants of underlying strata. It is likely that the vertical walls generate local upwelling of nutrient-rich water, leading to phytoplankton productivity that attracts aggregations of planktivorous and predatory fish, seabirds and foraging turtles (DSEWPaC 2012b).

As the pinnacles provide areas of hard substrate in an otherwise relatively featureless, soft sediment environment they are presumed to support a high number of species. Associated communities are thought to include sessile benthic invertebrates including hard and soft corals and sponges, and aggregations of demersal fish species such as snapper, emperor and grouper (Brewer et al. 2007). The pinnacles are thought to be a feeding area for flatback, loggerhead and olive ridley turtles, while green turtles may traverse the area. Humpback whales and green sawfish are also likely to occur in the KEF (Donovan et al. 2008). However, due to their ecology, sawfish (generally estuarine rather than open-ocean species) are not expected to be present within open-ocean environments.

4.2.8 Seringapatam Reef and Commonwealth waters in the Scott Reef Complex

The Seringapatam Reef and Commonwealth waters in the Scott Reef Complex KEF is located approximately 101 km west of WA-50-L, at its closest point. This KEF comprises Seringapatam Reef, Scott Reef North and Scott Reef South. Scott and Seringapatam reefs are part of a series of submerged reef platforms that rise steeply from the seafloor. The total area of this KEF is approximately 2,400 km^2 (DSEWPaC 2012a).

Seringapatam Reef is a small circular-shaped reef, the narrow rim of which encloses a relatively deep lagoon. Much of the reef becomes exposed at low tide. There are large boulders around its edges, with a few sandbanks, which rise about 1.8 m above the water, on the west side. The reef covers an area of 55 km^2 (including the central lagoon). Scott Reef North is a large circular-shaped reef composed of a narrow crest, backed by broad reef flats, and a deep central lagoon that is connected to the open sea by two channels. The reef and its lagoon cover an area of 106 km^2. Scott Reef South is a large crescent-shaped formation with a double reef crest. The reef and its lagoon cover an area of 144 km^2.

Scott and Seringapatam reefs are regionally significant because of their high representation of species not found in coastal waters off WA, and for the unusual nature of their fauna which has affinities with the oceanic reef habitats of the Indo-West Pacific, as well as the reefs of the Indonesian region.

The coral communities at Scott and Seringapatam reefs play a key role in maintaining the species richness and subsequent aggregations of marine life identified as conservation values for this KEF. Scott Reef is a particularly biologically diverse system and includes more than 300 species of reef-building corals, approximately 400 mollusc species, 118 crustacean species, 117 echinoderm species, and around 720 fish species (Woodside 2009).

Scott and Seringapatam reefs, and the waters surrounding them, attract aggregations of marine life, including humpback whales and other cetacean species, whale sharks and sea snakes (Donovan et al. 2008; Jenner et al. 2008; Woodside 2009). Two species of marine turtle, the green and hawksbill, nest during the summer months on Sandy Islet (a small sand cay), located on Scott Reef South. These species also internest and forage in the surrounding waters (Guinea 2006). The reef also provides foraging areas for seabird species, such as the lesser frigatebird, wedge-tailed shearwater, brown booby and roseate tern (Donovan et al. 2008).

4.2.9 Carbonate bank and terrace system of the Van Diemen Rise

The carbonate bank and terrace system of the Van Diemen Rise KEF is located approximately 580 km north-east from WA-50-L at its closest point, and to the north-west of the Tiwi Islands (the two principal islands of which are Melville Island and Bathurst Island).

This KEF supports a complex system of shallow carbonate banks and shoals over a limestone terrace, strongly dissected by tidal channels and paleo-river channels (including the >150 m deep Malita Shelf Valley). Shallow, clear waters provide for a deep euphotic zone, the depth to which sufficient light for photosynthesis penetrates into the ocean. Therefore, enhanced benthic primary production and localised upwellings generated by interactions between the complex topography and tidal currents encourage phytoplankton productivity and aggregations of fish. The banks, shoals and channels offer a heterogeneous environment of shallow to deep reef, canyon, soft sediment and pelagic habitats to a diverse range of tropical species of predominantly Western Australian affinities (DSEWPaC 2012b).

4.2.10 Shelf break and slope of the Arafura Shelf

The shelf break and slope of the Arafura Shelf KEF is located approximately 700 km north-east of WA-50-L, at its closest point. The Arafura Shelf is an area of continental shelf up to 350 km wide and mostly 50–80 m deep, comprising of sea-floor features such as canyons, terraces, the Arafura Sill and the Arafura Depression.

The shelf break and slope of the Arafura Shelf is characterised by continental slope and patch reefs, and hard substrate pinnacles (DSEWPaC 2012b). The ecosystem processes of the feature are largely unknown in the region; however, the Indonesian Throughflow and surface wind-driven circulation are likely to influence nutrients, pelagic dispersal and species and biological productivity in the region. Biota associated with the feature is typical of that found elsewhere in tropical waters around Northern Australia, Indonesia, Timor-Leste and Malaysia (DSEWPaC 2012b).

4.2.11 Tributary canyons of the Arafura Depression

The tributary canyons of the Arafura depression KEF is located approximately 1,050 km north-east of WA-50-L, at its closest point. The KEF comprises of a series of shallow canyons approximately 80–100 m deep and 20 km wide that lead into the Arafura Depression, which consists mainly of calcium carbonate–based sediments e.g. carbonate sand and subfossil shell fragments (DSEWPaC 2012b).

The largest of the canyons extend some 400 km from Cape Wessel into the Arafura Depression, and are the remnants of a drowned river system that existed during the Pleistocene era. Sediments in this feature are mainly calcium-carbonate rich, although sediment type varies from sandy substrate to soft muddy sediments and hard, rocky substrate. Marine turtles, deep sea sponges, barnacles and stalked crinoids have all been identified in the area (DSEWPaC 2012b).

4.3 Australian marine parks

Australian Marine Parks (AMPs) have been established around Australia as part of the National Representative System of Marine Protected Areas (NRSMPA). The primary goal of the NRSMPA is to establish and effectively manage a comprehensive, adequate and representative system of marine reserves to contribute to the long-term conservation of marine ecosystems and protect marine biodiversity.

AMPs under the EPBC Act, and any zones within them, must be assigned to an IUCN Category (Environment Australia 2002). The IUCN categories that are present within the AMPs intersected by the PEZ, as shown in Table 4-1, include:

- IUCN Category Ia – Strict nature reserve – Protected area managed mainly for science
- IUCN Category II – National Park – Protected area managed mainly for ecosystem conservation and recreation
- IUCN Category IV – Habitat/species management area – Protected area managed mainly for conservation through management intervention
- IUCN Category VI – Managed resources protected areas – Protected area managed mainly for the sustainable use of natural ecosystems. Area containing predominantly unmodified natural systems, managed to ensure long term protection and maintenance of biological diversity, while providing at the same time a sustainable flow of natural products and services to meet community needs.

The Director of National Parks may make, amend and revoke prohibitions, restrictions and determinations under regulations 12.23, 12.23A, 12.26, 12.56 and 12.58 of the EPBC Regulations where it is considered necessary to:

- protect and conserve biodiversity and other natural, cultural and heritage values; or
- to ensure human safety or visitor amenity; or
- where it is otherwise necessary to give effect to the management plan.

At commencement of the North-west Marine Parks Network Management Plan (Director of National Parks 2018) prohibitions made under regulation 12.23 of the EPBC Regulations are in place prohibiting entry to Ashmore Reef Marine Park, other than parts of West Lagoon and West Island, to protect the fragile habitats and biodiversity, and to Cartier Island Marine Park due to the presence of unexploded ordnance. These have been in place for many years.

All visitors to Ashmore Reef and Cartier Island (except recreational boat users accessing the Marine National Park Zone of Ashmore Reef) require approval from the Commonwealth Department of Agriculture, Water and the Environment (formerly the DEE). Undertaking other activities in these AMPs may also require approval from the Director of National Parks under Part 13 of the EPBC Act.

The Commonwealth Director of National Parks has issued a general approval under Section 359B of the EPBC Act allowing a range of activities to occur within these AMPs. The activities approved including 'mining operations' which, as defined under the EPBC Act, also includes all petroleum activities, including associated emergency response activities. No other approvals relating to this activity are required from the Director of National Parks.

Actions to respond to oil pollution incidents (including environmental monitoring and remediation) in AMPs, can be undertaken without an authorisation issued by the DNP, provided that the actions are undertaken in accordance with an EP that has been accepted by NOPSEMA. However, the DNP is to be notified of the pollution event or proposed spill response actions within AMPs prior to the activity being undertaken where practicable. WA-50-L does not overlap any AMPs (Figure 4-2). The AMPs that overlap the PEZ and their IUCN categories are outlined in Table 4-1 with a further description provided in subsequent sections.

Table 4-1: AMP and IUCN categories

AMP	Sanctuary Zone (IUCN Ia)	(Marine) National Park Zone (IUCN II)	Habitat Protection Zone (IUCN IV)	Recreational Zone (IUCN IV)	Multiple Use Zone (IUCN VI)	Special Purpose Zone (IUCN VI)	Special Purpose Zone (Trawl) (IUCN VI)
Arafura					X		
Argo-Rowley Terrace		X			X		X
Ashmore Reef	X			X			
Cartier Island	X						
Kimberley		X	X		X		
Mermaid Reef		X					
Oceanic Shoals		X	X		X		X

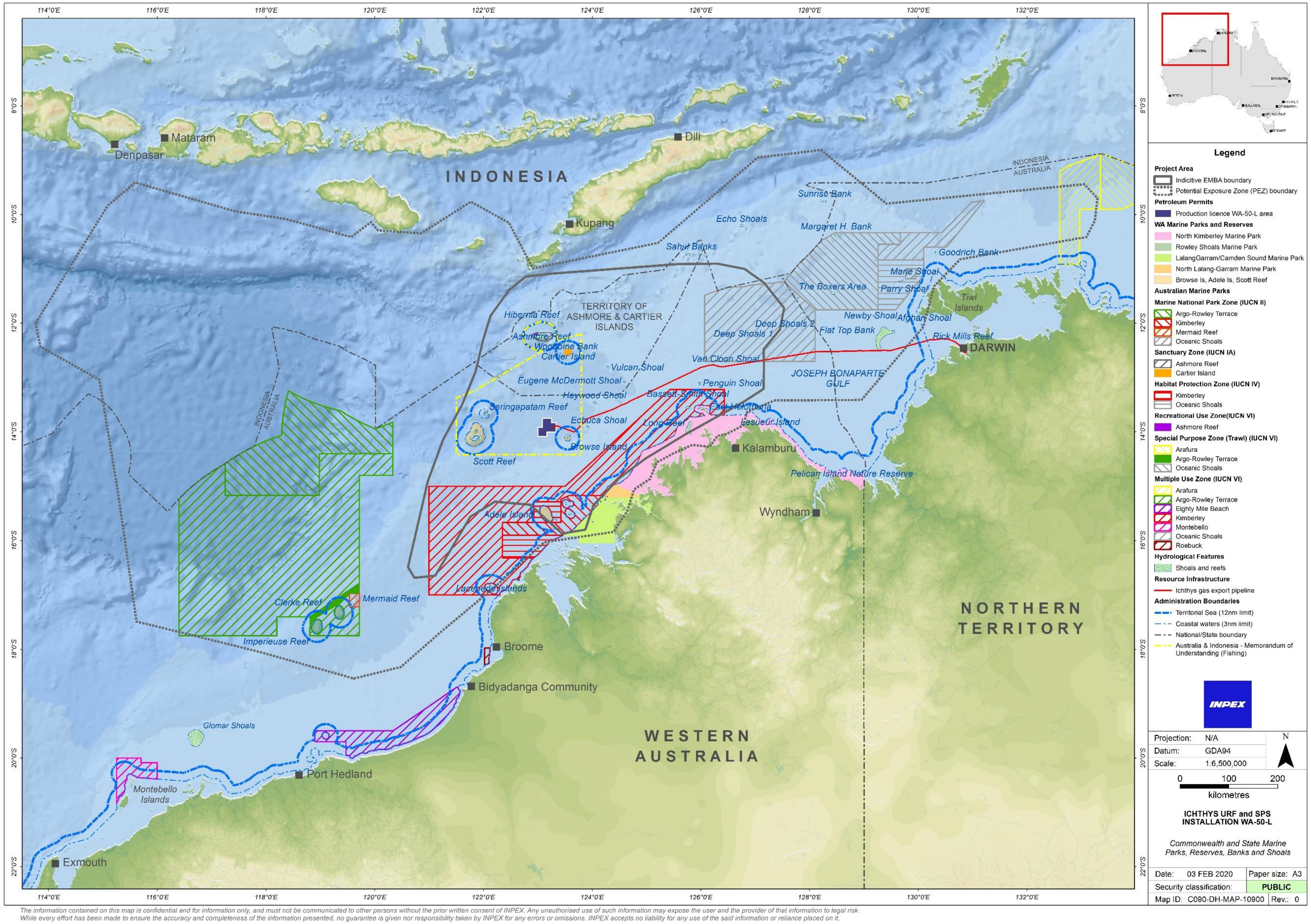

Figure 4-2: Australian and state marine parks, reserves, banks and shoals

4.3.1 Arafura MP

The Arafura MP in the NMR is Australia's most northerly marine park and covers an area of approximately 23,000 km^2 (Parks Australia 2020a). The boundary of Arafura MP borders Australia's EEZ and is located approximately 950 km from WA-50-L. The Arafura MP includes canyons that are remnants of an ancient drowned river system (the tributary canyons of the Arafura Depression). The canyons funnel deep, nutrient-rich ocean waters upward, boosting marine life in the MP (Director of National Parks 2018b).

Marine life found in the MP includes Spanish mackerel, whale sharks, sawfishes as well as marine turtles and deep-sea sponges (Parks Australia 2020a).

4.3.2 Argo-Rowley Terrace MP

The Argo-Rowley Terrace MP covers an area of approximately 146,000 km^2 and is the largest AMP in the north-west (Parks Australia 2020b). Its eastern boundary is approximately 300 km from WA-50-L.

The reserve is an important area for sharks, which are found in abundance around the Rowley Shoals, and provides important foraging areas for migratory seabirds and the endangered loggerhead turtle (Director of National Parks 2018a).

4.3.3 Ashmore Reef MP

Ashmore Reef MP is in the NWMR and is located 156 km north WA-50-L. It covers an area of 583 km^2 and the site is also a designated "wetland of international importance" under the Convention on Wetlands of International Importance (Ramsar Convention) especially as Waterfowl Habitat (Parks Australia 2020c) (refer Section 4.6.1).

Ashmore Reef is an atoll-like structure with low, vegetated islands, sand banks, lagoon areas, and surrounding reef. It is the largest of only three emergent oceanic reefs present in the north-eastern Indian Ocean and is the only oceanic reef in the region with vegetated islands. The reef exhibits a higher diversity of marine habitats compared with other North West Shelf (NWS) reefs, and supports an exceptionally diverse fauna, particularly for corals and molluscs (Director of National Parks 2018a).

The reef and its surrounding Commonwealth waters are regionally important for feeding and breeding aggregations of birds. It has major significance as a staging point for wading birds migrating between Australia and the northern hemisphere, including 43 species listed on one or both of the China–Australia Migratory Bird Agreement (CAMBA) and the Japan–Australia Migratory Bird Agreement (JAMBA).

Ashmore Reef supports some of the most important seabird rookeries on the NWS, including colonies of bridled terns, common noddies, brown boobies, eastern reef egrets, frigatebirds, tropicbirds, red-footed boobies, roseate terns, crested terns and lesser crested terns. It provides important staging points/feeding areas for many migratory seabirds (Parks Australia 2020c; Director of National Parks 2018a).

4.3.4 Cartier Island MP

Cartier Island MP is located in the NWMR approximately 132 km north of WA-50-L and covers an area of 172 km^2 (Parks Australia 2020d). The reserve includes Cartier Island and the area within a 4-nautical-mile-radius of the centre of the island, to a depth of 1 km below the seafloor. It is an IUCN Category Ia Sanctuary Zone with water depths from less than 15 m to 500 m (Director of National Parks 2018a).

Cartier Island is an unvegetated sandy cay surrounded by a reef platform. The island and its surrounding waters support prolific seabird rookeries, many species of which are migratory and have their main breeding sites on the small isolated islands. Seabirds at Cartier Island include colonies of bridled terns, common noddies, brown boobies, eastern reef egrets, frigatebirds, tropicbirds, red-footed boobies, roseate terns, crested terns and lesser crested terns (Parks Australia 2020d). Much like Ashmore Reef, Cartier Island is an important staging point/feeding area for many migratory seabirds. The island also supports significant populations of feeding and nesting marine turtles and a high abundance and diversity of sea snakes (DSEWPaC 2012a).

Cartier Island is part of the Ashmore Reef and Cartier Island and surrounding Commonwealth waters KEF (Section 4.2.3).

4.3.5 Kimberley MP

The Kimberley MP is located approximately 99 km to the south and east of WA-50-L and occupies an area of approximately 74,500 km^2 (Parks Australia 2020e).

This MP provides an important migration pathway and nursery areas for the protected humpback whale, and foraging areas for migratory seabirds, migratory dugongs, dolphins and threatened and migratory marine turtles (Director of National Parks 2018a). It is adjacent to important foraging and pupping areas for sawfish and important nesting sites for green turtles (Parks Australia 2020e).

4.3.6 Mermaid Reef MP

The Mermaid Reef MP is located approximately 485 km south-west of WA-50-L and is near the edge of Australia’s continental slope, surrounded by waters that extend to a depth of over 500 m. Mermaid Reef MP covers an area of approximately 540 km^2 and is the most north-easterly of three reef systems forming the Rowley Shoals (Parks Australia 2020f). Mermaid Reef is totally submerged at high tide and therefore falls under Australian Government jurisdiction. The other two reefs of the Rowley Shoals, Clerke Reef and Imperieuse Reef are managed by the WA Government.

Mermaid Reef (and the other Shoals) supports over 200 species of hard corals and 12 classes of soft corals with coral formations in pristine condition. The shoals are an important area for sharks, including the grey reef shark, the whitetip reef shark and the silvertip whaler; important foraging area for marine turtles; toothed whales; dolphins; tuna and billfish; and an important resting and feeding site for migratory seabirds (Parks Australia 2020f; Director of National Parks 2018a).

4.3.7 Oceanic Shoals MP

WA-50-L is located approximately 325 km from the Oceanic Shoals MP. The MP occupies an area of approximately 72,000 km^2 with water depths from less than 15 m to 500 m (Parks Australia 2020g). The Oceanic Shoals MP is the largest marine park in the NMR and also overlaps the NWMR.

The reserve is an important resting area for turtles (internesting) for the threatened flatback turtle and olive ridley turtle. It is also an important foraging area for the threatened loggerhead turtle and olive ridley turtle (Director of National Parks 2018b).

4.4 State and Territory reserves and marine parks

There are no State or Territory marine parks/reserves located within WA-50-L.

The EPBC Act Protected Matters search (Appendix B) identified a total of eight State reserves within the PEZ as listed below, all found within WA. Unnamed locations were identified using the Collaborative Australian Protected Areas Database (CAPAD 2018).

- Adele Island (WA)
- Browse Island (WA)
- Dambimangari (WA)
- Lacepede Islands (WA)
- Low Rocks (WA)
- Unnamed WA41775 (WA) identified as Browse Island
- Unnamed WA44673 (WA) identified as Adele Island
- Uunguu (WA)

Of these reserves, two are Indigenous Protected Areas (IPAs); Dambimangari IPA and the Uunguu IPA. The most relevant value and sensitivity within the IPAs is traditional fishing, which is practised within these reserves, and is further discussed in Section 4.9.3.

Further research and investigation of the Collaborative Australian Protected Areas Database (CAPAD 2018) for the State/Territory reserves and marine parks listed in Appendix B was undertaken. Where sites were considered not relevant to the PEZ they are not discussed further in this EP. This is primarily as there are no 'marine' values or sensitivities which could be impacted by an oil spill, unlike locations where significant turtle and seabird nesting rookeries may be present, and/or associated BIAs have been declared.

The EPBC Act Protected Matters search report (Appendix B) did not identify the following three additional marine parks/reserves listed below; however, these have been confirmed through previous stakeholder consultation between INPEX and the DBCA, and therefore they have been described in this EP:

- Scott Reef Nature Reserve
- Lalang-garram / Camden Sound Marine Park
- North Kimberley Marine Park
- North Lalang-garram Marine Park.

The relevant State and Territory reserves within the PEZ are described below and displayed on Figure 4-2. Should any new State or Territory marine park/reserve management plans come into effect, the impacts of these changes will be assessed in accordance with Section 9.8.1 and Section 9.7 of this EP.

4.4.1 Adele Island Nature Reserve

Adele Island is a declared nature reserve to protect seabird breeding colonies, and is located approximately 172 km south from WA-50-L.

It is a hook-shaped island off the central Kimberley coast, located around 97 km north-northwest of Cape Leveque. The island covers an area of 2.17 km^2. Its surrounding sand banks sit atop a shallow-water limestone platform, surrounded by an extensive reef system (CCWA 2010).

Adele Island is an important site for breeding seabirds with several species listed under the JAMBA, CAMBA and Republic of Korea–Australia Migratory Birds Agreement (ROKAMBA). There are known breeding colonies for masked booby (*Sula dactylatra*), red-footed booby (*Sula sula*), brown booby (*Sula leucogaster*), pied cormorant (Phalacrocorax varius), Australian pelican (*Pelecanus conspicillatus*), greater frigatebird (*Fregata minor*), lesser frigatebird (*Fregata ariel*), Caspian tern and lesser crested tern (CCWA 2010).

The seabird colonies at Adele Island tend to have peak breeding periods from May to July; however, birds may also be present during the non-breeding season (DEWHA 2008). A study undertaken as part of an Applied Research Program (ARP) between INPEX and Shell in the Browse Basin, reported 12 species of seabird were found to breed at Adele Island in the 2014/2015 season. An additional eight species of seabird were considered non-breeding visitors. Twenty-six migratory shorebird species and three Australian resident shorebird species were also reported as using the reserve (Clarke 2015).

4.4.2 Browse Island Nature Reserve

Browse Island is the nearest landform to WA-50-L (33 km away) and is a Class ‘C’ nature reserve. It is an isolated sand cay surrounded by an intertidal reef platform and shallow fringing reef. The purpose of this reserve (#41775) is conservation, navigation (a lighthouse is present on the island), communication, meteorology and survey.

The Browse Island reef complex is an outer shelf, biohermic structure rising from a depth of approximately 200 m. It is a flat-topped, oval-shaped, platform reef with the largest diameter being about 2.2 km. The island is a triangular, vegetated sandy cay, standing just a few metres above high-tide level. It measures approximately 700 m by 400 m.

Reef habitats at Browse Island are not diverse as confirmed by a study undertaken as part of the ARP for INPEX and Shell. In the study, a low level of diversity in invertebrates was reported. Soft corals and sponges were noted but reported levels were not considered abundant (Olsen et al. 2018). Rocky shore habitat on the island is represented only by exposed beach rock, and there are no intertidal sand flats. The lagoon habitat is poorly developed, with poor water circulation, and it shows evidence of recent infill and high mortality. The reef platform, especially on the western side, is high and barren in many places. Only the reef crest and seaward ramp habitats around the edge of the reef support moderately rich assemblages of molluscs. The shallow subtidal zone is narrow and supports relatively small areas of well-developed coral assemblages (INPEX 2010).

Green and flatback turtle (*Chelonia mydas* and *Natator depressus*) nesting occurs during the summer months and Browse Island also provides habitat for seabirds and shorebirds.

Further, the island (inclusive of a 20 km buffer) has been classified as critical habitat for green turtles from November to March under the Recovery Plan for Marine Turtles in Australia (DEE 2017a). It is thought that the Scott-Browse green turtles are a distinct genetic unit, nesting only at Scott Reef (Sandy Islet) and Browse Island.

It is not a regionally significant habitat for seabirds, with previous surveys finding a lack of diversity of seabirds breeding there (Clarke 2010). The DAWE has not listed Browse Island as a marine avifauna BIA. However, colonies of nesting crested terns (*Thalasseus bergii*) were observed nesting on the north-western side of the island in a colony of approximately 1,000 birds (Olsen et al. 2018). Browse Island has also been recognised, through stakeholder consultation between INPEX and the DBCA, as an important location for seabirds and specifically green turtles, known to be part of a genetically distinct management unit.

4.4.3 Lacepede Islands

The Lacepede Islands are a Class ‘C’ nature reserve, located 320 km south of WA-50-L, and 120 km north-west of Broome. The purpose of this reserve is the conservation of flora and fauna, navigation, communication, meteorology and survey. The Lacepede Islands are a 12 km long chain of four islands known as West Island, Middle Island, Sandy Island and East Island. They are all small, low spits of coarse sand and coral rubble, lying atop a platform coral reef. They are treeless but support low vegetation.

INPEX (2010) identified these islands as the largest green turtle (*Chelonia mydas*) breeding rookery along the Kimberley coastline. The Recovery Plan for Marine Turtles in Australia recognises these islands as a major important nesting area (DEE 2017a) and confirmed as an important rookery based on track counts (Waples et al. 2019). The Recovery Plan has provided a 60 km internesting buffer around the Lacepede Islands for flatback turtle nesting occurring from October to March, with a peak in December and January. A 20 km internesting buffer has also been provided for green turtle nesting, occurring from November to March each year.

The Lacepede Islands support over 1% of the world populations of brown boobies (*Sula leucogaster*) and roseate terns (*Sterna dougallii*). The breeding colony of brown boobies, of up to 18,000 breeding pairs, is possibly the largest in the world. Core foraging habitat of the brown boobies was reported to range from 50 km – 90 km from the colony with the furthest recorded as approximately 120 km north-west of the Lacepede Islands (Cannell et al. 2018). Up to 20,000 roseate terns have been recorded there (Birdlife International 2020). Other birds breeding on the islands include masked boobies, Australian pelicans, lesser frigatebirds, eastern reef egrets, silver gulls, crested, bridled and lesser crested terns, common noddies, and pied and sooty oystercatchers. Visiting waders include grey-tailed tattlers, ruddy turnstones, great knots and greater sand plovers (Birdlife International 2020).

4.4.4 Scott Reef Nature Reserve

Sandy Island is a C class nature reserve (under Western Australian legislation) for the purpose of conservation (No. 42749), declared to Low Water Mark (LWM). It has an approximate area of 11,658 hectares. This encompasses much of the South Scott lagoon, and the south-western reef flat of North Scott Reef. The remainder of the South Scott Reef lagoon and North Scott Reef are Commonwealth waters and Commonwealth jurisdiction applies. The Scott Reef Nature Reserve values and sensitivities are described in Section 4.8.

Scott Reef (including a 20 km buffer) has been classified as habitat critical to the survival of marine turtles in the Recovery Plan for Marine Turtles (2017a).

4.4.5 Lalang-garram/Camden Sound Marine Park

The Lalang-garram / Camden Sound Marine Park is located in the Buccaneer Archipelago of the Kimberly coast, approximately 177 km from WA-50-L. The marine park covers an area of approximately 7,050 km^2 (DPaW 2013). The marine park is located approximately 150 km north of Derby and 300 km north of Broome and lies within the traditional country of three Aboriginal native title groups. It is under joint management between DBCA and the Traditional Owners.

The marine park includes a principal calving habitat and resting area for the humpback whale (*Megaptera novaeangliae*) and a wide range of other protected species, including marine turtles, snubfin and Indo-Pacific humpback dolphins, dugong, saltwater crocodiles and several species of sawfish. The park also includes a wide range of marine habitats and associated marine life, such as coral reef communities, rocky shoal and extensive mangrove forests (DPaW 2013).

Within the marine park, mangroves and their associated invertebrate-rich mudflats are an important habitat for migratory shorebirds from the northern hemisphere. Up to 35 species of migratory shorebirds potentially occur in the marine park, which are subject to the JAMBA, CAMBA and ROKAMBA migratory bird agreements and are listed as migratory species under the EPBC Act (Appendix B). Many other bird species may also be found in mangrove habitat with nesting occurring in the dense mangrove foliage and birds seeking prey around the roots of mangrove trees. (DPaW 2013).

4.4.6 North Kimberley Marine Park

The North Kimberley Marine Park is located approximately 176 km from WA-50-L. This park extends all the way from the northern boundary of the Camden Sound Marine Park to the Northern Territory border (DPaW 2016a). The park was declared in December 2016 and is the second largest marine park in Australia spanning approximately 18,540 km^2. This vast area has a complex coastline with many gulfs, headlands, cliff-lined shores and archipelagos. Extensive tidal flats have formed in places, some associated with the mouths of the numerous rivers that drain to the coast. Marine ecosystems include extensive fringing mangrove forests and remote and virtually untouched coral reefs and sponge gardens which in turn support a wide range of marine life (DPaW 2016a).

High densities of dugongs have been recorded in areas of the marine park with extensive seagrass habitat (Waples et al 2019). The park also supports populations of Manta rays (*Manta* spp*.*) and six species of threatened marine turtle found in Australia. Cetaceans that are known to utilise the area include humpback whales (*Megaptera novaeangliae*), Indo-Pacific humpback dolphins (*Sousa chinensis*) and snubfin dolphins (*Orcaella heinsohni*) (DPaW 2016a). Saltwater crocodiles (*Crocodylus porosus*), and a variety of fish, sharks, rays and sea snakes also inhabit the waters of this park. A wide variety of seabirds also utilise the offshore islands and intertidal flats for breeding and foraging. Nature based tourism, commercial and recreational fishing and remote seascapes are also identified as values within the park's management plan (DPaW 2016a).

4.4.7 North Lalang-garram Marine Park

The North Lalang-garram Marine Park, located approximately 153 km from WA-50-L, includes the waters from the edge of Cape Wellington (WA mainland) to the WA state waters boundary, and several islands, including Booby Island, Duguesclin Island and Jackson Island. Its northern boundary adjoins the North Kimberley Marine Park, and its southern boundary adjoins the Lalang-garram / Camden Sound Marine Park. This parks geology, wide variety of habitats, ecological values and sensitivities (DPaW 2016b) are virtually identical to that described above for the North Kimberley Marine Park (DPaW 2016b).

4.5 International marine parks

4.5.1 Savu Sea Marine National Park

The Savu Sea (Laut Sawu) Marine National Park (MNP) is located within the Lesser Sunda Ecoregion located to the south of the Coral Triangle and covers approximately 35,000 km^2 (MCI 2020; Protected Planet 2020). It was established in 2009 and has an IUCN Category II status (Protected Planet 2020). The MNP is split into three management areas; the Pantar Strait Marine Protected Area, the Sumba Strait Marine Area and the Tirosa-Batek Marine Area.

The Savu Sea MNP acts as a marine corridor and migratory pathway for marine fauna and is also an important upwelling zone in the Indo-Pacific region due to the presence of deep ocean trenches (Perdanahardja & Lionata 2017). The MNP area is a known migration route for several cetacean species, including the blue whale and sperm whale (Huffard et al. 2012). Other cetacean species such as pygmy killer whales, melon-head whales, short-finned pilot whales and numerous dolphin species (including Risso’s dolphin, Fraser’s dolphin, common dolphin, bottlenose dolphin and spinner dolphin) are known to frequent the MNP area (Coral Triangle Atlas 2014). Several species of marine turtle, including the green turtle, hawksbill turtle and leatherback turtle have also been recorded in the MNP area (Huffard et al. 2012).

The Sauv Sea MNP provides productive marine habitats that support large populations of fish and artisanal and commercial fisheries. It is estimated that 65% of the East Nusa Tenggara regional fisheries production comes from the Savu Sea (Perdanahardja & Lionata 2017).

4.6 Wetlands of conservational significance

4.6.1 Ashmore Reef National Nature Reserve

In addition to being listed as a National Nature Reserve, Ashmore Reef has been designated a Ramsar site due to the importance of the islands in providing a resting place for migratory shorebirds and supporting large breeding colonies of seabirds (Hale & Butcher 2013). Ashmore Reef is located within the PEZ and is approximately 156 km from WA-50-L (Figure 4-8).

The reserve provides a staging point for many migratory wading birds from October to November and March to April as part of the migration between Australia and the northern hemisphere (Commonwealth of Australia 2002). Migratory shorebirds use the reserve's islands and sand cays as feeding and resting areas during their migration. The values of this wetland (habitat which supports migratory birds) are described above in Section 4.3.1.

4.6.2 Mermaid Reef

Although not a Ramsar site, Mermaid Reef is identified as a Nationally Important Wetland in the EPBC Act Protected Matters search (Appendix B). The intertidal and subtidal reef system and associated ecological values and sensitivities are described above in Section 4.3.6. It is considered that marine avifauna which roost on the islands within Clerke and Imperieuse Reef may forage at Mermaid Reef.

4.7 Physical environment

4.7.1 Climate

Air temperature

Air temperatures recorded at Browse Island, the closest Bureau of Meteorology (BOM) climatological station to WA-50-L, shows a maximum temperature of 33.3 degrees Celsius (°C) and a minimum of 21.6 °C (BOM 2020). Air temperatures in the Browse Basin remain warm throughout the year with means and maxima ranging from 26–30 °C and 32–35 °C, respectively (INPEX 2010).

Winds

The climate of northern Australia shows two distinct seasons: winter, from April to September; and summer, from October to March. There are rapid transitional periods between the two main seasons, generally in April and September/October (RPS MetOcean Pty Ltd 2011).

The winter season is characterised by steady north-east to south-east winds of 5 metres per second (m/s) to 12 m/s, driven by south-east trade winds. The prevailing south-east winds bring predominantly fine conditions throughout the north of Australia. The summer season is the period of the predominant north-west monsoon. It is characterised by north-west to south-west winds of 5 m/s for periods of five to 10 days with surges in airflow of 8 m/s to 12 m/s for periods of one to three days.

During the summer season, the weather in the north is largely determined by the position of the monsoon trough, which can be in either an active or an inactive phase. The active phase is usually associated with broad areas of cloud and rain, with sustained moderate to fresh north-westerly winds on the north side of the trough. Widespread heavy rainfall can result if the trough is close to, or over, land. An inactive phase occurs when the monsoon trough is temporarily weakened or retreats north of Australia. It is characterised by light winds, isolated showers, and thunderstorm activity, sometimes with gusty squall lines.

Tropical cyclones can also develop off the coast in the northern wet season, usually forming within an active monsoon trough. Heavy rain and strong winds, sometimes of destructive strength, can be experienced along the coast within several hundred km of the centre of the cyclone. The Browse Basin is prone to tropical cyclones, mostly during the tropical wet season from December to March (INPEX 2010). Under extreme cyclone conditions, winds can reach 300 km/h.

Rainfall

The region has a pronounced monsoon season between December and March, which brings with it heavy rainfall. Heaviest rainfall is typically associated with tropical cyclones.

Troughton Island located on the Kimberley coastline is the closest location to WA-50-L with a historical rainfall record. Historical rainfall data shows the highest maximum (269.8 mm) and mean (>100 mm) monthly rainfalls occur from December to March (BOM 2020). Rainfall intensity at the Ichthys Field is expected to range from approximately 215 mm/h to 460 mm/h over a 5-minute interval (based on 1-year and 200-year average recurrence intervals) (AMEC Ltd. 2011).

Air quality

There is currently no air quality data recorded within the vicinity of WA-50-L. However, given the distance from land, air quality is expected to be relatively high. Potential sources of air pollution associated with anthropogenic influences are expected to be emissions generated by shipping, and oil and gas activities, and therefore considered to be localised in relation to the regional setting.

4.7.2 Oceanography

Currents

Broad-scale oceanography in the north-west Australian offshore area is complex, with major surface currents influencing the region, including the Indonesian Throughflow, the Leeuwin Current, the South Equatorial Current, and the Eastern Gyral Current (Figure 4-3). The Indonesian Throughflow current is generally strongest during the south-east monsoon from May to September (Qiu et al. 1999). The Indonesian Throughflow is a key link in the global exchange of water and heat between ocean basins. It brings warm, low-nutrient, low-salinity water from the western Pacific Ocean, through the Indonesian archipelago, to the Indian Ocean. It is the primary driver of the oceanographic and ecological processes in the region (DSEWPaC 2012a).

Offshore regions with water depths exceeding 100-200 m tend to experience significant large-scale drift currents. These drift currents tend to be stronger than tidal currents and are the dominant driver of the long term (> several days) transport of effluent plumes. Drift currents in the location of the INPEX *Ichthys Venturer* FPSO within WA-50-L are expected to be directed towards the south-west during summer and winter. During the transitional period, drift currents will be variable, predominantly switching between the south-west and north-east directions. Typical drift current speeds range from zero to 0.3 m/s throughout the year (APASA 2015). Tidal current data, also from the FPSO location, indicate that tidal currents are likely to be directed along a north-west to south-east axis throughout the year. Typical tidal current speeds are in the range of 0.2–0.6 m/s (APASA 2015). Wind shear at the surface also generates local-scale currents.

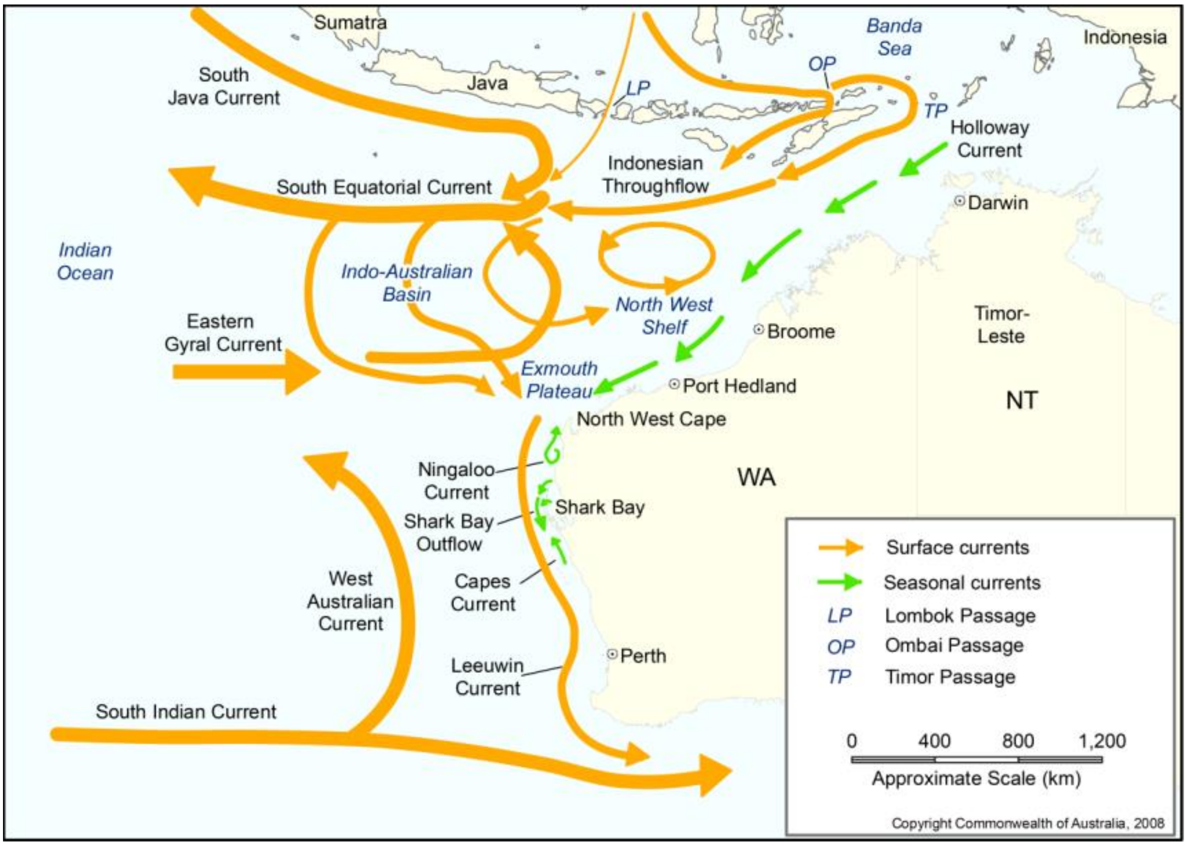

Figure 4-3: Surface currents for Western Australian waters

Tides

The tides are semidiurnal, with two daily high tides and two daily low tides (McLoughlin et al. 1988). Both the semidiurnal and diurnal tides appear to travel north-eastwards in the deep water leading to the Timor Trough before propagation eastwards and southwards across the wide continental shelf. The NWMR experiences some of the largest tides along a coastline adjoining any open ocean in the world.

Mean sea level in the vicinity of WA-50-L is about 2.7 m above lowest astronomical tide (LAT), with a spring tidal range of about 5.0 m.

Waves

Summertime tropical cyclones generate waves propagating radially out from the storm centre. Depending upon the storm size, intensity, relative location and forward speed, tropical cyclones may generate swell with periods of 6–10 seconds (s) from any direction and with wave heights of 0.5–9.0 m. During severe tropical cyclones, which can generate major short-term fluctuations in current patterns and coastal sea levels (Fandry & Steedman 1994; Hearn & Holloway 1990), current speeds may reach 1.0 m/s and occasionally exceed 2.0 m/s in the near-surface water layer. Such events are likely to have significant impacts on sediment distributions and other aspects of the benthic habitat.

4.7.3 Bathymetry and seabed habitats

Water depths within WA-50-L ranges from 235 m to 275 m at LAT. Studies using sub-bottom profiling, multibeam echo-sounder and sidescan sonar have been undertaken by INPEX at the Ichthys Field and in areas close to Heywood and Echuca shoals and south-east towards the Kimberley coast (INPEX 2010). These studies indicated that seabed topography is relatively flat and featureless and the geology is generally homogeneous through the region.

Soft substrates in the Browse Basin and continental shelf are typical of deep-sea, outer continental shelf and slope benthic habitats found along the length of the NWS (RPS 2007). This habitat generally supports a diverse infauna dominated by polychaetes and crustaceans typical of the broader region and this is reflected in survey results which indicate the epibenthic fauna is diverse but sparsely distributed (RPS 2008). Deep-sea infaunal assemblages of this kind are very poorly studied on the NSW but are likely to be widely distributed in the region (INPEX 2010).

Areas of mud and fine sand are widespread on the outer shelf and slope in the Browse Basin indicating that it is a depositional area where fine sediments and detritus accumulate. The distribution of seabed type shows some correlation with water depth, with sediments becoming coarser as water depth increases (INPEX 2010). However, there are also large sand waves in parts of the basin, showing that, locally, there are strong seabed currents. The sand waves are likely to move in response to seasonal changes in the currents and the substrate instability is expected to limit the development of infaunal communities in this habitat.

During surveys of the Ichthys Field, no obstructions were noted on the seafloor and no features such as boulders, reef pinnacles or outcropping hard layers were identified (INPEX 2010; Fugro Survey Pty Ltd 2005). In general, the seabed sediments grade from soft featureless sandy silts to gravelly sand suggestive of strong near-seabed currents and mobile sediments that do not favour the development of diverse epibenthic communities.

4.7.4 Water quality

Water quality has been measured by INPEX during numerous surveys in order to describe the natural water quality conditions in the Ichthys Field and in surrounding areas including WA-50-L. An overview of the water quality studies undertaken are as follows:

- water quality sampling was conducted at 27 offshore locations near the Ichthys Field, Echuca Shoal and their surrounds between March 2005 to June 2007 as a part of the INPEX Ichthys EIS studies
- near-seabed temperature and salinity profiles were obtained along the proposed pipeline route from the Ichthys Field to Darwin Harbour during geophysical and geotechnical surveys conducted between August and October 2008.

The results of these studies, as relevant to this EP, are summarized in Table 4-2.

Furthermore, as part of the ARP between INPEX and Shell in the Browse Basin, a significant amount of environmental baseline data has been collected. This included 66 water quality profiles and more than 1,300 water samples collected from 56 locations around the Ichthys Field in 2015.

Sampling locations were based on a gradient design away from a central point in the Ichthys Field and also included increased sampling around Browse Island, Echuca and Heywood shoals. Samples were analysed for metals and hydrocarbons. In addition to the May 2015 survey, ad hoc water quality samples have also been collected from sampling locations during other ARP field surveys to increase the dataset and knowledge. An interpretive report of all the aforementioned ARP water quality results was delivered in 2017 (Ross et al. 2017).

Offshore surface waters are typically oligotrophic. This has been confirmed by studies recording low nitrate concentrations and low phytoplankton abundance. In general, the region experiences an influx of comparatively nutrient-rich waters at depth in summer and a variety of processes, such as tidal currents, internal waves and cyclone mixing, are known to carry these nutrients into the bottom waters of the shelf (Hallegraeff 1995).

Inshore coastal waters tend to be more turbid than offshore open ocean waters due to suspension of sediments by wave action and sediment laden runoff from the land. Higher total suspended solids (TSS) concentrations tend to occur during spring tide conditions due to stronger tidal currents and meteorological perturbations, such as periods of strong winds.

Table 4-2: Summary of water quality parameters in the vicinity of WA-50-L

Parameter	Description
Surface-water temperature	The surface waters of the region are tropical year-round, with surface temperatures of ~26 °C in summer and ~22 °C in winter (DSEWPaC 2012a). The baseline monitoring in the Ichthys Field area recorded surface water temperatures of ~30 °C in summer (March) and ~26–27 °C in winter (July) (INPEX 2010). Offshore waters in the region are typified by thermal stratification, with the start of the thermocline generally around 60 m below sea surface (but ranging from 30-80 m) (Ross et al 2017). Temperature decays rapidly through the water column to 14 °C at approximately 200 m and then decays more slowly to a minimum of circa 8 °C recorded at the deepest sites (Ross et al. 2017).
Salinity	Salinity was spatially and temporally consistent at 34 to 35 parts per thousand (ppt) across all sampling sites and can reasonably be expected to be similar within the wider area, given the distance from major freshwater discharges (INPEX 2010). Minor variations in the salinity profile were identified however data indicated lower salinity values were recorded in the top layer of the water column with higher salinity values corresponding to deeper within the water column (Ross et al. 2017).

Parameter	Description
Dissolved oxygen	Dissolved oxygen concentrations in the Ichthys Field mirrored water temperatures, with concentrations varying considerably between the surface and subsurface layers. The surface mixed layer was generally well oxygenated throughout; however, below the thermocline (starting at approximately 60 m through to 200 m water depth), the concentration of dissolved oxygen decreased consistently with depth (RPS 2007; Ross et al. 2017). Dissolved oxygen concentrations were recorded at constant levels of 6.0 to 6.5 ppm at or above the thermocline in both summer and winter. In the cooler waters below the thermocline, dissolved oxygen decreased with increasing depth, with levels as low as 4.5 to 5.0 ppm recorded at a depth of 93 m and 3 ppm at a depth of 250 m (INPEX 2010). This indicates that the strong thermal stratification at the offshore locations results in limited oxygen replenishment of subsurface waters due to the lack of regular mixing between water layers (RPS 2007).
pH	The average pH of waters was measured at approximately 8.4 (RPS 2007), which is slightly higher (more alkaline) than normally encountered in the marine environment and is above the default criteria given in the *Australian and New Zealand guidelines for fresh and marine water quality* (ANZG 2018).
Turbidity and light attenuation	Turbidity is generally higher in the shallow waters of the continental shelf and towards the base of many of the deeper water column profiles. This has been attributed to re- suspension of fine sediments in these higher energy environments (Ross et al. 2017). The re-suspension of materials from the seafloor includes organic material which could comprise a pathway for hydrocarbon materials to become incorporated into sediments. Light attenuation coefficients calculated from photosynthetically active radiation (PAR) measurements ranged from 0.026 to 0.043 in October and December 2006, and 0.048 to 1.09 in June 2007. These were observed to be consistent with reported "typical" levels for the region (RPS 2007).
Petroleum hydrocarbons	Baseline sampling has indicated low levels of naturally occurring hydrocarbons released by organic matter decay or higher trophic level organisms. Shallow water sites showed a constant hydrocarbon concentration through the profile. Deep water sites showed a low and constant concentration above the thermocline, with a peak of 0.2-0.25 µg/L at the thermocline before slowly diminishing (Ross et al. 2017).
Radionuclides	Water-column sampling for radionuclides in the Ichthys Field area indicated concentrations of radium-226 ranging from below lower limits of reporting (LLR) to 0.034 (±0.012) becquerels per litre (Bq/L) and concentrations of radium-228 ranging from below LLR to 0.167 (±0.128) Bq/L. With the exception of one mid-depth sample, all samples returned gross alpha-particle and gross beta-particle radiation levels below the Australian Drinking Water Guidelines (ADWG) screening criterion of 0.5 Bq/L provided by the National Health and Medical Research Council (NHMRC) and the Natural Resource Management Ministerial Council (NRMMC).
Metals	Total metal concentrations in the offshore waters sampled were below the 99% species protection level for marine waters (ANZG 2018), with the exception of zinc and cobalt at one site each. The reason for these two slightly elevated readings is unknown (INPEX 2010).

Parameter	Description
	Ultra-trace-level analysis methods were used to assess metal concentrations in surface waters because ANZG (2018) guideline trigger values at the 99% species protection level are lower than the limits of standard laboratory methods. Mercury was the only metal not detected above the LLR, while cobalt was marginally above the LLR at only one site. Concentrations of arsenic, nickel, chromium and zinc were consistent across all sites, but the concentrations of cadmium, copper and lead showed greater variability (INPEX 2010).

Water quality in the Indonesian waters of the PEZ is unknown. However, the Asian Development Bank (2014) reported that approximately 40% of domestic sewage in Indonesia is discharged directly or indirectly via rivers and into the sea without proper treatment. The high organic and nutrient content of untreated sewage can lead to eutrophication or excessive nutrient enrichment, which triggers the growth of phytoplankton in the form of harmful algal blooms, or red tides, in many places in Indonesia.

4.7.5 Sediment quality

Similar to water quality, marine sediments have been sampled during numerous surveys in order to characterise the marine sediments in the Ichthys Field and surrounding areas. Overviews of the studies are listed below, with the results as relevant to this EP summarised in Table 4-3:

- Sampling and characterisation of marine sediments in the Ichthys development area was conducted at 10 sites in September 2005 and May 2007. This included five sites within 20 km of the Ichthys Venturer FPSO location and another five sites between 36 km and 134 km away. A further 10 sites were also sampled for particle size distribution (PSD) between 24 km and 66 km of the FPSO location in WA-50-L.
- Seabed sediment sampling along the proposed pipeline route from the Ichthys Field to Darwin Harbour was also conducted at approximately 10 km intervals during geophysical and geotechnical surveys between August and October 2008.

Furthermore, as a part of the ARP, a 133 sediment samples at 56 locations were collected around the Ichthys Field in May 2015. Sampling locations were based on a gradient design away from a central point in the Ichthys Field and also included increased sampling around Browse Island, Echuca and Heywood shoals. Samples have been analysed for metals and hydrocarbons. In addition to the May 2015 survey, ad hoc sediment samples have also been collected from sampling locations during other ARP field surveys to increase the dataset and knowledge. An interpretive report of all the aforementioned ARP sediment sample results was delivered in 2017 (Ross et al. 2017).

Table 4-3: Summary of sediment quality parameters in the vicinity of WA-50-L

Parameter	Description
Particle size distribution (PSD)	The seabed in offshore locations on the continental shelf is known to consist of generally flat, relatively featureless plains characterised by soft sandy-silt marine sediments that are easily resuspended. Similarly, the substrate of the Scott Reef – Rowley Shoals Platform, in water depths of 200–600 m, is considered to be a depositional area with predominantly fine and muddy sediments (INPEX 2010). The PSD of sediment at sites located within the Ichthys Field was primarily sand, with some silts.

Parameter	Description
Petroleum hydrocarbons	Concentrations of BTEX and PAH compounds in sediments in the vicinity of the sampling sites were very low (Ross et al. 2017, RPS 2007). The components of the more prevalent alkane compounds found indicated that the concentrations observed were likely to have originated from biogenic sources (Ross et al. 2017).
Radionuclides	Naturally occurring radioactive materials for the majority of results were below or close to LLR. Radium-226 was detected at one site but all other samples were below LLR for each radium isotope. The concentration of uranium and thorium was consistent across all sites (RPS 2007).
Metals	Concentrations of all metals were consistent across the sampling sites and well below the interim sediment quality guidelines (ISQG) low screening level (ANZG 2018), with the majority also below their respective LLR (RPS 2007). Organometallics (i.e. tributyltin (TBT)) were below ANZG (2018) guidelines and lower than the LLR at all sampling locations.

4.7.6 Underwater noise

The Centre for Marine Science and Technology (CMST) at Curtin University undertook a study on behalf of INPEX from September 2006 to August 2008 to assess ambient biological and anthropogenic sea noise sources in the Browse Basin. Ambient noise in the Ichthys Field was measured using a sea noise logger deployed at a depth of 240 m on the seabed 45 km north-west of Browse Island. The monitoring revealed an average ambient noise level of 90 dB re 1 μPa under low sea states, with inputs of low frequency energy from the Indian Ocean (INPEX 2010).

Biological noise sources recorded in the Ichthys Field included regular fish choruses (one at >1 kHz and another at around 200 Hz) and several whale calls from humpback whales, pygmy blue whales, minke whales and other unidentified species. Results from this survey are considered to be indicative of typical underwater noise levels and frequencies within the NWMR and NWR bioregion as a whole.

4.8 Biological environment

4.8.1 Planktonic communities

Plankton communities comprise phytoplankton and zooplankton, including fish eggs and larvae. Phytoplankton and zooplankton are a source of primary and secondary productivity, and key food sources for other organisms in the oceans (Brewer et al. 2007). Eggs and larvae may be dispersed throughout the water column and throughout the region, playing an important role in species recruitment.

Plankton abundance and distribution is patchy, dynamic and strongly linked to localised and seasonal productivity (Evans et al. 2016). The mixing of warm surface waters with deeper, more nutrient-rich waters (i.e. areas of upwelling) generates phytoplankton production and zooplankton blooms. In the offshore waters of north-western Australia, productivity typically follows a ‘boom and bust’ cycle. Productivity booms are thought to be triggered by seasonal changes to physical drivers or episodic events, which result in rapid increases in primary production over short periods, followed by extended periods of lower productivity.

The Indonesian Throughflow has an important effect on biological productivity in the northern areas of Australia and Indonesia. Generally, its deep, warm and low nutrient waters suppress upwelling of deeper, comparatively nutrient-rich waters, thereby forcing the highest rates of primary productivity to occur at depths associated with the thermocline (generally 70 – 100 m depth). When the Indonesian Throughflow is weaker, the thermocline lifts, and brings deeper, more nutrient-rich waters into the photic zone, which results in conditions favourable to increased productivity. Consequently, plankton populations have a high degree of temporal and spatial variability. In tropical regions, higher plankton concentrations generally occur during the winter months (June to August).

The waters of north-western Australia, encompassing the Ichthys Field (WA-50-L), are generally considered to be of low productivity in comparison with other global oceanic systems. This is largely due to the relatively low-nutrient, shallow water environment. Planktonic community densities recorded in the Ichthys Field are considered to be very sparse and are indicative of offshore waters where no significant nutrient sources exist. The most common plankton classes recorded from the sampling of the Ichthys Field development area were the Prasinophyceae (68%), followed by the Bacillariophyceae (30%), the Dinophyceae (1%) and the Cryptophyceae (<1%), all of which are common throughout the region (INPEX 2010).

4.8.2 Benthic communities

Banks and shoals

A number of banks, shoals and reefs exist within the Browse Basin (Figure 4-2). The closest to WA-50-L are Echuca and Heywood shoals that are located approximately 79 km and 96 km away respectively. Browse Island is the nearest intertidal habitat which is located 33 km away from WA-50-L (INPEX 2010).

Other representative banks and shoals within the PEZ, with approximate distances from WA-50-L include:

- Vulcan Shoals (173 km)
- Eugene McDermott Shoals (175 km)
- Barracouta Shoals (179 km)
- Woodbine Bank (180 km)
- Fantome Shoals (266 km)
- Penguin Shoal (277 km)
- Gale Bank (350 km)
- Van Cloon Shoals (383 km)
- Rowley Shoals (500 km)
- Sunrise Bank (600 km)
- Flat Top Bank (670 km).

The shoals and banks within the PEZ are characterised by abrupt bathymetry, rising steeply from the surrounding shelf to horizontal plateau areas typically 20–30 m deep (AIMS 2012). Substrate types tend to differ from patches of coarse sand, to extensive fields of rubble and rocks, limited areas of consolidated reef and occasional isolated rock or live coral outcrops.

A detailed study on Echuca and Heywood Shoals, the two closest submerged shoals to WA-50-L, was undertaken as part of the Shell/INPEX ARP comprising of annual field surveys conducted from 2014 to 2016 (Heyward et al. 2018). The focus of the study was the shoal benthic habitats and associated fish communities predominantly on the plateau areas, present as horizontal or gently sloping seabed in depths of 15m to 30 m. The outcome of the study by Heyward et al. (2018) reported that Echuca Shoal's oval shaped and slightly shallower 11 km^2 plateau had less unconsolidated substrate, such as sand or rubble, than Heywood Shoal's plateau of approximately 31 km^2. The benthic habitats and fish communities were similar, with many species in common. All epibenthic organisms on both shoals appeared normal and healthy throughout the study. Fish abundance and diversity was high but varied over time and between the shoals in a consistent manner. Species richness, abundance and fish community structure were influenced mainly by depth and the abundance of epibenthos, especially hard coral (Heyward et al. 2018). These results are comparable with other shoals throughout the region.

The submerged shoals within the PEZ can support diverse tropical ecosystems, including phototrophic benthos typical of tropical coral reefs. The shoals support a diverse biota, including algae, reef-building corals, hard corals and filter-feeders. In general, the flora and faunal assemblages are typical of the oceanic reefs of the Indo–West Pacific region (INPEX 2010), with many of the species in common with those found at the Ashmore, Cartier and Scott Reef complexes. The shoals and banks of the area may therefore act as 'stepping stones' for enhanced biological connectivity between the reef systems of the region. Shoal and bank habitats are thought to provide additional regional habitat for marine fauna, including sharks and sea snakes (AIMS 2012).

The community structure of the banks and shoals is likely to be influenced by a number of processes, including disturbance resulting from storms and cyclones, and localised recruitment due to the limited larval dispersal of some invertebrate species (AIMS 2012). It is unknown how interconnected the individual banks and shoals are in regard to larval recruitment. The majority lie in the path of a south-westerly flowing current originating in the Indonesian Throughflow. However, seasonal reversals of current flow suggest larval recruitment can be supplied from outside this process. Seasonal current patterns, local effects within ocean currents (e.g. reversal of current direction against prevailing winds) and species lifecycle characteristics are all likely to exert an influence over the larval recruitment (and hence biodiversity) of the banks and shoals (INPEX 2010).

Coral reefs

Coral reefs within the region can be categorised into three general groups: fringing reefs, large platform reefs, and intertidal reefs. Corals are significant benthic primary producers that play a key ecosystem role in many reef environments and have an iconic status in the environments where they occur.

Coral reefs considered to have significant value within the PEZ include:

- Ashmore Reef
- Cartier Island
- Seringapatam Reef
- Scott Reef
- Hibernia Reef
- Rowley Shoals
- Mermaid Reef.

These reefs, in particular Ashmore Reef, are recognised as having the highest richness and diversity of coral species in Western Australia (Mustoe & Edmunds 2008, cited in Department of State Development 2010). Scott Reef also supports very high coral species diversity, as discussed in Section 4.2 and Section 4.3. Coral reefs associated with Browse Island (the nearest coral reef to WA-50-L) are discussed in Section 4.4.2.

Indonesia has the largest coral reef area in Southeast Asia and estimates of the extent of these coral reefs vary, but they likely total about 51,000 km² (ABD 2014). More than 590 species of corals have been identified in Indonesian waters. The Lesser Sunda Ecoregion which intersects the far northern boundary of the PEZ is considered important for coral endemism. Fringing coral reefs tend to be less developed on the southern, more exposed shorelines (Wilson et al. 2011). Coral species composition is influenced by regional and local scale seasonal upwellings that typically occur from April to May each year on the southern side of the Indonesian islands (DeVantier et al. 2008).

Observations throughout the world indicate that coral spawning on most reefs extends over a few months during the spawning period, typically between late spring and autumn (Stoddart & Gilmour 2005, cited in INPEX 2010). Spawning of corals in the Northern Territory Aquarium has been observed around the full moon period in October and November (TWP 2006, cited in INPEX 2010). In northern Queensland, captive corals have been observed to spawn at the same time as those in the adjacent waters. Coral spawning has been observed at Scott Reef during summer/autumn (March/April; main spawning event) and spring (October/November) (Gilmour et al. 2009). This has been confirmed by AIMS research at Scott Reef, which estimates that 60–75% of community reproductive output occurs in autumn, 15–25% in spring, and 5–15% in summer, with comparatively little reproductive output during winter (Gilmour et al. 2013). Research into coral larval dispersal (Gilmour et al. 2009, 2010, 2011; Underwood et al. 2009, 2017; Cook et al. 2017; Waples et al. 2019) has indicated that dispersal and recruitment is predominately local and limited to within a few kilometres to a few tens of kilometres from natal reef patches.

Seagrass

There is no seagrass within WA-50-L due to water depth (approximately 250 m) and lack of suitable habitat.

Seagrasses occur in the PEZ with the closest seagrasses to the licence area located at Ashmore Reef, approximately 156 km north of WA-50-L, where a high coverage of seagrass supports a small dugong population (Whiting & Guinea 2005).

The largest known seagrass locations for the NWMR have been reported from around the Buccaneer Archipelago located north of the Dampier Peninsula (Wells et al. 1995). Other important seagrass habitats include the Lacepede Islands, Browse Island, Scott Reef and Cartier Island. Coastal shallow-water seagrass habitats are generally rare in the region, accounting for only 11.5 km or 0.2% of the total Australia coastline surveyed by Duke et al. (2010). The regionally dominant genera in Australia are *Halophila* and *Halodule*.

Seagrass habitats are widely distributed across the Lesser Sunda Ecoregion and within Indonesian waters the lower intertidal and upper subtidal zones are considered important areas for the growth of seagrass (Hutumo & Moosa, 2005). Pioneering vegetation in the intertidal zone is dominated by *Halophila ovalis* and *Halodule pinifolia* while *Thalassodendron ciliatum* dominate the lower subtidal zones (Hutumo & Moosa, 2005). Data from the United Nations Environment Program's (UNEP) World Conservation Monitoring Centre has identified the south-west and west Lombok, Savu and the south coast of Timor-Leste as potential areas of importance for seagrass (DeVantier et al. 2008).

4.8.3 Shoreline habitats

There are no islands within WA-50-L, with the closest intertidal habitat located at Browse Island (33 km south-east of the licence area). However, within the PEZ there are many islands that occur including numerous small islands and literally thousands of islands along the Australian and Indonesian coastlines.

In the offshore waters of the PEZ there are multiple islands which have an associated Commonwealth or State marine park/reserve status. The values and sensitivities associated with the shorelines of these islands are described in sections 4.3, 4.4 and 4.5.

Sandy beaches

Sandy beaches are the dominant shoreline habitat on all the offshore islands within the PEZ and provide significant habitat for turtles and seabird nesting above the high tide line. Sandy beaches are present within the PEZ at the sandy cays of Ashmore Reef, Cartier Island, Browse Island, Scott Reef and the Tiwi Islands as described in Sections 4.2, 4.3 and 4.4. The southern coastlines of the islands of the Lesser Sunda Ecoregion of Indonesia are known to contain sandy beaches consisting of soft black sand, formed by volcanic activity. Within this region, a number of important sites for turtle nesting beaches have been identified (Huffard et al. 2012).

Generally, sands are highly mobile and therefore do no support a high level of biodiversity. Fauna within sandy beach habitats usually consists of polychaete worms, crustaceans and bivalves. These fauna provide a valuable food source for resident and migratory sea and shorebirds (DEC/MPRA 2005). Natural processes tend to supply fresh sediments and larval stock (food source) with each tidal influx.

Mangroves

Mangrove communities make up a common shoreline habitat along the northern Western Australian coastlines with extensive mangrove communities along the Australian and Indonesian coastline within the PEZ and they commonly occur in sheltered coastal areas in tropical and sub-tropical latitudes. Mangroves play an important role in connecting the terrestrial and marine environments and reducing coastal erosion. They also play an important ecosystem role in nutrient cycling and carbon fixing (NOAA 2010).

More than a quarter of the world’s species of mangroves can be found along the Kimberley coast, covering an area of approximately 1,400 km^2. During 2009, shoreline ecological aerial and ground surveys were conducted from Darwin in the NT to Broome in WA in response to the Montara oil spill (Duke et al. 2010). Approximately 5,100 km of shoreline was surveyed, analysed and mapped to quantitatively characterise coastal ecological features. Mangroves were found to grow along 63% of the surveyed shoreline and salt marshes occurred over 24% of the shoreline.

Within Indonesia, 41 species of mangroves, occupying some 32,000 km^2 have been recorded (ABD 2014).

4.8.4 Marine fauna

Species of conservation significance

Species of conservation significance within the PEZ were identified through a search of the EPBC Act Protected Matters Database (including a 1 km buffer).

The search identified a total of 56 “listed threatened” species and 69 “listed migratory” species that potentially use or pass through the PEZ.

In addition, 134 "listed marine" species were identified, of which 29 are "whales and other cetaceans" that may occur at, or immediately adjacent to, the area. The full search results are contained in Appendix B.

Table 4-4 presents the marine species that are "listed threatened" species or "listed migratory species". Note that true terrestrial species have not been listed in Table 4-4.

Table 4-4: Listed threatened and/or migratory species under the EPBC Act potentially occurring within the PEZ

Species	Common name	Conservation status	Migratory
Marine mammals			
Balaenoptera borealis	Sei whale	Vulnerable	Migratory
Balaenoptera edeni	Bryde's whale	N/A	Migratory
Balaenoptera musculus	Blue whale	Endangered	Migratory
Balaenoptera physalus	Fin whale	Vulnerable	Migratory
Megaptera novaeangliae	Humpback whale	Vulnerable	Migratory
Orcinus orca	Killer whale	N/A	Migratory
Physeter macrocephalus	Sperm whale	N/A	Migratory
Dugong dugon	Dugong	N/A	Migratory
Orcaella heinsohni	Australian snubfin dolphin	N/A	Migratory
Sousa chinensis	Indo-Pacific humpback dolphin	N/A	Migratory
Tursiops aduncus	Spotted bottlenose dolphin	N/A	Migratory
Marine reptiles			
Caretta caretta	Loggerhead turtle	Endangered	Migratory
Chelonia mydas	Green turtle	Vulnerable	Migratory
Dermochelys coriacea	Leatherback turtle	Endangered	Migratory
Eretmochelys imbricata	Hawksbill turtle	Vulnerable	Migratory
Lepidochelys olivacea	Olive Ridley turtle	Endangered	Migratory
Natator depressus	Flatback turtle	Vulnerable	Migratory
Crocodylus porosus	Saltwater crocodile	N/A	Migratory
Aipysurus apraefrontalis	Short-nosed sea snake	Critically Endangered	N/A
Aipysurus foliosquama	Leaf-scaled sea snake	Critically Endangered	N/A

Species	Common name	Conservation status	Migratory
Sharks, fish and rays			
Rhincodon typus	Whale shark	Vulnerable	Migratory
Carcharodon carcharias	Great white shark	Vulnerable	Migratory
Glyphis garricki	Northern river shark	Endangered	N/A
Glyphis glyphis	Speartooth Shark	Critically Endangered	N/A
Pristis clavata	Dwarf sawfish	Vulnerable	Migratory
Pristis pristis	Northern sawfish, Freshwater sawfish, Largetooth sawfish	Vulnerable	Migratory
Pristis zijsron	Green sawfish	Vulnerable	Migratory
Anoxypristis cuspidata	Narrow sawfish	N/A	Migratory
Isurus oxyrinchus	Shortfin mako	N/A	Migratory
Isurus paucus	Longfin mako	N/A	Migratory
Manta alfredi	Reef manta ray	N/A	Migratory
Manta birostris	Giant manta ray	N/A	Migratory
Marine avifauna			
Anous tenuirostris melanops	Australian lesser noddy	Vulnerable	N/A
Calidris canutus	Red Knot	Endangered	Migratory
Calidris ferruginea	Curlew Sandpiper	Critically Endangered	Migratory
Calidris tenuirostris	Great Knot	Critically Endangered	Migratory
Charadrius leschenaultii	Greater Sand Plover	Vulnerable	Migratory
Charadrius mongolus	Lesser Sand Plover	Endangered	Migratory
Limosa Lapponica baueri	Bar-tailed Godwit	Vulnerable	Migratory
Limonsa lapponica menzbieri	Northern Siberian Bar-tailed Godwit	Critically Endangered	Migratory
Numenius madagascariensis	Eastern curlew	Critically Endangered	N/A
Papasula abbotti	Abbott's Booby	Endangered	Migratory
Rostratula australis	Australian Painted Snipe	Endangered	N/A

Species	Common name	Conservation status	Migratory
Anous stolidus	Common noddy	N/A	Migratory
Apus pacificus	Forktailed swift	N/A	Migratory
Ardenna pacifica	Wedge-tailed Shearwater	N/A	Migratory
Calonectris leucomelas	Streaked shearwater	N/A	Migratory
Fregata ariel	Lesser frigatebird	N/A	Migratory
Fregata minor	Great frigatebird	N/A	Migratory
Hydroprogne caspia	Caspian tern	N/A	Migratory
Onychoprion anaethetus	Bridled tern	N/A	Migratory
Phaethon lepturus	White-tailed tropicbird	N/A	Migratory
Phaethon rubricauda	Red-tailed tropicbird	N/A	Migratory
Sterna dougallii	Roseate tern	N/A	Migratory
Sternula albifrons	Little tern	N/A	Migratory
Sula dactylatra	Masked booby	N/A	Migratory
Sula leucogaster	Brown booby	N/A	Migratory
Sula sula	Red-footed booby	N/A	Migratory
Acrocephalus orientalis	Oriental Reed-Warbler	N/A	Migratory
Actitis hypoleucos	Common Sandpiper	N/A	Migratory
Arenaria interpres	Ruddy Turnstone	N/A	Migratory
Calidris acuminata	Sharp-tailed Sandpiper	N/A	Migratory
Calidris alba	Sanderling	N/A	Migratory
Calidris melanotos	Pectoral Sandpiper	N/A	Migratory
Calidris ruficollis	Red-necked Stint	N/A	Migratory
Charadrius veredus	Oriental Plover	N/A	Migratory
Glareola maldivarum	Oriental Pratincole	N/A	Migratory
Limosa limosa	Black-tailed Godwit	N/A	Migratory
Numenius phaeopus	Whimbrel	N/A	Migratory
Pandion haliaetus	Osprey	N/A	Migratory

Species	Common name	Conservation status	Migratory
Pluvialis fulva	Pacific Golden Plover	N/A	Migratory
Pluvialis squatarola	Grey Plover	N/A	Migratory
Thalasseus bergii	Crested Tern	N/A	Migratory
Tringa brevipes	Grey-tailed Tattler	N/A	Migratory
Tringa nebularia	Common Greenshank	N/A	Migratory
Tringa totanus	Common Redshank	N/A	Migratory
Xenus cinereus	Terek Sandpiper	N/A	Migratory

Conservation management plans

In addition to species being identified as threatened or migratory and MNES, depending on the threat classification, the DAWE has established management policies, guidelines, plans and other materials for threatened fauna, threatened flora (other than conservation-dependent species) and threatened ecological communities listed under the EPBC Act.

In particular, the objectives of DAWE recovery plans and conservation advice, seek to support the long-term recovery of various species outlining research and management measures that must be undertaken to stop the decline of, and support the recovery of a species, including the management of threatening processes.

Species identified during the EPBC Act Protected Matters search that have a conservation advice or a recovery plan in place, as well as any particular relevant actions to assist their recovery and conservation, including threat abatement plans, are summarised in Appendix B.

Biological important areas

The DAWE has, through the marine bioregional planning program, identified, described and mapped biologically important areas (BIAs) for protected species under the EPBC Act. BIAs spatially and temporally define areas where protected species display biologically important behaviours (including breeding, foraging, resting or migration), based on the best available scientific information. These areas are those parts of a marine region that are particularly important for the conservation of protected species.

Table 4-5 provides an overview of the EPBC-listed species, identified by the EPBC Act Protected Matters search, that are associated with a BIA in the PEZ. The locations of relevant BIAs for EPBC-listed species are shown in Figure 4-4 to Figure 4-8.

Note, there are no BIAs that intersect the licence area, with the closest BIAs being a green turtle internesting buffer at Browse Island and the whale shark foraging BIA located approximately 15 km south east of WA-50-L at its closest point.

Table 4-5: BIAs intersecting the PEZ

Species	Migration route	Foraging	Internesting	Resting/breeding	Aggregation/calving	Pupping/ nursing
Humpback whale	x				x	
Pygmy blue whale	x	x				
Dugong		x				
Coastal dolphins: Australian snubfin and bottlenose dolphin		x		x	x	
Whale shark		x				
Largetooth/freshwater, dwarf, and green sawfish		x				x
Avifauna		x		x		
Flatback turtle		x	x			
Green turtle		x	x			
Hawksbill turtle		x	x			
Loggerhead turtle		x				

Marine mammals

Noise logging surveys were undertaken by INPEX to determine the critical areas of use and to establish a baseline of abundance for cetaceans within the Kimberley region. Noise loggers were set on the sea floor at two sites: in the Browse Basin 45 km north west of Browse Island (in 240 m of water) and at an inshore site near the Maret Islands (in 45 m of water) between September 2006 and August 2008. The loggers detected anthropogenic noise signals from vessel activities and seismic surveys, as well as signals from pygmy blue whales, humpback whales, Antarctic and dwarf minke whales, a signal which is believed to be from Bryde's whales, and several unknown great whale signals, plus a plethora of fish signal types and choruses (McCauley 2009).

There are no identified BIAs for marine mammals within WA-50-L. However, a number of marine mammal BIAs overlap the PEZ as outlined in Table 4-5 and shown in Figures 4-4 and 4-5. Marine mammals associated with a BIA in the PEZ are described in more detail within this subsection.

Humpback whale

There are two humpback whale (Megaptera novaeangliae) BIAs located within the PEZ; a migratory corridor and a breeding and calving area, as shown in Figure 4-4. During their annual northern and southern migrations, transitory humpback whales will pass through the PEZ generally between June and October, with peak ingress during July. The population increases up to mid-August when whales begin to depart on their southern migration. Peak egress occurs around September and the final groups of whales tend to have departed by late October (Jenner et al. 2001; Thums et al. 2018).

The migratory habitat for the humpback whale around mainland Australia is primarily coastal waters less than 200 m in depth and generally within 20 km of the coast (Jenner et al. 2001). Breeding and calving generally occurs between the Lacepede Islands and Camden Sound. Camden Sound is considered the northern most limit and is considered an important calving and breeding area (Jenner et al. 2001). A recent study as part of the Kimberley Marine Research Project (Thums et al. 2018) analysed three decades of satellite, aerial, boat-based sightings and determined that abundance was greatest in nearshore waters in water depths of approximately 35 m. However, whales (including cows and calves) may also occur in lower abundance elsewhere within and further offshore from the BIAs, with whales having been recorded in offshore locations such as Browse Island and Scott Reef (e.g. McCauley 2009). Isolated observations of humpback whales and their calves have been noted within the Ichthys Field. The closest BIA to WA-50-L relates to calving and resting and is located approximately 120 km south east of the licence area.

Blue Whale

There are two recognised subspecies of blue whale in the southern hemisphere, which are both recorded in Australian waters. They are the southern (or 'true') blue whale (*Balaenoptera musculus intermedia*) and the 'pygmy' blue whale (*Balaenoptera musculus brevicauda*) (DoE 2015). In general, southern blue whales occur in waters south of 60°S and pygmy blue whales occur in waters north of 55°S (i.e. not in the Antarctic) (DoE 2015). On this basis, any blue whales present within the licence area/PEZ would be expected to be pygmy blue whales.

The 2015 Conservation Management Plan for the Blue Whale (DoE 2015) outlines the distribution of blue whales in Australian waters, and associated BIAs (i.e. migratory corridor and foraging areas). The closest BIA present within the PEZ, is a migratory corridor, located approximately 60 km west of WA-50-L at its closest point, and a foraging BIA at Scott Reef, approximately 98 km west of WA-50-L (Figure 4-4).

Pygmy blue whale migration is thought to follow deep oceanic routes. More recently, the migration route has been defined as along the shelf edge at depths between 500 m to 1,000 m (DoE 2015). Observations suggest most pygmy blue whales pass along the shelf edge out to water depths of 1,000 m but centred near the 500 m depth contour (McCauley & Jenner 2010). Satellite tagging (2009–2011) confirmed that the general distribution of pygmy blue whales was offshore in water depths >200 m and commonly >1,000 m (Double et al. 2014).

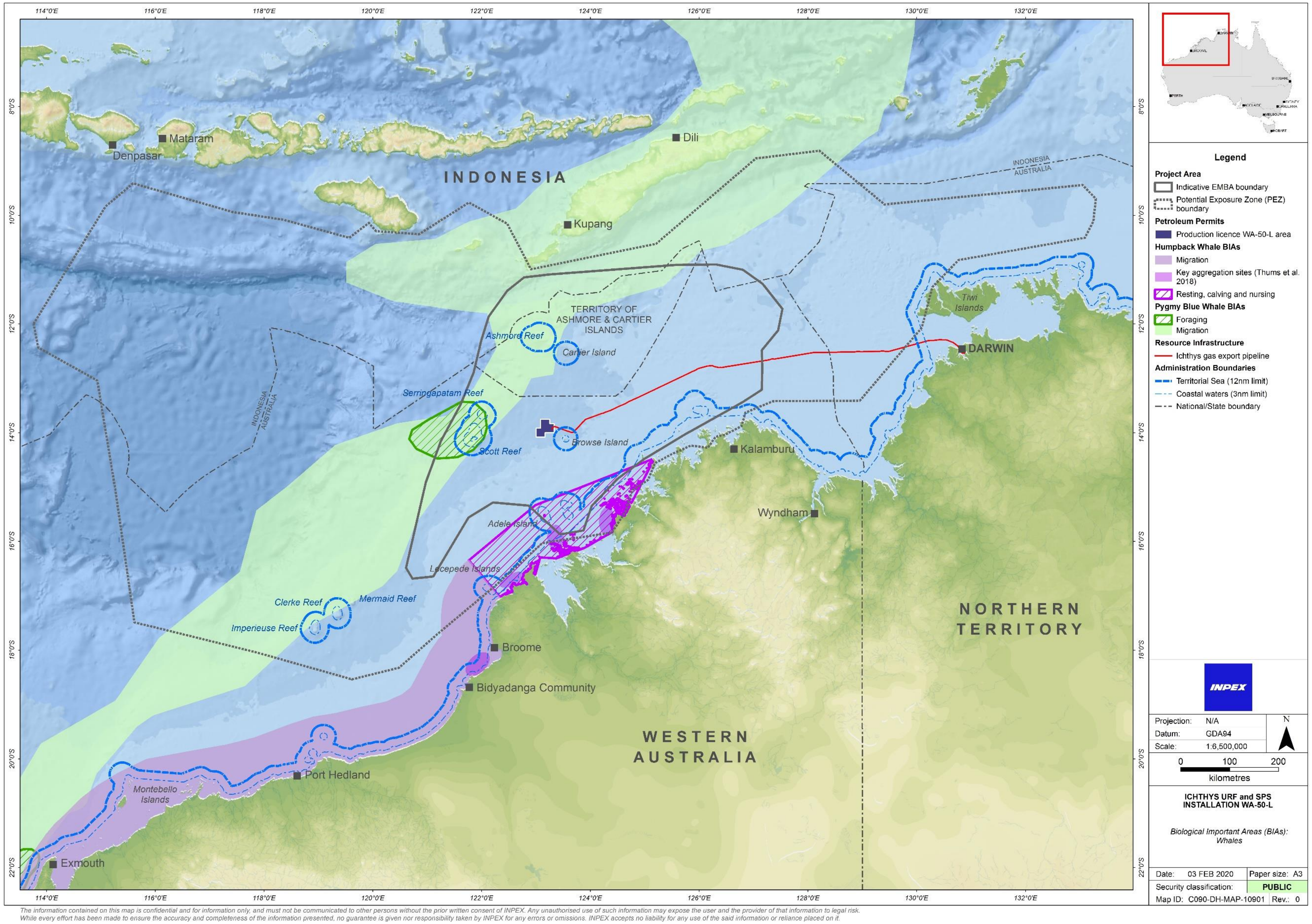

Figure 4-4: Biologically important areas associated with whales

Dugongs

Within the PEZ, there is a dugong foraging BIA at Ashmore Reef and another along the Dampier Peninsula, near Broome (Figure 4-5) which correlates with seagrass habitats (refer Section 4.8.2).

Dugongs are considered Specially Protected under Schedule 4 of the Biodiversity Conservation Act 2018 (WA) and are listed as migratory species under the EPBC Act. However, a significant proportion of the world's dugong population occurs in the coastal waters of the west-Pilbara nearshore, as well as Ningaloo Reef and Exmouth Gulf (Marsh et al 2011). Dugongs generally inhabit shallow waters (around 10 m depth) and are commonly found in mangrove channels of inshore islands and shallow areas near the seagrass habitats on which they feed (DEE 2020b).

Dolphins

Coastal dolphin BIAs for breeding, resting, calving and foraging are shown in Figure 4-5. There are three species of coastal dolphin to which these BIAs relate with two species potentially occurring within the PEZ (Appendix B) although their presence is unlikely to be common given their preference for coastal waters. A recent study of snubfin and humpback dolphins in the Kimberley region (Waples et al. 2019) confirmed these species of dolphins are present at low densities and occur as relatively small populations across the Kimberley.

Spotted bottlenose dolphin

The spotted bottlenose dolphin (*Tursiops aduncus*) is generally considered to be a warm water subspecies of the common bottlenose dolphin (*Tursiops truncatus*). This species of dolphin appears to occupy inshore waters, often in depths of less than 10 m (Bannister et al. 1996). It is known to occur from Shark Bay, north to the western edge of the Gulf of Carpentaria and is regarded as a migratory species under the EPBC Act (DEE 2020c).

Australian snubfin dolphin

All available data on the distribution and habitat preferences of Australian snubfin dolphin (*Orcaella heinsohni*) indicate that they mainly occur in the shallow coastal and estuarine waters of the NT and north WA (Beasley et al. 2002). There are no data to estimate any past or potential future declines in the area of occupancy for snubfin dolphins in Australia; however, incidental catches in gillnets (albeit at unknown levels), in addition to habitat degradation, may lead to a reduction of area of occupancy over the next three generations for Australian snubfin dolphins. (DEE 2020d).

Indo-Pacific humpback dolphin

The Indo-Pacific humpback dolphin (*Sousa chinensis*) occurs along the northern coastline of Australia down to Exmouth on the WA coastline. The total population size of the Indo-Pacific humpback dolphin in Australian waters is unknown. Given that the required shallow habitat preferred by this species occurs continuously throughout its recorded range, the distribution of the Indo-Pacific Humpback Dolphin is considered to represent one continuous location (DEE 2020e).

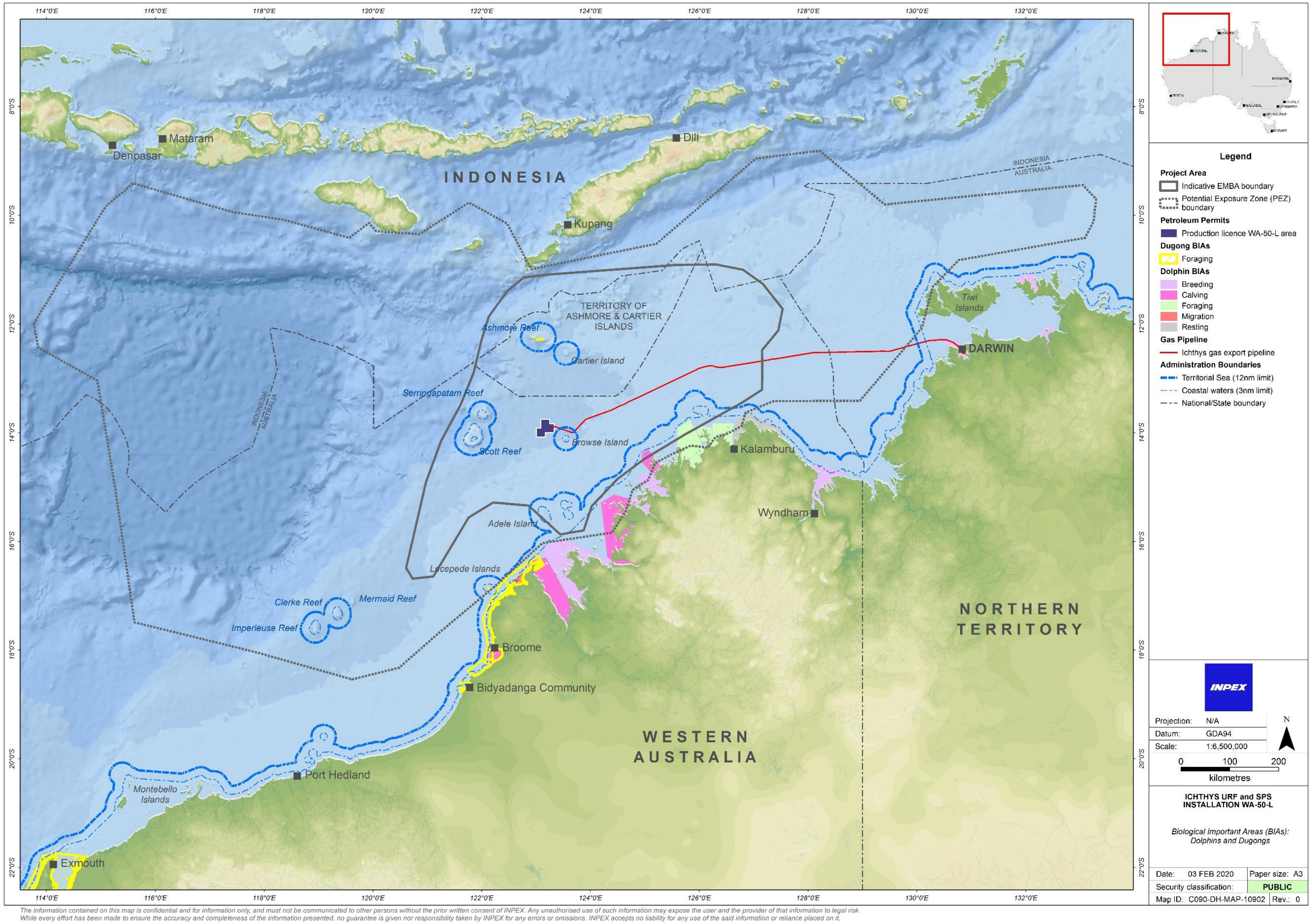

Figure 4-5: Biologically important areas associated with dugongs and dolphins

Marine reptiles

Turtles

The EPBC Act Protected Matters search identified six species of marine turtle which may occur within the PEZ: the green turtle (*Chelonia mydas*), loggerhead turtle (*Caretta caretta*), leatherback turtle (*Dermochelys coriacea*), flatback turtle (*Natator depressus*), hawksbill turtle (*Eretmochelys imbricate*) and olive ridley turtle (*Lepidochelys olivacea*). While there are no known BIAs for marine turtles within WA-50-L, there are a range of BIAs for turtle breeding, foraging and internesting within the PEZ (Figure 4-6). Nesting rookeries within the PEZ include Browse Island, Ashmore Reef, Cartier Island, Scott Reef, Tiwi Islands and the Lacepede Islands as identified in the Recovery Plan for Marine Turtles in Australia (DEE 2017a). Peak nesting periods for all turtle species within these areas are generally between November and April. Further, 20 km internesting buffers associated with green turtles have been identified for Browse Island and Scott Reef (Sandy Islet) between November and March (DEE 2017a). At the Tiwi islands, an internesting buffer for flatback (60 km) and olive ridley (20 km) turtles has been identified year-round (DEE 2017a) with peak nesting occurring between June – September and April - June respectively. Foraging BIAs for these species occurs at the Joseph Bonaparte Depression and Joseph Bonaparte Gulf, which overlap the PEZ (Figure 4-6).

Satellite tagging of nesting female loggerhead turtles from the Ningaloo/Pilbara coast of Western Australia have shown dispersal north-west as far as Indonesia and southern Borneo, north-east as far as the Tiwi Islands and south as far as the Great Australian Bight (Waayers et al. 2015; Whiting et al. 2008). Flatback turtles are known to forage across the Australian continental shelf as far north as Indonesia and Papua New Guinea (DEE 2017a). There is limited tag recovery data for olive ridley turtles, but satellite tracking data indicates that they appear to remain on the Australian continental shelf (Waayers et al. 2015).

Turtles are not expected to be present in high numbers in WA-50-L. However, individual green turtles may occasionally be present associated with the internesting buffer at Browse Island, and other marine turtle species are likely to be present in the waters of the PEZ as it encompasses a number of locations that support turtle foraging, nesting and internesting behaviours.

Sea snakes

The EPBC search identified 25 sea snakes which may occur within the PEZ. There are no reported BIAs for sea snakes. Most of the knowledge of sea snakes in Australian waters comes from trawler bycatch (Milton et al. 2009; Ward 1996). These studies indicate that sea snakes in northern regions of Australia tend to breed in shallow embayments and estuaries which are only represented in the PEZ. Therefore, these species may be seen in the open waters of WA-50-L but their presence is unlikely to be common.

Crocodiles

The salt-water crocodile has a tropical distribution that extends across the northern coastline of Australia, where it can be found in coastal waters, estuaries, freshwater lakes, inland swamps and marshes, as well as far out to sea (Webb et al. 1987). There are no reported BIAs for crocodiles. Due to the species preference for estuaries and swamps and coastal waters it is unlikely to occur in the open waters of WA-50-L and is more likely to be observed in the PEZ where these preferred habitats occur.

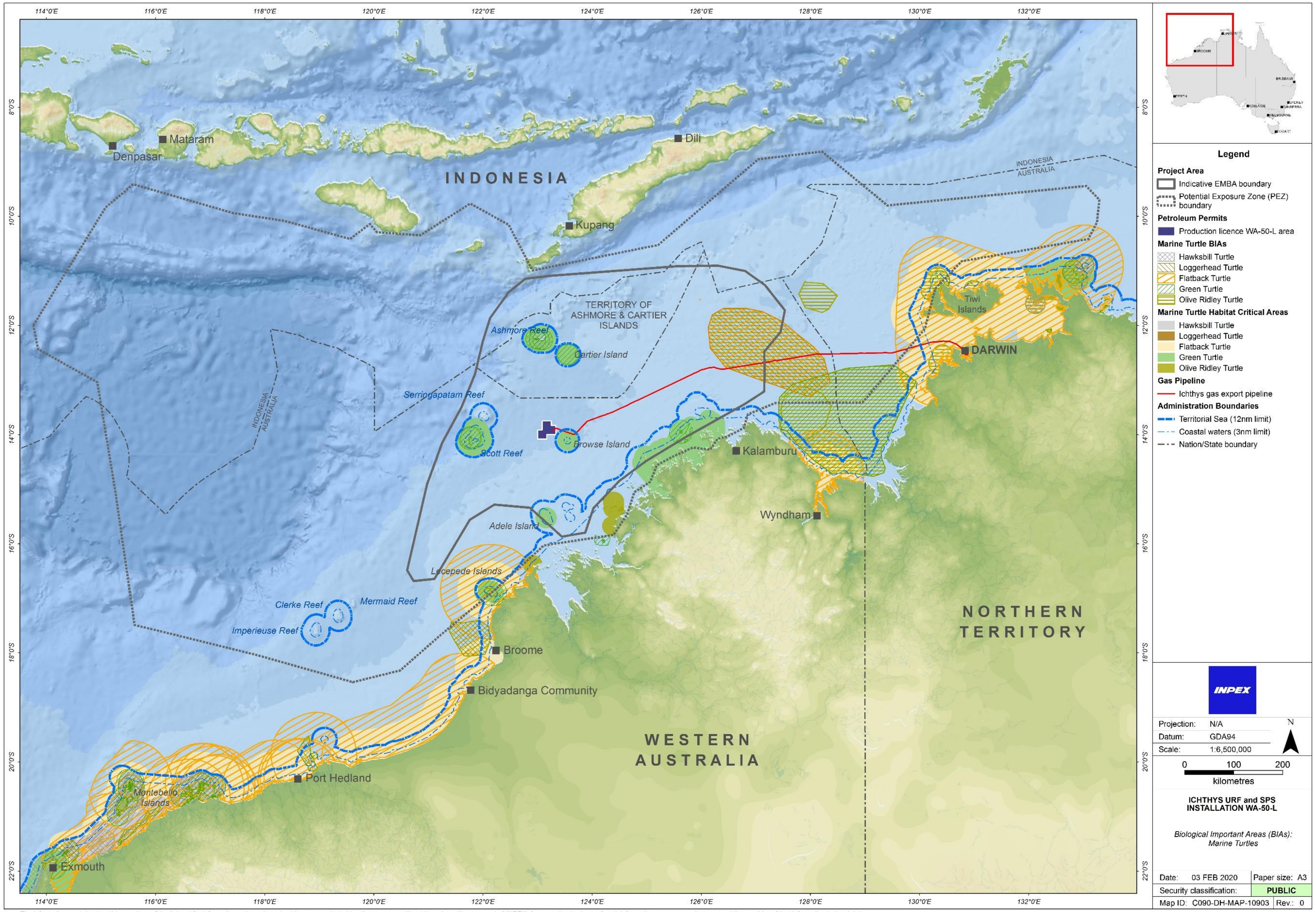

Figure 4-6: Biologically important areas associated with marine turtles

Fishes and sharks

While there are no BIAs for fishes and sharks within WA-50-L, in the PEZ a BIA exists for whale sharks (foraging area) that largely follows the 125 m ancient coastline and at its closest point is approximately 15 km south east of WA-50-L as shown in Figure 4-7. There are also BIAs for sawfish (green, dwarf and freshwater) located to the south-west and north-east of Broome.

Although not specifically identified as BIAs, several of the KEFs within the PEZ, as described in Section 4.2 are also known to provide important habitat for diverse fish assemblages.

Whale shark

The whale shark is a solitary planktivorous species that spends the greater part of its foraging time at water depths above 100 m, often near the surface (Brunnschweiler & Sims 2011; Wilson et al. 2006). However, whale sharks are also known to engage in mesopelagic and even bathypelagic diving when in bathymetrically unconstrained habitats (Brunnschweiler et al. 2009; Wilson et al. 2006).

Whale sharks appear to prefer different locations at different times of year, and despite a reasonable understanding of the various whale shark aggregation locations and timings, little is known about the large-scale transoceanic movements in response to seasonal abundance of planktonic prey species (Eckert & Stewart 2001).

It is however understood that whale sharks can travel over vast distances between aggregation sites. One whale shark tagged in the Seychelles was relocated after 42 days having travelled 3,000 km to south of Sri Lanka and then located again 4 months later, a further 5,000 km away in the waters of Thailand (Hsu et al. 2007). Therefore, it is possible that whale sharks may transit through the PEZ in both Australian and International waters.

Whale sharks are widely distributed in tropical Australian waters. Within WA, whale sharks aggregate seasonally (March–June) to feed in coastal waters off Ningaloo Reef (Wilson et al. 2006). Taylor (1996) and Rowat & Gore (2007) examined whale shark movements at Ningaloo Reef and observed that the sharks swim parallel to the reef but found no clear evidence of a north-south migration.

Whilst Ningaloo is the nearest aggregation to the WA-50-L, it is located over 1,300 km to the south. Research on the migration patterns of whale sharks in the western Indian Ocean, indicates that a small number of the WA (Ningaloo) population migrate through the wider vicinity of the Browse Basin region (McKinnon et al. 2002; Wilson et al. 2006; Jenner et al. 2008; Meekan & Radford 2010). Whale sharks from Ningaloo Reef fitted with satellite trackers were observed to travel either north-east towards Timor Leste, or north-west towards the Indonesia islands of Sumatra and Java, with some individuals passing through the broad vicinity of Scott Reef (McKinnon et al. 2002, Wilson et al. 2006, Meekan & Radford 2010; Sleeman et al. 2010). Aerial (Jenner & Jenner 2009a; RPS Environment and Planning Pty Ltd 2010, 2011) and vessel (Jenner et al. 2008; Jenner & Jenner 2009b) surveys conducted in 2008 and 2009, involving over 1,000 hours of observer effort, recorded one whale shark in 2008 and two whale sharks in 2010 in the Browse Basin (Jenner et al. 2008 and RPS Environment and Planning Pty Ltd 2011 respectively).

Within the PEZ, the whale shark BIA largely follows the ancient coastline at 125 m depth contour KEF and at its closest point is located approximately 15 km south east of WA-50-L. However, based on the levels of whale shark abundance observed in the studies listed above, the likelihood of whale shark presence within this BIA is considered very low, with no specific seasonal pattern of migration.

Sawfish

Four species of sawfish (largetooth/freshwater/northern, narrow, dwarf and green sawfish) were identified in the EPBC search (Table 4-4). While sawfish are identified as being found within the PEZ due to their ecology (generally estuarine rather than open-ocean species) it is expected that they will only be present on the periphery of the PEZ (Figure 4-7).

As described in Section 4.3, environments found in the PEZ provide protection for shallow shelf habitats that are important foraging, nursing and pupping areas for freshwater, green and dwarf sawfish. The range of sawfish species overlaps with popular recreational fishing locations in some parts of the NMR (DSEWPaC 2012b) and adjacent areas. Observations of dead discarded sawfish species from recreational fishing highlights that mortality occurs as a direct result of capture and discarding (DSEWPaC 2012b).

Sawfish are not expected to occur within the open ocean location of WA-50-L.

Pipefish and seahorses

The EPBC search identified 37 species of the family Syngnathidae potentially present within the PEZ. Syngnathidae is a group of bony fishes that includes seahorses, pipefishes, pipehorses and sea dragons. Seahorses and pipefishes are a diverse group and occupy a wide range of habitats. However, the species identified in the EPBC search (Appendix B) generally display a preference for shallow water habitats such as seagrass and macroalgal beds, coral reefs, mangroves and sponge gardens that may be found in the shallower areas of the PEZ (Foster & Vincent 2004; Lourie et al. 1999; Scales 2010). In WA-50-L, water depths are approximately 250 m and preclude the presence of seagrass; and hard bottom substrates, which can potentially support coral and macroalgae sponge garden communities. Therefore, pipefish and seahorses are only expected to occur in the PEZ in areas where suitable habitats are present.

Sharks and rays

Six shark species (including whale shark described above) and two ray species were identified as having the potential to occur within the PEZ (Table 4-4; Appendix B).

It is considered possible that larger pelagic sharks such as the great white, whale and mako sharks may transit through the licence area. The likelihood of these species occurring in WA-50-L is expected to be very low as the licence area is not considered to provide habitat that is of breeding or feeding importance. As such, these species are unlikely to be common or resident within WA-50-L.

The majority of recorded great white shark movements in Australian waters are reported to occur between the coast and the 100 m depth contour (DEE 2020f).

Listed manta rays have been observed within the PEZ, but for the same reasons as the large pelagic sharks, are unlikely to be common or resident within WA-50-L.

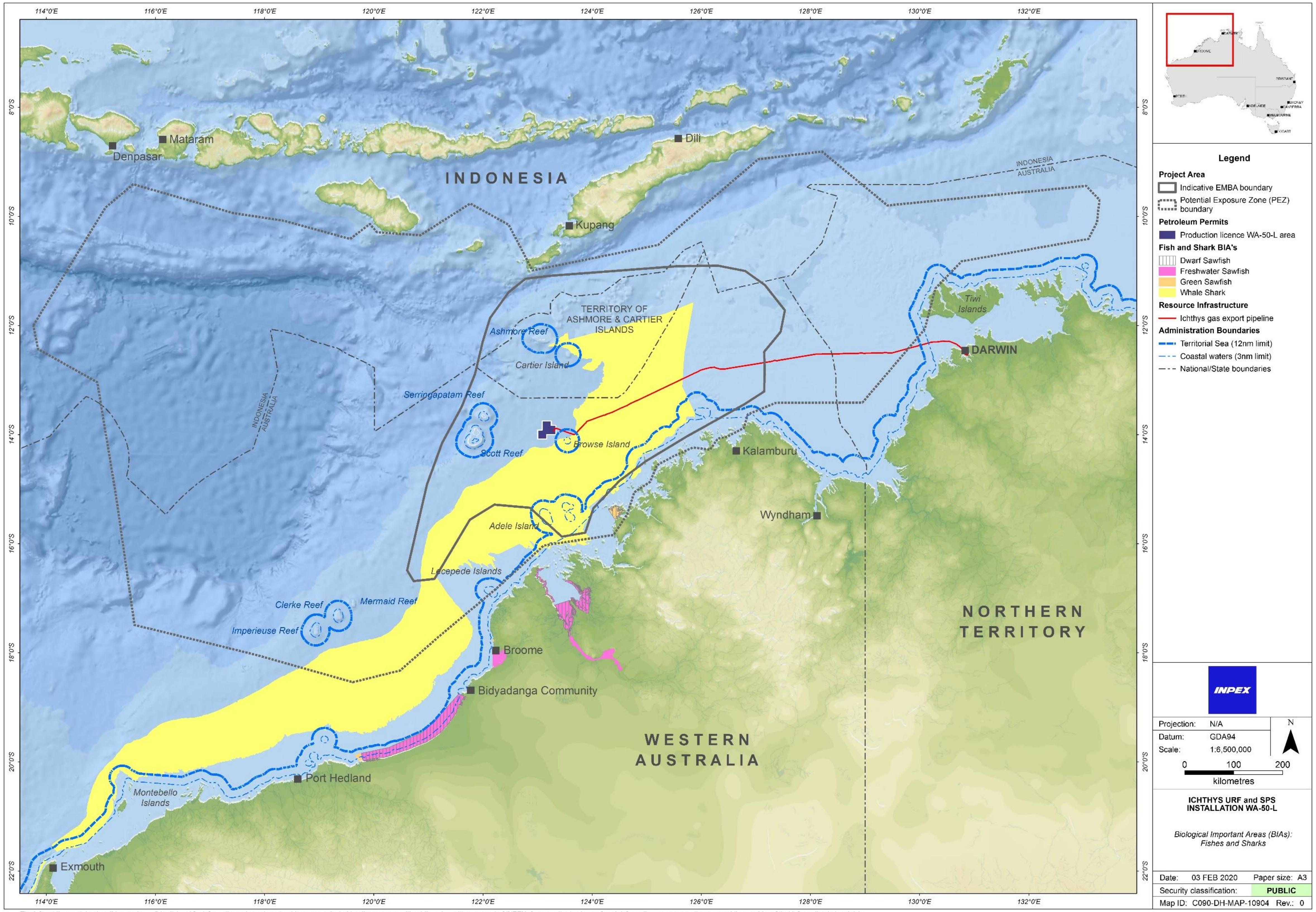

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Figure 4-7: Biologically important areas associated with fishes and sharks

Marine avifauna

WA-50-L is located within what is known as the East Asian–Australasian Flyway an internationally recognised migratory bird pathway that covers the whole of Australia and its surrounding waters. ‘Flyway’ is the term used to describe a geographic region that supports a group of populations of migratory waterbirds throughout their annual cycle. There are 54 species of migratory shorebirds that are known to specifically follow migration paths within the EAA Flyway (Bamford et al. 2008). Migratory shorebird species are mostly present in Australia during the non-breeding period, from as early as August to as late as April/May each year. After arrival in Australia at the end of long migrations, they disperse throughout the country to a wide variety of habitats including coastal wetlands, mudflats, reefs and sandy beaches (DEE 2017b).

There are no BIAs for marine avifauna within WA-50-L. However, the PEZ overlaps a large number of BIAs for a number of different marine avifauna species (Figure 4-8). The closest BIAs for marine avifauna relate to foraging around Adele Island, Ashmore Reef and Cartier Island, and Scott Reef. A Ramsar site (Ashmore Reef) and nationally important wetland (Mermaid Reef) are also present within the PEZ (refer to Section 4.6), these sites provide important habitat for marine avifauna.

Vessel-based surveys conducted around the Ichthys gas field, Browse Island and to the west as far as Scott Reef were conducted by the Centre for Whale Research in 2008. Seabirds observed included frigatebirds, boobies, terns, noddies, tropicbirds, petrels, shearwaters and gulls, with the brown booby the most common species recorded. Of the species recorded during the vessel-based surveys, a number are migratory species listed under the EPBC Act, including the streaked shearwater, brown booby, masked booby, lesser frigatebird, bridled tern, lesser crested tern and little tern. These migratory species can be expected to be encountered in low numbers as they are likely to transit through the licence area and the PEZ.

In addition to seabirds, the search of the EPBC database identified 25 species of migratory wetland bird species potentially present within the PEZ. These species may migrate through the PEZ to wetland habitats on the mainland and/or larger coastal islands (DEE 2017b). It is considered unlikely that WA-50-L would provide any significant resources to support these species.

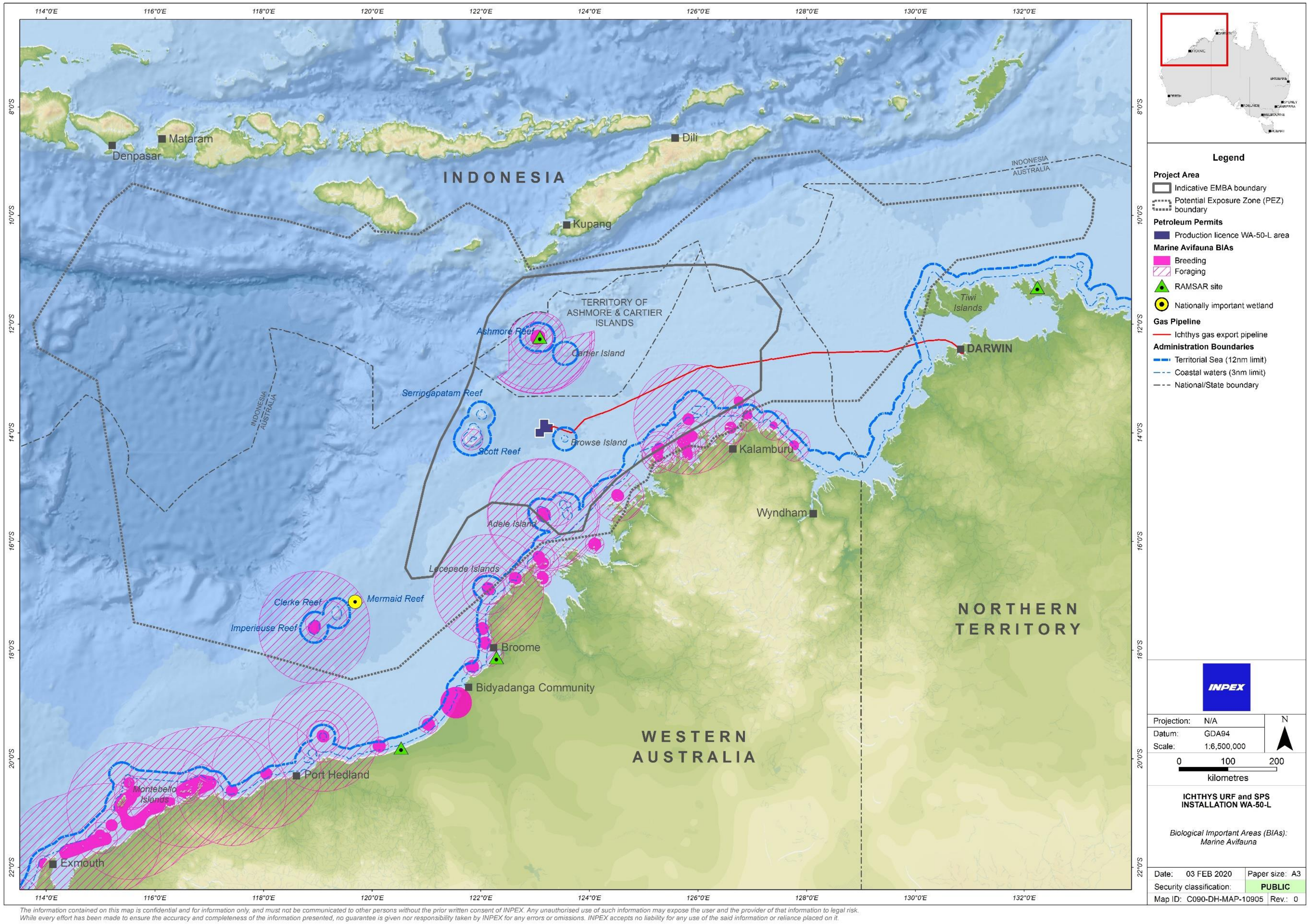

Figure 4-8: Biologically important areas associated with marine avifauna

4.9 Socioeconomic and cultural environment

4.9.1 World heritage areas

No world heritage areas were identified as overlapping WA-50-L or the PEZ.

4.9.2 National heritage places

The West Kimberley

The West Kimberley was included on the National Heritage List in 2011 and has numerous values which contribute to the significance of the property, including indigenous, historic, aesthetic, cultural and natural heritage values (DEE 2020g). The West Kimberley is characterised by a diversity of landscapes and biological richness found in its cliffs, headlands, sandy beaches, rivers, waterfalls and islands.

4.9.3 Fishing

Commercially significant fish stocks, considered to be key indicator species, that may be present in the licence area are shown in Table 4-6, including spawning and aggregation times. Although potentially present, given the water depth and absence of suitable habitats these species are considered not likely to spawn or aggregate in the deep waters of WA-50-L as their preferred spawning and aggregation areas are shallow coastal habitats, reefs and headlands and around estuaries.

Table 4-6: Commercially significant fish species

Key commercial fish species	Spawning/aggregation times
Goldband snapper	Goldband snapper typically occur in 50 – 200 m water depths, and often concentrated in depths from 80 – 150 m. They spawn throughout their range (rather than aggregating at specific locations) during November to May (extended peak spawning period).
Spanish mackerel	Spanish mackerel occur in continental shelf waters and congregate in coastal waters around reefs, shoals and headlands to feed and spawn, occurring typically in water depths from 1 -50 m. They form spawning schools around inshore reefs with peak spawning period of September to January.
Rankin cod	Rankin cod typically occur in water depths of 10 – 150 m. They spawn throughout their range (rather than aggregating at specific locations) during June to December and March (peak spawning period August to October.
Red emperor	Red emperor typically occur in 10 – 180 m water depths, and are often concentrated in depths from 60 – 120 m. They spawn throughout their range (rather than aggregating at specific locations) during September to June (with bimodal peaks from September to November and January to March).
Bluespotted emperor	Blue spotted emperor typically occur in water depths of 5 – 110 m. They spawn throughout their range (rather than aggregating at specific locations) during July to March (extended peak spawning period).

Commercial fisheries– Australian waters

Within the PEZ, five Commonwealth-managed fisheries have the potential to operate with four fishery boundaries overlapping WA-50-L as summarised in Table 4-7.

In addition to the Commonwealth-managed fisheries, 32 State-managed commercial fisheries have the potential to operate within the PEZ. Of these, five fishery boundaries overlap with WA-50-L (Table 4-8).

Fisheries highlighted in bold have potential fishing grounds that overlap with WA-50-L, it does not indicate that they are currently active within the licence area; however, there is a potential that they may be in the future.

Table 4-7: Commonwealth-managed commercial fisheries (AFMA-managed)

Commercial fishery **(BOLD denotes overlap with WA-50-L)**	**Fishery summary**
Western Tuna and Billfish Fishery	The Western Tuna and Billfish Fishery targets bigeye tuna (*Thunnus obesus*), yellowfin tuna (*Thunnus albacares*), broadbill swordfish (*Xiphias gladius*) and striped marlin (*Tetrapturus audax*). The fishery targets areas of reef which are present within the PEZ and mainly use longline fishing gear to catch the targeted species. The Billfish Fishery covers the sea area west from the tip of Cape York in Queensland, around Western Australia, to the border between Victoria and South Australia. Fishing occurs in both the Australian Fishing Zone and adjacent high seas. In the fishery there are currently 95 boats with statutory fishing rights (AFMA 2020a).
Western Skipjack Fishery	The Western Skipjack Fishery covers the entire sea around WA out to 200 nm from the coast. The fishery targets the skipjack tuna (*Katsuwonus pelamis*) and employs the purse seine, pole and line, and longline methods as its techniques. Although 14 permits are in place, the fishery is not currently active (AFMA 2020b).
North West Slope Trawl Fishery	The North West Slope Trawl Fishery targets scampi (*Metanephrops australiensis*) and deepwater prawn. The fishery is located in deep water from the coast of the Prince Regent National Park to Exmouth between the 200 m depth contour to the outer limit of the Australian Fishing Zone (AFMA 2020c). There are seven fishing permits (maximum number of vessels active at one time) each with a five-year duration in the North West Slope Trawl Fishery. It is the only active fishery in the vicinity of WA-50-L, with reportedly low negligible trawl-fishing in the Ichthys Field; however, catch data is confidential for this fishery (AFMA 2020c).
Southern Bluefin Tuna Fishery	The Southern Bluefin Tuna Fishery covers the entire sea around Australia, out to 200 nm from the coast. There are 84 statutory fishing right owners in the fishery. This fishery is managed under a quota system to ensure the species is not subject to overfishing as has happened in the past. Commercial fishers mainly use the purse seine fishing method to catch southern bluefin tuna. With the fish being towed closer inshore and transferred to permanent floating pontoons. The major landing port is Port Lincoln in South Australia (AFMA 2020d) and therefore does not overlap the PEZ. No catch is taken from the NWS.
Northern Prawn Fishery	The Northern Prawn Fishery targets banana prawns (*Fenneropenaeus merguiensis, F. indicus*) tiger prawns (*Penaeus esculentus, P. semisulcatus*) and endeavour prawns (*Metapenaeus endeavouri, M. ensis*) in northern Australian waters. The fishery

Commercial fishery **(BOLD denotes overlap with WA-50-L)**	**Fishery summary**
	occasionally operates from from Cape York in Queensland to Cape Londonderry in WA and is predominantly active in the shallower waters of the PEZ. To manage the fishery, there are 2 fishing seasons (April –June and August to November). There are currently 52 boats with fishing rights in the fishery (maximum number vessels at one time) and bottom trawl fishing gear is used in this fishery (AFMA 2020e).

Table 4-8: State/Territory-managed commercial fisheries (WA DPIRD/NT DPIR)

Commercial fishery **(BOLD denotes overlap with WA-50-L)**	**Fishery summary**
Northern Demersal Scalefish Managed Fishery (WA) Area 2 (Area 1 & 2 overlaps PEZ but not WA-50-L)	The Northern Demersal Scalefish Managed Fishery is primarily a trap-based fishery which targets red emperor and gold band snapper. The fishery operates off the north-west coast of WA in the waters east of longitude 120°E and overlaps the PEZ. The typical catch is in the order of 3,000 tonnes annually, making these fisheries the most valuable finfish sector in the State, with an estimated annual value of at least $12 million (Gaughan & Santoro 2018).
Mackerel Managed Fishery (WA) Area 1 (Area 2 overlaps PEZ but not WA-50-L)	The Mackerel Managed Fishery uses near-surface trolling gear from vessels in coastal areas around reefs, shoals and headlands (WAFIC 2020a). The fishery targets Spanish mackerel (*Scomberomorus commerson*). There are currently 50 licences in the fishery with 15 active in the Kimberley area where the majority of the catch is taken (Gaughan & Santoro 2018).
North Coast Shark Fishery (Cwlth/WA) Northern Zone (Southern Zone overlaps PEZ but not WA-50-L)	The northern shark fisheries comprise the state-managed WA North Coast Shark Fishery in the Pilbara and western Kimberley, and the Joint Authority Northern Shark Fishery in the eastern Kimberley. Target species of the northern shark fisheries include the sandbar, hammerhead, blacktip and lemon sharks (AFMA 2020f). This fishery has not been active since 2008/2009 (AFMA 2020f).
Pearl Oyster Managed Fishery (WA) Zone 3 (Zones 1 and 2 overlap PEZ but not WA-50-L)	The Pearl Oyster Managed Fishery is the only remaining significant wild-stock fishery for pearl oysters. It is a quota-based, dive fishery operating in the shallow coastal waters along the NWS (WAFIC 2020b). The main fishing grounds are off Eighty Mile Beach, with smaller catches being taken around the Lacepede Islands (Gaughan & Santoro 2018). The catch for 2016 was reported to be 541,260 oysters harvested over 19,699 dive hours (Gaughan & Santoro 2018).
West Coast Deep Sea Crustacean Fishery (WA)	The West Coast Deep Sea Crustacean Fishery operates predominantly around the entrance to Shark Bay in water depths from 150-1,200 m (Gaughan & Santoro 2018). Catch in 2016 was 153 tonnes dominated by crystal crabs.

Commercial fishery **(BOLD denotes overlap with WA-50-L)**	**Fishery summary**
Kimberley Prawn Managed Fishery (WA)	The Kimberley Prawn Managed Fishery predominantly target banana prawns (*Penaeus merguiensis*) and catch also includes tiger prawns (*Penaeus esculentus*), endeavour prawns (*Metapenaeus endeavouri*) and western king prawns (*Penaeus latisulcatus*). The fishery operates from the north eastern boundary of the Exmouth Gulf Prawn Fishery to Cape Londonderry, in the PEZ (WAFIC 2020c).
Trochus Fishery (WA)	The Trochus Fishery is a small fishery based on a single target species (*Trochus niloticus*) harvested by hand. The trochus are found on reef tops and are harvested at low tide. The annual harvest in the past decade has ranged between 2 and 15 tonnes. Fishing grounds are located in the remote Kimberley region (WAFIC 2020d)
Specimen Shell Managed Fishery (WA)	The Specimen Shell Managed Fishery is based on the collection of individual shells for the purposes of display, collection, cataloguing, classification and sale. Just over 200 different Specimen Shell species were collected in 2016, using a variety of methods. The main methods are by hand by a small group of divers operating from small boats in shallow coastal waters or by wading along coastal beaches below the high-water mark (Gaughan & Santoro 2018). While the fishery covers the entire WA coastline, there is some concentration of effort in areas adjacent to population centres such as Broome in the PEZ.
South West Coast Salmon Managed Fishery (WA)	South West Coast Salmon Managed Fishery targets Western Australian salmon (*Arripis truttaceus*). This fishery uses beach seine nets. In 2015 and 2016 very large schools of salmon were observed in south-western waters and as far north as Exmouth, which is further north than ever previously reported.
North Coast Crab Fishery (Including Kimberley Mud Crab and Pilbara Crab) (WA)	The North Coast Crab Fishery is a trap-based fishery which targets blue swimmer crabs in the Pilbara (the Pilbara Developing Crab Fishery) and mud crabs in the Kimberley (the Kimberley Developing Mud Crab Fishery) (WAFIC 2020e). Catch rates in these fisheries is very low.
Marine Aquarium Fish Fishery (WA)	This Marine Aquarium Fish Fishery is typically more active in coastal waters between Esperance and Broome with higher levels of effort around the Capes region, Perth, Geraldton, Exmouth and Dampier (Gaughan & Santoro 2018). More than 950 species of marine aquarium fishes may be accessed, with some operators also permitted to take coral, live rock, algae, seagrass and invertebrates.
Hermit Crab Fishery (WA)	The Hermit Crab Fishery specifically targets the Australian land hermit crab (*Coenobita variabilis*) for the domestic and international live pet trade. The fishery operates throughout the year and is one of two land-based commercial fisheries in WA. The fishery is currently permitted to fish in waters north of Exmouth Gulf with three active licences in 2016 (Gaughan & Santoro 2018).

Commercial fishery **(BOLD denotes overlap with WA-50-L)**	**Fishery summary**
Broome Prawn Managed Fishery (WA)	The Broome Prawn Fishery predominantly targets banana prawns (*Penaeus merguiensis*) but also catches tiger prawns (*Penaeus esculentus*), endeavour prawns (*Metapenaeus endeavouri*) and western king prawns (*Penaeus latisulcatus*) (WAFIC 2020f).
Abalone Managed Fishery (WA)	The Abalone Managed Fishery includes the West Coast Roe's Abalone resource and the South Coast Greenlip / Brownlip Abalone resource. Roe's abalone is found in commercial quantities from the SA border to Shark Bay. The commercial fishery harvest method is a single diver working off a 'hookah' (surface-supplied breathing apparatus) using an abalone 'iron' to prise the shellfish off rocks (WAFIC 2020g). The fishery operates in shallow coastal waters coinciding with abalone distributions (Gaughan & Santoro 2018). Although the area of the fishery overlaps WA-50-L, no fishing effort occurs in the licence area given the water depth, water temperature and lack of suitable habitat.
Nickol Bay Prawn Managed Fishery (WA)	The Nickol Bay Prawn Managed Fishery predominantly target banana prawns (*Penaeus merguiensis*) but also catch tiger prawns (*Penaeus esculentus*), endeavour prawns (*Metapenaeus endeavouri*) and western king prawns (*Penaeus latisulcatus*) (WAFIC 2020f).
Pilbara Fish Trap and Trawl Managed Fishery (WA)	The Pilbara Fish Trap and Trawl Fishery lands the largest component of the catch of demersal finfish in the Pilbara (and North Coast Bioregion) comprising more than 50 scalefish species (Gaughan & Santoro 2018).
Pilbara Line	Pilbara line fishery uses drop line fishing method for fish. The indicator species are bluespotted emperor, red emperor, Rankin cod and ruby snapper. Catches around 45 to 50 scalefish species and some deeper offshore species.
Kimberley Gillnet and Barramundi Fishery (WA)	The Kimberley Gillnet and Barramundi Fishery operates in the nearshore and estuarine zones of the North coast bioregion from the WA/NT border to the northern end of Eighty Mile Beach, covering the river systems and tidal creek systems of the Cambridge Gulf, the Ria coast of the northern Kimberley, King Sound, Roebuck Bay and the northern end of Eighty Mile Beach. The fishery targets barramundi and other species taken by the fishery include king threadfin (*Polydactylus macrochir*) and blue threadfin (*Eleutheronema tetradactylum*) (WAFIC 2020h). The fishery is limited to five licences.
Timor Reef Fishery (NT)	The Timor Reef Fishery primarily targets the higher-valued gold-band snapper (*P. multidens*) and other Pristipomoides species. Significant quantities of red snappers (*L malabaricus, L. erythropterus*), red emperors (*L. sefcae*) and cods (Family Serranidae) are also harvested (AFMA 2020f). In 2016 there were 16 licences but only 7 were active (NTSC 2020a). The fishery operates from north-east of Darwin to the WA/NT border and to the outer limit of the Australian Fishing Zone (NTSC 2020a).

Commercial fishery **(BOLD denotes overlap with WA-50-L)**	**Fishery summary**
Demersal (multigear) Fishery (NT)	The Demersal Fishery targets mainly red snappers (*Lutjanus malabaricus, L. erythropterus*) and gold-band snappers (*Pristipomoides spp.).* Painted sweetlips (*Diagramma pictum*) and cods (Family Serranidae) are key byproduct species. Drop lines, traps and trawl are the main gear types used in the fishery (AFMA 2020f). The fishery extends 15 nm from the low water mark to the outer boundary of the Australian Fishing Zone (NTSC 2020b). In 2016, there were 19 licences with only 9 active.
Bait Net Fishery (NT)	Commercial fishers within the Bait Net Fishery are allowed to take all fish for use as bait except barramundi, threadfin salmon, Spanish mackerel or mud crab. Commercial fishing for bait is allowed from the high-water mark to the 3 nm seaward of the low water mark but excluding Darwin Harbour and Shoal Bay. The fishery is currently restricted to two licences which are both allocated (NT DPIR 2020a).
Coastal Net Fishery (NT)	The Coastal Net Fishery targets a range of species, particularly mullet, blue threadfin (*Eleutheronema tetradactylum*), shark and queenfish (*Scomberoides commersonnianus*) (AFMA 2020f). As with the Coastal Line Fishery, the Coastal Net Fishery operates inshore, extending from the high water mark out to 3 nm. There are five current licences with mullet being the primary species taken in the fishery (NT DPIF 2020b).
Coastal Line Fishery (NT)	The Northern Territory's Coastal Line Fishery mainly targets black jewfish (*Protonibea diacanthus*) and golden snapper (*Lutjanus johnii*) (AFMA 2020f). The fishery extends along the NT coast between the high-water mark and15 nm out from the low water mark. The western zone extends from the WA border to the Cobourg Peninsula. It is restricted to 52 licences. The main species taken are black jewfish and golden snapper with the total catch limited to 145 tonnes and 4.5 tonnes respectively (NT DPIF 2020c).
Trepang Fishery (NT)	The Trepang Fishery area extends from the NT high-water mark out to 3 nm. There are 6 licences in the Trepang Fishery, with only one or two boats active over the past few years. Trepang are typically harvested by hand from the intertidal and subtidal zones within the PEZ. The main species targeted is the sandfish (*Holothuria scabra*), commonly found in coastal areas with soft sediments and seagrass beds. There is no closed season for the fishery, although harvesting generally takes place from around April to November due to better water clarity and decreased temperatures (NTSC 2020c).
Aquaculture (NT)	The two major aquaculture activities include Pearl Oyster (*Pinctada maxima*) culture and Barramundi farming (*Lates calcarifer*). Other products include sea cucumber (trepang), giant clams and freshwater plants (NTSC 2020d).

Commercial fishery **(BOLD denotes overlap with WA-50-L)**	**Fishery summary**
Aquarium Fishery (NT)	The Aquarium Fishery extends from the NT inland estuarine and marine waters out to the outer boundary of the Australian Fishing Zone, excluding Aboriginal sacred sites and other closed areas. The fishery targets freshwater and marine species including fish, plants and invertebrates using hand collections or small scoop nets. In 2016, there were 11 licences with only 3 boats active. (NTSC 2020e).
Jigging Fishery (NT)	The Jigging Fishery is currently closed.
Mollusc Fishery (NT)	The Mollusc Fishery operates in intertidal waters from the high water mark out to the low water mark. Molluscs are collected by hand and only shell fish can be taken with no collection of pearl oysters or cephalopods allowed (NT DPIR 2020d). As of 2019, only one commercial licence was allocated by NT DPIR (NT DPIR 2020d).
Mud Crab Fishery (NT)	The Mud Crab Fishery targets mud crabs. The fishery operates in NT tidal waters year-round but most activity stops during the wet season (NTSC 2020f). As of 2016, 49 licences were active across 35 operators, with most working from a single dinghy (NTSC 2020f).
Offshore Net and Line Fishery (NT)	The Offshore Net and Line Fishery targets blacktip sharks (*Carcharhinus tilstoni*, *C. limbatus* and *C. sorrah*) and grey mackerel (*Scomberomorus semifasciatus*) (AFMA 2020f). The fishery extends from the NT high water mark out to the Australian Fishing Zone. However, most fishing occurs in the coastal zone within 12 nm of the coast, and immediately offshore in the Gulf of Carpentaria. The fishery is restricted to 17 licences (NT DPIR 2020e).
Pearl Oyster Fishery (NT)	The Pearl Oyster Fishery extends from the NT high water mark to the outer boundary of the Australian Fishing Zone. A total of 138,000 oysters can be collected by hand only each year (NT DPIR 2020f). As of 2019, there are 5 licences in the fishery.
Spanish Mackerel Fishery (NT)	The Spanish Mackerel Fishery targets Spanish mackerel (*Scomberomorus commerson*) within Territory waters from the high water mark out to the outer boundary of the Australian Fishing Zone; however, most effort is generally focused around reefs, headlands and shoals. The fishery is restricted to 15 licences (NT DPIR 2020g).

Recreational fishing

A wide range of recreational activities occur within the NWMR and NMR. Recreational fishing activities peak in winter and are concentrated in coastal waters along the Kimberley and NT coastlines, generally around the population centres of Broome, Wyndham and Darwin. Some of the recreationally important species of the coastal areas include barramundi, mangrove jack, jewfish and bream.

Fishing methods typically involve rod and line gear and approximately three quarters of fish caught by fishing tour operators are released (NTG 2016). While the survivorship of released Barramundi is high, the same is not true for reef-associated species, such Golden Snapper and Black Jewfish. Both species are susceptible to pressure-induced injuries (barotrauma), with the rate of injury and post-release mortality proportional to capture depth. Concerns regarding the impacts of barotrauma on reef fishes (and other factors) have led to the development of new management controls on the harvest of these species (NTG 2016).

Offshore islands, coral reef systems and continental shelf waters are increasingly targeted by fishing-based charter vessels (Gaughan & Santoro 2018). Extended fishing charters are known to operate during certain times of the year to fishing spots off the WA coast, including Scott Reef, Tiwi Islands and Flat Top Bank. Generally, there is little recreational fishing that occurs within WA-50-L because of its distance from land, lack of features of interest and deep waters.

Traditional fishing

Aboriginal fishing

Traditional fishing occurs along the majority of the Kimberley coastline. The practice of traditional fishing includes taking turtles, dugong, fish and other marine life (DEE 2020h).

The EPBC Act Protected Matters Search (Section 4.4, Appendix B, NIAA 2019) identified the following two IPAs:

- Dambimangari IPA (located in the Buccaneer Archipelago/Prince Regent area)
- Uunguu IPA (600 km north-east of Derby on the far north-west coast of the Kimberley).

These IPAs are all expected to have traditional aboriginal fishing activities ongoing. Other non-designated areas along the WA coastline may also be used for traditional fishing.

Aboriginal communities on the Tiwi Islands, such as Wurrumiyanga on Bathhurst Island have been actively involved in managing their own sea turtle stocks in consultation with the NT government forming an Indigenous marine ranger program. Anecdotal evidence indicates that green turtles are harvested in the water, while eggs of any turtle species are taken periodically. Dugongs are also sometimes taken (DEWR 2006).

The extraction of living resources via illegal, unregulated and unreported fishing along the northern edges of the NWMR is a pressure of potential concern for the carbonate bank and terrace system of the Sahul Shelf and the Commonwealth waters surrounding Ashmore Reef and Cartier Island (DSEWPaC 2012a).

Indonesian fishing

The Australian and Indonesian governments signed a memorandum of understanding (MoU) in 1974 (DSEWPaC 2012a) which permits fishing by Indonesian and Timorese fishers, using traditional fishing methods only, in an area of Australian waters in the Timor Sea. The MoU area, which has become known as the “MoU Box”, covers Scott Reef and its surrounds, Seringapatam Reef, Browse Island, Ashmore Reef, Cartier Island and various banks and shoals (Figure 4-2).

The MoU requires fishers to use traditional sail-powered fishing vessels and non-motorised equipment, and prohibits them from taking protected species, such as turtles, dugongs and clams. Fishers target a range of animals, including trepang, *trochus* (topshell), reef fish and sharks. Indonesian fishing effort is high at Scott Reef and also takes place at Browse Island.

Although WA-50-L falls within the MoU Box, due to the nature of traditional fishing activities, the actual fishing effort generally only occurs in the shallow subtidal / intertidal habitats of the reefs and islands within the PEZ.

Traditional Indonesian fishing effort is intense at Seringapatam Reef and Commonwealth waters in the Scott Reef complex. Depending on the intensity of effort and composition of catch, the extraction of living resources from these KEFs may affect trophic structures and ecological functioning (DSEWPaC 2012a). Indigenous harvest of traditional marine resources (e.g. turtles, whale sharks and dugong) in international waters adjacent to the NWMR is also a pressure of potential concern (DSEWPaC 2012a).

4.9.4 Aquaculture

There are no aquaculture operations in WA-50-L. Aquaculture development in the region is dominated by the production of pearls from the species *Pinctada maxima.* A large number of pearl oysters for seeding is obtained from wild stocks and supplemented by hatchery-produced oysters with major hatcheries operating at Broome and on the Dampier Peninsular. The wild shell collection occurs in shallow coastal waters (WAFIC 2020b). All the leases are within 35 m diving depth. Pearl farm sites are located mainly along the Kimberley coast, particularly in the Buccaneer Archipelago, in Roebuck Bay and at the Montebello Islands.

Developing marine aquaculture initiatives in the Kimberley region include growing trochus and barramundi. Marine production of barramundi is focussed in Cone Bay (WA) (Gaughan & Santoro 2018).

An analysis by WorldFish has indicated that aquaculture will overtake capture fisheries as the major source of fish in Indonesia before 2030 (Phillips et al. 2015). By volume, Indonesian aquatic production is dominated by seaweeds due to the simple farming techniques required, low requirements of capital and material inputs, and short production cycles. However, by value, domestically consumed species such tilapia and milkfish, together with export-orientated commodities such as shrimp and tuna, are of greater importance (Phillips et al. 2015).

4.9.5 Shipping and ports

Vessel tracking data from AMSA's Craft Tracking System (CTS) for May 2019 is presented in Figure 4-9. CTS collects vessel traffic data from a variety of sources, including terrestrial and satellite shipborne Automatic Identification System (AIS) data sources. Figure 4-9 highlights the presence of commonly used transit routes in the vicinity of the licence area used by supply vessels routinely supporting offshore developments in the Browse Basin including the INPEX Ichthys within WA-50-L itself, and the nearby Shell Prelude FLNG facility. The major shipping lanes linking WA to Indonesia are situated over 180 km to the west of WA-50-L (Figure 4-9).

The closest ports to WA-50-L are Derby, Broome and Wyndham. These are small ports, exporting nickel, lead, zinc and cattle, and importing products to support their local communities. The Port of Broome provides supply facilities for the petroleum industry operating in the Browse Basin.

By comparison, the ports along the north-west and north coast, such as Onslow, Dampier, Cape Lambert, Port Hedland, and Darwin handle much larger tonnages of iron ore, and petroleum exports, with shipping routes throughout the region. Darwin Port is developing into a major service centre for the mining and energy sectors. Darwin Port operations consist of marine traffic of non-commercial vessels (e.g. recreational anglers) and trading vessels, including commercial ships carrying cargo and passengers, rig tenders, tankers and bulk-cargo vessels.

4.9.6 Oil and gas industry

The Browse Basin is subject to considerable exploration activity. The closest operational production facilities to WA-50-L, excluding the INPEX Ichthys facility, is the Shell Prelude FLNG facility located approximately 17 km to the north east.

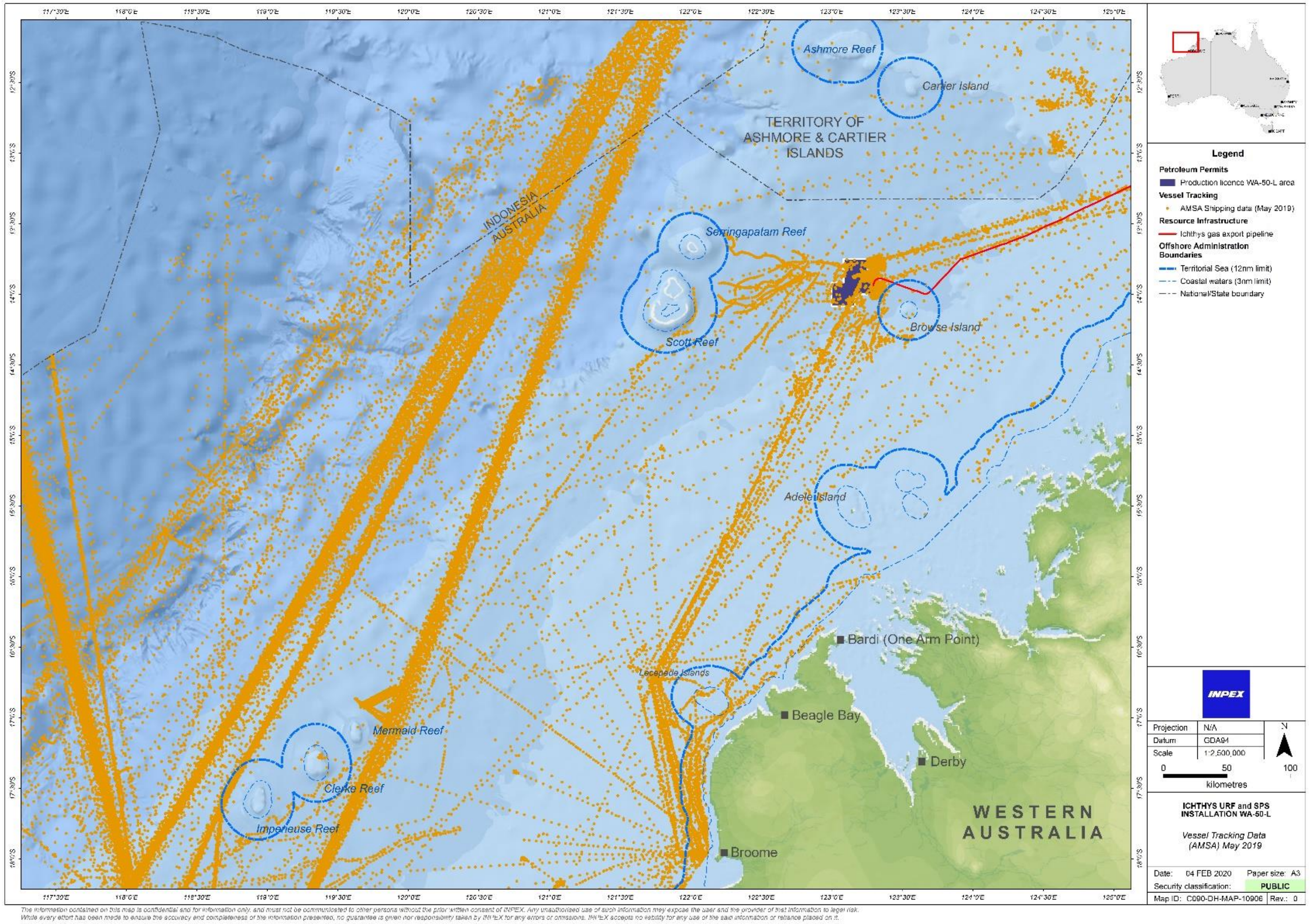

Figure 4-9: Vessel tracking data in the Browse Basin (May 2019)

4.10 Summary of values and sensitivities

4.10.1 WA-50-L

Table 4-9: Particular values and sensitivities potentially within WA-50-L

<table>
<tr><th colspan="2">Value and sensitivity</th><th>Description</th></tr>
<tr><td colspan="2">Receptors that are considered socially important as identified during stakeholder engagement (including social and cultural heritage).</td><td>Fisheries (traditional and commercial).</td></tr>
<tr><td colspan="2">Benthic primary producer habitat, defined by the Western Australian Environmental Protection Authority (WA EPA) Environmental Assessment Guideline No. 3 Environmental Assessment Guidelines for Protection of Benthic Primary Producer Habitat in Western Australia’s Marine Environment as functional ecological communities that inhabit the seabed within which algae (e.g. macroalgae, turf and benthic microalgae), seagrass, mangroves, corals, or mixtures of these groups, are prominent components.</td><td>None identified within WA-50-L.</td></tr>
<tr><td colspan="2">Regionally important areas of high diversity (such as shoals and banks).</td><td>WA-50-L overlaps the continental slope demersal fish communities KEF.</td></tr>
<tr><td colspan="2">World heritage values of a declared World Heritage property within the meaning of the EPBC Act.</td><td>None identified within WA-50-L.</td></tr>
<tr><td colspan="2">National heritage values of a National Heritage place within the meaning of the EPBC Act.</td><td>None identified within WA-50-L.</td></tr>
<tr><td colspan="2">Ecological character of a declared Ramsar wetland within the meaning of the EPBC Act.</td><td>None identified within WA-50-L.</td></tr>
<tr><td colspan="2">Presence of a listed threatened species or listed threatened ecological community within the meaning of the EPBC Act.</td><td rowspan="2">A number of threatened species or migratory species have been identified as having the potential to transit through WA-50-L.
These have been categorised as marine fauna:
• marine mammals
• marine reptiles
• fishes and sharks
• marine avifauna.
Also refer to Appendix B (EPBC Act Protected Matters Report).</td></tr>
<tr><td colspan="2">Presence of a listed migratory species within the meaning of the EPBC Act.</td></tr>
<tr><td rowspan="2">Any values and sensitivities that exist in, or in relation to, part or all of:</td><td>a Commonwealth marine area within the meaning of the EPBC Act.</td><td>Productivity and diversity associated with planktonic communities and benthic communities.</td></tr>
<tr><td>Commonwealth land within the meaning of the EPBC Act.</td><td>None identified within WA-50-L.</td></tr>
<tr><td colspan="2">BIAs associated with EPBC-listed species.</td><td>There are no known BIAs associated with listed threatened species or migratory species within WA-50-L.</td></tr>
</table>

4.10.2 PEZ

Table 4-10: Particular values and sensitivities potentially within the PEZ

Value and sensitivity	Description
Receptors that are considered socially important as identified during stakeholder engagement (including social and cultural heritage).	Fisheries (commercial, traditional and recreational).
Benthic primary producer habitat, defined by the Western Australian Environmental Protection Authority (WA EPA) Environmental Assessment Guideline No. 3 *Environmental Assessment Guidelines for Protection of Benthic Primary Producer Habitat in Western Australia's Marine Environment* as functional ecological communities that inhabit the seabed within which algae (e.g. macroalgae, turf and benthic microalgae), seagrass, mangroves, corals, or mixtures of these groups, are prominent components.	Benthic primary producer habitats are described in Section 4.8.2 and include the Commonwealth and state marine reserves and KEFs listed below.
Regionally important areas of high diversity (such as shoals and banks).	KEFs: • Continental slope demersal fish communities • Ancient coastline at 125 m depth contour • Ashmore Reef and Cartier Island and surrounding Commonwealth waters • Canyons linking the Argo Abyssal Plain with Scott Plateau • Carbonate bank and terrace system of the Sahul Shelf • Mermaid Reef and Commonwealth waters surrounding the Rowley Shoals • Pinnacles of the Bonaparte Basin • Seringapatam Reef and Commonwealth waters in the Scott Reef complex • Carbonate bank and terrace system of the Van Diemen Rise • Shelf break and slope of the Arafura Shelf • Tributary Canyons of the Arafura Depression. Benthic habitats: • Various banks and shoals, and coral reefs (Section 4.8.2) • Seagrasses (Ashmore Reef and along the Indonesian coastline) Shoreline habitats: • Islands, mangroves and sandy beaches (Section 4.8.3).
World heritage values of a declared World Heritage property within the meaning of the EPBC Act.	None identified within this area.

<table>
<tr><th colspan="2">Value and sensitivity</th><th>Description</th></tr>
<tr><td colspan="2">National heritage values of a National Heritage place within the meaning of the EPBC Act.</td><td>The West Kimberley is identified as natural National Heritage Places (Section 4.9.2).</td></tr>
<tr><td colspan="2">Ecological character of a declared Ramsar wetland within the meaning of the EPBC Act.</td><td>One Ramsar site (Section 4.5):
• Ashmore Reef National Nature Reserve</td></tr>
<tr><td colspan="2">Presence of a listed threatened species or listed threatened ecological community within the meaning of the EPBC Act.</td><td rowspan="2">A number of threatened species or migratory species have been identified as having the potential to transit through the PEZ.
These have been categorised as marine fauna (Section 4.8.4):
• marine mammals
• marine reptiles
• fishes and sharks
• marine avifauna.
Also refer to Appendix B (EPBC Act Protected Matters Report).</td></tr>
<tr><td colspan="2">Presence of a listed migratory species within the meaning of the EPBC Act.</td></tr>
<tr><td rowspan="2">Any values and sensitivities that exist in, or in relation to, part or all of:</td><td>a Commonwealth marine area within the meaning of the EPBC Act.</td><td>Productivity and diversity associated with planktonic communities and benthic communities.</td></tr>
<tr><td>Commonwealth land within the meaning of the EPBC Act.</td><td>None identified within this area.</td></tr>
<tr><td colspan="2">BIAs associated with EPBC-listed species.</td><td>A large number of BIAs are present within the PEZ including:
Marine mammals
• humpback whale migration route and aggregation/calving areas
• pygmy blue whale foraging and migration route
• dugong foraging at Ashmore Reef and near Broome.
Marine reptiles
• Turtle nesting, internesting and adjacent foraging areas including Browse Island, Ashmore Reef, Cartier Island, Sandy Islet (Scott Reef), Joseph Bonaparte Gulf and Tiwi Islands.
Fish and sharks
• whale shark foraging area
• green sawfish BIA
• KEFs associated with increased species diversity and abundance (i.e. continental slope demersal fish communities and the ancient coastline at 125 m depth contour).
Marine avifauna
• a number of resting and breeding areas associated with shoreline habitats (e.g. Ashmore Reef, Browse Island, Cartier Island, and Sandy Islet (Scott Reef). Including Nationally Important Wetland at Mermaid Reef.</td></tr>
</table>

Value and sensitivity	Description
	• a large number of offshore foraging areas that are adjacent to these shoreline habitats.

5 STAKEHOLDER CONSULTATION

INPEX has been a member of the Australian business community since 1986 and during this time has engaged on a regular basis with stakeholders in WA and in federal jurisdictions on a broad range of activities. INPEX maintains a corporate webpage (http://www.inpex.com.au) to provide company and project-related information to the public. INPEX also participates in industry forums, conferences and community meetings in order to facilitate opportunities for meaningful engagement about current and future activities.

INPEX acknowledges the importance of consultation to ensure that persons who may be affected by a proposed petroleum activity ('relevant persons') are informed about the proposed activity and have the opportunity to advise INPEX of any functions, interests or activities that could be impacted by the proposed activity.

INPEX's awareness of the functions, interests or activities of relevant persons supports the development of management plans that consider and address any environmental, social or economic objections or claims about the proposed activity.

INPEX's process for stakeholder engagement (consultation) in the development and implementation of an EP and relevant management plans is shown in Figure 5-1 and further described in this section.

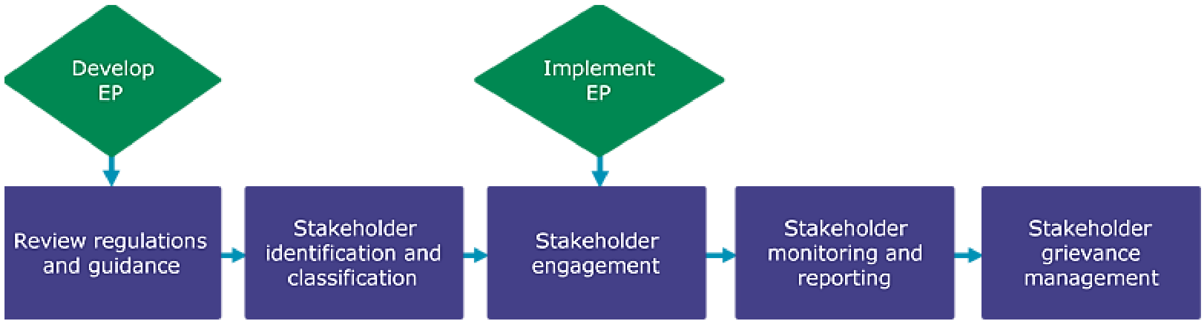

Figure 5-1: Process for stakeholder engagement (consultation) for development and implementation of an EP

5.1 Regulatory requirements and guidelines

As a first step in EP development, INPEX reviewed the following documents to prepare for stakeholder consultation on the proposed offshore petroleum activity:

- Offshore Petroleum Greenhouse Gas Storage (Environment) Regulations
- NOPSEMA policies, guidance and information papers related to environment plan development, including:
  - GL1721 - Environment plan decision making - Rev 5 - June 2018
  - GN1344 - Environment plan content requirements - Rev 4 - April 2019
  - GN1488 - Oil pollution risk management - Rev 2 - February 2018
  - IP1411 - Consultation requirements under the OPGGS Environment Regulations 2009 - Rev 2 - 2014
  - A696998 – Bulletin #2 Clarifying statutory requirements and good practice consultation – Rev 0 – November 2019
  - GN1785 – Petroleum activities and Australian marine parks – Rev 0 – July 2018

- Guidance issued by relevant stakeholders (as known or provided to INPEX), including:
  - Australian Government Guidance: Offshore Petroleum and Greenhouse Gas Activities: Consultation with Australian Government agencies with responsibilities in the Commonwealth Marine Area
  - Australian Fisheries Management Authority (AFMA): Petroleum industry consultation with the commercial fishing industry
  - WA Department of Primary Industry and Regional Development (WA DPIRD): Guidance statement for oil and gas industry consultation with the Department of Fisheries
  - WA Department of Transport (WA DoT): Offshore Petroleum Industry Guidance Note – Marine Oil Pollution: Response and Consultation Arrangements
- INPEX stakeholder engagement procedures and guidelines.

INPEX acknowledges its responsibility under the various legislative instruments and other guidance to ensure that relevant persons are appropriately identified and consulted in the development of its EPs and in the conduct of its offshore activities.

5.2 Stakeholder identification and classification

With an understanding of the general requirements and expectations for consultation, INPEX conducted stakeholder identification and classification activities.

As an initial exercise, 'relevant persons' were identified, then classified, to determine a suitable engagement priority and method. Key INPEX personnel met in a workshop to outline the requirement for engagement, established the context of the proposed activities, and identified relevant persons in accordance with Regulation 11A(1) of the OPPGS (E) Regulations and NOPSEMA's additional clarifications of Regulation 11A(1) as provided in Issues Paper IP1411 (NOPSEMA 2014) and Bulletin #2 (NOPSEMA 2019b).

INPEX treats stakeholder identification (and subsequent activities) as an iterative process whereby the company may become aware of relevant persons both during the process of consultation and also after the development and submission of an EP. INPEX acknowledges that relevant persons may be identified during an EP assessment period and also in the lead up to and conduct of an accepted petroleum activity.

5.2.1 Definition of 'relevant persons'/relevant stakeholders

In identifying relevant persons to be consulted on the proposed petroleum activity, INPEX prescribes to the definition provided under Subregulation 11A(1) of the OPGGS (E) Regulations, being:

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.*

5.2.2 Relevant activity

In determining who is a relevant stakeholder, it was necessary for INPEX to determine what constitutes a relevant activity, and for which activities a stakeholder should be engaged.

Petroleum activity (planned activity)

The OPGGS (E) Regulations require that consultation be undertaken to ensure that persons who may be affected by a petroleum activity are given the opportunity to inform the titleholder how they may be affected and to allow the titleholder to assess and address any objections or claims about that activity in the preparation of environment submissions.

Regulation 4 of the OPGGS (E) Regulations defines a petroleum activity as *"any operations or works in an offshore area carried out for the purpose of:*

a. exercising a right conferred on a petroleum titleholder under the Act by a petroleum title; or

b. discharging an obligation imposed on a petroleum titleholder by the Act or a legislative instrument under the Act."

When identifying relevant persons, INPEX considers which stakeholders perform a function in the relation to – or have a function, activity or interest that may be impacted by – the planned, physical petroleum activity.

The planned activity for this EP is the URF installation activity to be undertaken in Commonwealth waters. Therefore, in determining who is a relevant person for engagement on the petroleum activity, INPEX sought to identify and engage with stakeholders whose functions, interests or activities could be affected by the activity.

Unplanned event/activity (emergency conditions)

INPEX undertakes a more targeted approach to consultation with stakeholders in relation to unplanned – and highly improbable – emergency conditions, e.g. a loss of containment of hydrocarbons during the URF installation activity.

Stakeholders who may perform a function in INPEX's planning for, or management of an unplanned activity, and whose information is integral to the development of those management plans, are engaged during the development of the EP and OPEP.

Stakeholders whose functions, interests or activities otherwise overlap the PEZ for the unplanned activity are not engaged during the development of those plans but may be engaged in the event of an unplanned emergency condition.

This approach has been adopted to reduce consultation fatigue for stakeholders who will not be impacted by the (physical) petroleum activity.

INPEX will engage contrary to this approach where a stakeholder has expressed a significant (high to very high) level of concern about loss of containment events and wishes to understand more about the potential impact and planned response activities.

INPEX maintains an extended stakeholder list which includes stakeholders who may have a function, activity or interest that falls within for the PEZ, but for the purpose of the development of these plans, engages with stakeholders as outlined in Table 5-1.

Table 5-1: Classification and method of engagement with stakeholders in relation to an unplanned oil spill event and oil spill response

Stakeholder category	Method of engagement	Stakeholders
Government departments, agencies or organisations with functions or roles directly relevant to emergency and oil spill preparedness and response	Involve / consult regarding the proposed activity and potential unplanned emergency conditions during the preparation of the EP and OPEP.	• Australian Maritime Safety Authority (AMSA) • WA Department of Transport (DoT) • WA Department of Primary Industries and Regional Development (WA DPIRD) • WA Department of Biodiversity, Conservation and Attractions (DBCA) • Australian Marine Oil Spill Centre (AMOSC)
Stakeholders where land access is required to be agreed prior to the activity commencing	Involve / consult regarding the proposed activity and potential unplanned emergency conditions during the preparation of the EP and OPEP.	• Landowners • Native title holders • Aboriginal and Torres Strait Islander communities
Stakeholders whose level of interest (or expectation) in relation to a potential oil spills and oil spill response for the planned activity is high or very high.	Inform regarding the proposed activity and potential unplanned emergency conditions during the preparation of the EP and OPEP.	As determined during stakeholder identification workshop.
Stakeholders whose level of interest (or expectation) in relation to a potential oil spills and oil spill response for the planned activity is low or medium.	To be informed only in the event of an unplanned emergency condition (i.e. oil spill) that has the potential to affect their functions, activities or interests.	As determined during stakeholder identification workshop.

5.2.3 Commercial fishery stakeholder identification and classification

In addition to the process outlined above for planned activities and unplanned events, identification of relevant commercial fishing stakeholders distinguishes between:

- fisheries that overlap the planned petroleum activity; and
- fisheries that overlap the PEZ but not the location of the planned petroleum activity.

INPEX used a variety of resources (e.g. data files and fishery reports) to identify and classify stakeholders according to these criteria.

With the view to minimise stakeholder fatigue, INPEX restricted engagement activities to licence holders in fisheries that overlap the area (location) of the planned petroleum activity. INPEX also considered if and where licence holders are active (or potentially active) within a fishery to assess whether that licence holder should be engaged.

In summary, identification of and engagement with commercial fishing stakeholders was conducted as follows:

- Government authorities (AFMA, Department of Agriculture and WA DPIRD) were engaged regarding the proposed activity and engagement with commercial fishing stakeholders. Materials made available by government authorities, e.g. WA FishCube (fishing effort) data files and fishing reports, were used in fisheries determinations.

- Fishing industry associations that represent fisheries with licence areas that overlap the proposed activity (e.g. WAFIC, Commonwealth Fisheries Association) were consulted regarding the proposed activity and engagement with their members.
- Licence holders in commercial fisheries were engaged/not engaged according to the following criteria:
  - Active or potentially active licence holders in commercial fisheries whose activities overlap or are very close to the proposed petroleum activity <u>were considered to be relevant stakeholders</u>, and were accordingly engaged during the development of the EP.
  - Licence holders in commercial fisheries that overlap or are close to the planned petroleum activity, but whose activities or interests are not expected to be affected by the planned petroleum activity <u>are not considered to be relevant stakeholders</u>. Such licence holders were not engaged during the development of the EP, but the industry associations representing these fisheries were informed. An example would be where the licence holder fishes in a distant part of that fishery, e.g. off the southern coast of Australia.
  - Licence holders in commercial fisheries that overlap the broader PEZ but not the area of the proposed petroleum activity <u>are not considered affected parties/relevant stakeholders</u> and were therefore not informed during the development of the EP.

Licence holders that are not considered to be relevant to the planned petroleum activity are included in the expanded list of stakeholders who would be informed in the event of an unplanned emergency condition.

Table 5-2 presents the commercial fisheries classified according to their relevance to the planned petroleum activity or an unplanned emergency condition. No commercial fishery has been active within WA-50-L within the last 4 years, though it is noted that the Northern Demersal Scalefish Fishery (WA) and the North West Slope Trawl Fishery (Cwth) fish in adjacent waters and so licence holders of these two fisheries were determined to be relevant stakeholders. No other commercial fisheries fish in or close to the proposed petroleum activity.

Table 5-2: Classification of commercial fishery licence holders

Fishery	**Relevance and process of engagement**
Commercial fisheries overlapping or close to the planned petroleum activity area and with licence holder activities or interests that may be affected by the planned petroleum activity.	
Northern Demersal Scalefish Fishery – Area 2 (WA)	Relevant. Licence holders directly consulted.
North West Slope Trawl Fishery (Cwth)	
Commercial fisheries overlapping the planned petroleum activity area, but licence holder activities or interests are not expected to be affected by the planned petroleum activity.	
Mackerel Managed Fishery – Area 1 (WA)	Not affected. Licence holders not consulted during the development of the EP; however, representative industry associations were informed, and each fishery's
Pearl Oyster Managed Fishery - Zone 3 (WA)	
North Coast Shark Fishery (Northern Zone) (WA)	

Western Tuna and Billfish Fisheries (Cwth)	interests considered in the development of the EP. Licence holders to be informed in the event of an unplanned emergency condition.
Southern Bluefin Tuna Fishery (Cwth)	
Western Skipjack Fishery (Cwth)	
West Coast Deep Sea Crustacean Managed Fishery (WA)	
Commercial fisheries overlapping the PEZ but not the proposed petroleum activity area.	
Northern Prawn Fishery (Cwlth)	Not affected. Licence holders not consulted during the development of the EP, but each fishery's interests considered in the development of the EP. Licence holders to be informed in the event of an unplanned emergency condition.
Broome Prawn Managed Fishery (WA)	
Kimberley Prawn Managed Fishery (WA)	
Nickol Bay Prawn Managed Fishery (WA)	
Pilbara Trap Managed Fishery (WA)	
Pilbara Trawl Interim Managed Fishery (WA)	
Pilbara Line Fishery (WA)	
Pilbara Developing Crab Fishery (WA)	
Specimen Shell Managed Fishery (WA)	
Abalone Managed Fishery – Area 8 (WA)	
Hermit Crab Fishery (WA)	
Kimberley Mud Crab Managed Fishery (WA)	
Kimberley Gillnet and Barramundi Fishery (WA)	
Mackerel Managed Fishery – Area 2 (WA)	
Marine Aquarium Fish Managed Fishery (WA)	
Northern Demersal Scalefish Managed Fishery – Area 1 (WA)	
Pearl Oyster Managed Fishery – Zones 1 and 2 (WA)	
Trochus Fishery (WA)	
North Coast Shark Fishery (WA) – Southern Zone	
Joint Authority Northern Shark Fishery (Cwlth/WA)	
South West Coast Salmon Managed Fishery (WA)	
Timor Reef Fishery (NT)	
Demersal (multigear) Fishery (NT)	

Bait Net Fishery (NT)	
Coastal Net Fishery (NT)	
Coastal Line Fishery (NT)	
Trepang Fishery (NT)	
Aquaculture (NT)	
Aquarium Fishery (NT)	
Jigging Fishery (NT)	
Mollusc Fishery (NT)	
Mud Crab Fishery (NT)	
Offshore Net and Line Fishery (NT)	
Pearl Oyster Fishery (NT)	
Spanish Mackerel Fishery (NT)	

5.2.4 Stakeholder classification

Stakeholders were then classified based on their level of interest in/potential impact by, and influence over, the proposed petroleum activity. The purpose of this activity was to determine a 'priority' for consultation that was appropriate to the classification. Priority levels are shown in Table 5-3.

Table 5-3: Engagement classification

Priority	Interest/potential impact level and/or Influence level	Stakeholder classification (engagement priority)
Level 1	(Both) High to very high	**Collaborate/empower**: partner with stakeholder on each aspect of the decision; allow stakeholder (regulatory or approvals bodies) to make the final decision
Level 2	(Either) High to very high	**Consult/involve**: ensure stakeholder concerns and expectations are consistently understood and considered, and obtain feedback from stakeholders on analysis, alternatives and/or decisions
Level 3	(Both) Low to medium	**Inform**: provide balanced, objective, timely and consistent information to stakeholder

Stakeholders who are relevant only in the event of unplanned emergency conditions were classified separately based on their role or function in relation to unplanned emergency conditions or based on their level of interest and influence in unplanned emergency conditions.

5.3 Stakeholder engagement

Following the stakeholder identification and classification exercise, an engagement plan was developed to register identified stakeholders and the following information:

- the activity/ies (planned and unplanned) for which they have been identified as relevant
- the activities on which they should be engaged
- the function, activity or interest that may be affected by the relevant activity
- their assigned classification (priority for engagement)
- the proposed manner of engagement (i.e. modes, timing, and by whom).

Those INPEX personnel responsible for engagement were provided with a copy of the plan and instructions on how to carry out the necessary engagement.

INPEX prepared a consultation information sheet to provide relevant stakeholders with important details of the proposed petroleum activity. The document (Appendix C) includes the following information:

- description of the activity, including location and map
- schedule
- methodology (i.e. how the activity will be undertaken, as well as general logistics and safety information)
- environmental management approach
- enquiries and feedback information.

The accompanying email (or cover letter) may provide more information relevant to the functions, activities or interests of the stakeholder receiving the information sheet. Additional information was also sent to stakeholders in subsequent communications, as requested by the stakeholder and/or as the information became available.

5.4 Stakeholder monitoring and reporting

Using the stakeholder engagement plan as a guide, INPEX retains a record of all communications sent and received as part of the stakeholder engagement activity. This includes email correspondence, telephone call logs, letters and minutes of meetings.

All queries and feedback from stakeholders were logged, and where applicable, forwarded for follow up, where applicable. All responses provided to stakeholders were appropriate to the nature of their communication, e.g. technical queries were investigated by area experts and responses provided.

5.4.1 Relevant matters, objections and claims

During stakeholder consultation, each meeting, phone call or piece of correspondence received from a stakeholder was assessed by INPEX for relevant information or for objections, claims or concerns raised regarding the activity. The INPEX assessment of relevance and assessment of merit considered four broad categories:

- objection, claim or concern has merit – The objection, claim or concern raised is relevant to both the planned petroleum activity and the stakeholder’s functions, activities or interests. The matter has merit if there is a reasonable / scientific basis for related effects or impacts to occur and/or there is reasonable basis for the matter to be addressed in the EP.

- objection, claim, or concern does not have merit – The objection, claim or concern raised may be relevant to the planned petroleum activity or the stakeholder's functions, activities or interests, however, the matter raised has no credible or scientific basis.
- relevant matter – The matter raised does not fit the criteria descriptions for objections, claims or concerns with/without merit. However, the matter raised is relevant to the planned petroleum activity, comprises a request to INPEX for further relevant information, or provides information to INPEX that is relevant to the petroleum activity or the EP.
- not a relevant matter – Correspondence does not relate to the planned petroleum activity or the stakeholder's functions; interests or activities being affected by the petroleum activity. Non-relevant matters may also be generic in nature with no specific issues raised (e.g. salutations, acknowledgements, meeting arrangements, etc.).

A summary of all stakeholder consultation undertaken, and the full assessment relevance and merit are provided in Appendix C. The actual records of correspondence are provided in a 'Sensitive Matters Report' that is submitted to the Regulator separately to this EP.

An overview of feedback received from stakeholders that resulted in material inputs to the EP is provided in Table 5-4.

Table 5-4: Summary of relevant matters, objections, claims or concerns from stakeholder consultation

Stakeholder	Summary of material stakeholder feedback	Summary of INPEX action
Australian Maritime Safety Authority (AMSA)	AMSA requested: • The Master notify AMSA's Joint Rescue Coordination Centre (JRCC) for promulgation of radio-navigation warnings at least 24-48 hours before operations commence. • The JRCC be advised when operations start and end. • The Australian Hydrographic Office (AHO) be contacted no less than four working weeks before operations to promulgate the appropriate Notice to Mariners (NTM).	The relevant notifications requested by AMSA have been adopted as controls in Section 7.6.1 of the EP.
Department of Agriculture (DA; now the Department of Agriculture, Water and the Environment)	DA advised that where domestic conveyances become exposed through interactions with persons, goods or conveyances outside of Australian Territorial Sea, they automatically become subject to biosecurity control upon their return. Advised that if the DA concludes that the level of biosecurity risk associated with the offshore installation is low, an exposed conveyance (the support vessels to the offshore installation) may be eligible for exemption from biosecurity control.	INPEX provided DA with a copy of INPEX's Domestic Biofouling risk assessment process and an example of a Biosecurity risk assessment. The biosecurity matters raised by DA have been considered in Section 7.4.1 of the EP.

Stakeholder	Summary of material stakeholder feedback	Summary of INPEX action
Department of Mines, Industry Regulation and Safety WA (DMIRS)	Requested INPEX send through activity commencement and cessation notifications.	DMIRS's request to be notified of the activity commencement has been incorporated into Section 9.8.3 of the EP (ongoing stakeholder consultation).
Office of the Director of National Parks (DNP)	DNP confirmed that the planned activities associated with the EP do not overlap any AMPs and therefore there no authorisation requirements from DNP. DNP do not require further notification of progress made in relation to this activity unless details regarding the activity changes and result in an overlap with a marine park or for emergency responses. In emergency situations, DNP requested to be made aware as soon as possible of oil/gas pollution incidences which occur within or are likely to impact on a marine park.	Information provided from the DNP with respect to the values associated with the closest AMPs have been described in Section 4 of the EP and considered in Sections 7 and 8 with respect to control measures that will ensure the activity is managed in accordance with AMP management plans. In the event of a spill, INPEX oil spill notifications are aligned with the DNP requirements as described in Section 4.3, Section 9.11.3 and Appendix D (OPEP – Section 2.4.3/Table 2-3).
WA Department of Transport (DoT)	WA DoT confirmed that as Controlling Agency in WA State Waters, the DoT will deploy its own equipment and personnel (including SCAT, shoreline clean-up, inshore booming kits and Divisional staging area kit and inshore support vessels) to supplement the resources provided by the Petroleum Titleholder (PT). However, DoT expects the PT would immediately commence deploying pre-determined response equipment and personnel to the nominated Divisional Staging area, in accordance with its OPEP.	INPEX has included reference to WA DoT personnel and equipment in Section 8.5 and within the OPEP.

5.5 Stakeholder grievance management

For the development of an EP or OPEP and subsequent performance of the activities described therein, a grievance is a complex stakeholder objection or claim ('relevant matter') which has progressed beyond management through the Stakeholder Monitoring and Reporting process.

In line with grievance management as described in the INPEX Community Grievance Management Procedure, a relevant matter that cannot be resolved with the concerned stakeholder (grievant) by the applicable contact person (supported by area experts where required) will be referred to the INPEX Community Relations Working Group (CRWG) for advice and resolution before a response is made to the grievant.

If the resolution proposed by the INPEX CRWG is unacceptable to the grievant, a third-party mediator may become involved to facilitate a resolution between the parties.

In relation to engagement activities for this EP, all stakeholder enquiries were either dealt with as outlined above or are ongoing due to the iterative process of engagement being applied.

5.6 Ongoing consultation

Ongoing consultation activities ensure that INPEX develops and maintains a current and comprehensive view of stakeholder functions, interests and activities, and provide a forum for enquiries, objections or claims by relevant persons in the lead up to and during the conduct of a petroleum activity.

Ongoing consultation for the proposed activity is outlined in the implementation strategy (Section 9.8.3).

6 ENVIRONMENTAL IMPACT AND RISK ASSESSMENT METHODOLOGY

In accordance with Division 2.3, Regulation 13(5) of the OPGGS (E) Regulations 2009, an environmental risk assessment was undertaken to evaluate impacts and risks arising from the activities described in Section 3. This section describes the process in which impacts and risks were identified. A summary of the outcomes from this process are included in Section 7 and Section 8.

An environmental hazard identification (HAZID) workshop was undertaken for the petroleum activity. The workshop involved environmental, engineering, compliance, health, safety, and emergency response personnel.

The workshop was undertaken in accordance with INPEX health, safety and environment (HSE) Risk Management processes. The approach generally aligned to the processes outlined in ISO 31000:2009 *Risk Management – Principles and guidelines* (Standards Australia/ Standards New Zealand, 2009) and Handbook 203:2012 *Managing environment-related risk* (Standards Australia/Standards New Zealand 2012).

The environmental impact and risk evaluation process has been undertaken in nine distinct stages:

1. the establishment of context
2. the identification of aspects, hazards and threats
3. the identification of potential consequences (severity)
4. the identification of existing design safeguards and control measures
5. proposal of additional safeguards (ALARP evaluation)
6. an assessment of the likelihood
7. an assessment of the residual risk
8. an assessment of the acceptability of the residual risk
9. the definition of environmental performance outcomes, standards and measurement criteria.

6.1 Establishment of context

The first stage in the process involved defining the activity, characterising the environment and identifying the particular values and sensitivities of that environment. The outcomes of these exercises are presented in Section 3 *Description of Activity* and Section 4 *Existing Environment*, of this EP.

6.2 Identification of aspects, hazards and threats

An assessment was undertaken to identify the aspects associated with the petroleum activity. An aspect is defined by ISO 14001: 2015 *Environmental Management Systems (EMS)* as:

"An element or characteristic of an activity, product, or service that interacts or can interact with the environment".

The aspects were grouped to align with the INPEX HSEQ-MS environment standards. A summary of the aspects identified for the petroleum activity were as follows:

- emissions and discharges
- waste management
- noise and vibration

- loss of containment
- biodiversity and conservation protection
- land disturbance (or seabed disturbance)
- social and cultural heritage protection.

Hazards are defined by the *INPEX HSE Hazard and Risk Management Standard* as:

"A physical situation with the potential to cause harm to people, damage to property, damage to the environment".

As the definition suggests, for an environmental risk or impact to be realised, there needs to be a chance of exposing an environmental value or sensitivity to a hazard.

Given the various receptors present in the environment, they have been refined to environmentally sensitive or biologically important receptors (values and sensitivities). They have been selected using regulations, government guidance and stakeholder feedback.

For the purposes of the evaluation, environmental values and sensitivities to be considered include the following:

- receptors that are considered socially important as identified during stakeholder engagement (including social and cultural heritage)
- benthic primary producer habitat, defined by the Western Australian Environmental Protection Authority (WA EPA) Environmental Assessment Guideline No. 3 *Environmental Assessment Guidelines for Protection of Benthic Primary Producer Habitat in Western Australia's Marine Environment* as functional ecological communities that inhabit the seabed within which algae (e.g. macroalgae, turf and benthic microalgae), seagrass, mangroves, corals, or mixtures of these groups, are prominent components
- regionally important areas of high diversity (such as shoals and banks)
- particular values and sensitivities as defined by Regulation 13(3) of the OPGGS(E) Regulations 2009:
  - the world heritage values of a declared World Heritage property within the meaning of the EPBC Act
  - the national heritage values of a National Heritage place within the meaning of the EPBC Act
  - the ecological character of a declared Ramsar wetland within the meaning of the EPBC Act
  - the presence of a listed threatened species or listed threatened ecological community within the meaning of the EPBC Act
  - the presence of a listed migratory species within the meaning of the EPBC Act
  - any values and sensitivities that exist in, or in relation to, part or all of:
    - a Commonwealth marine area within the meaning of the EPBC Act – Note that this value and sensitivity includes receptors (e.g. planktonic and benthic communities) that, when exposed, have the potential to affect regionally significant ecological diversity and productivity from benthic and planktonic communities
    - Commonwealth land within the meaning of the EPBC Act.
- biologically important areas associated with EPBC-listed species.

6.3 Identify potential consequence

In sections 7 and 8, for each aspect, the greatest consequence (or potential impact) of an activity, is evaluated with no additional safeguards or control measures in place. This allows the assessment to be made on the maximum foreseeable exposure of identified values and sensitivities to the hazard taking into account the extent and duration of potential exposure. The consequence is defined using the INPEX Risk Matrix (Figure 6-1).

Given that the receptors, identified as particular values and sensitivities are the most regionally significant or sensitive to exposure, these are considered to present a credible worst-case level of consequence to assess against.

6.4 Identify existing design safeguards/controls

Control measures associated with existing design are then identified to prevent or mitigate the threat and/or its consequence(s).

6.5 Propose additional safeguards (ALARP evaluation)

Where existing safeguards or controls have been judged as inadequate to manage the identified hazards (on the basis that the criteria for acceptability is not met as defined in Section 6.8), additional safeguards or controls are proposed.

The INPEX *HSE Hazard and Risk Management Standard* describes the process in which additional engineering and management control measures are identified, taking account of the principle of preferences illustrated in Figure 6-2. The options were then systematically evaluated in terms of risk reduction. Where the level of risk reduction achieved by their selection was determined to be grossly disproportionate to the "cost" of implementing the identified control measures, the control measure will not be implemented, and the risk is considered ALARP. Cost includes financial cost, time or duration, effort, occupational health and safety risks, or environmental impacts associated with implementing the control.

6.6 Assess the likelihood

The likelihood (or probability) of a consequence occurring was determined, taking into account the control measures in place. The likelihood of a particular consequence occurring was identified using one of the six likelihood categories shown in Figure 6-1.

6.7 Assess residual risk

Where additional controls/safeguards are identified, the residual risk is then evaluated and ranked.

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Risk Matrix

Refer to the Risk Management Guideline [0000-A0-GLN-60010] for guidance on how to apply the risk matrix.

LIKELIHOOD TABLE

Time Frame Could be experienced	100 year timeframe or less	50 year timeframe	10 - 20 year timeframe	5 year strategic planning time frame	1 -2 year budget timeframe	Once or more during the next year
Experience History of occurrence in Company or Industry	Unheard of in the industry or in Projects	Has occurred once or twice in the industry or rarely occurs in Projects	Has occurred many times in the industry but not in the company or in <1 out of 100 Projects	Has occurred once or twice in the company or in <1 out of 10 Projects	Has occurred frequently in the company or in many Projects	Has occurred frequently at the location or in every Project
Frequency Continuous Operation	Once every 10 000 – 100 000 years at location	Once every 1,000 – 10 000 years at location	Once every 100 - 1000 years at location	Once every 10 - 100 years at location	Once every 1 - 10 years at location	More than once a year at location or continuously
Probability Single activity	1 in 100 000 – 1 000 000	1 in 10 000 – 100 000	1 in 1000 – 10 000	1 in 100 - 1000	1 in 10 - 100	>1 in 10

CONSEQUENCE TABLE

CONSEQUENCES

Severity Level	Financial: NPV	Financial: A$	Health & Safety	Environment	Reputation	Cultural & Social Heritage	Legal
A	>$1B	> $5B **Project Schedule** >24 months	>20 fatalities or permanent total disabilities	Regional scale event, permanent impact on environment. Eradication of local populations of protected species	Prolonged international multi-NGO and media and by public protests. Loss of host government support and/ or social licence to operate. Company reputation severely tarnished	Permanent, long-term impact on social structure, and destruction of highly-valued heritage, aesthetic, economic or recreational items	Criminal prosecution, potential jail sentences for directors and senior officers. Civil prosecution, class actions. Heavy fines, threat to licence to operate or future approvals
B	$100M – $1B	$1B – $5B **Project Schedule** 12 – 24 months	2 – 20 fatalities or permanent total disabilities	Large scale event, long term impact on environment. Extensive impact on populations of protected species	International multi-NGO and media condemnation. Host government registers concerns. Prolonged large protests. Company reputation seriously impacted	Widespread disruption to a number of communities with damage to highly-valued heritage, aesthetic, economic or recreational items	Criminal prosecution for directors and senior officers. Civil prosecution and class actions. Heavy fines, threat to licence to operate
C	$10M – $100M	$100M – $1B **Project Schedule** 6 – 12 months	Single fatality or Permanent Total Disability	Medium to large scale event, medium term impact on environment. No threat to overall population viability of protected species	Serious public or national media outcry. Damaging NGO campaign. Large protests. Company reputation impacted	Significant impact to regional communities, and to heritage, aesthetic, economic or recreational items of significant value	Significant, multiple breaches of regulation or licence conditions. Significant litigation and fines
D	$1M – $10M	$10M – $100M **Project Schedule** 1 - 6 months	Major injury or illness, permanent partial disability, lost time injury	Local to medium scale event with short to medium term impact on environment. No threat to overall population viability of protected species	Major adverse national media, public or NGO attention. Significant protests. Asset reputation impacted	Regional community disruption with moderate impact on heritage, aesthetic, economic or recreational values	Serious breach of regulation. Investigation by regulatory authorities. Potential litigation and moderate fines
E	$100K– $1M	$1M – $10M **Project Schedule** 2 - 4 weeks	Minor injury or illness, alternative duties injury, medical treatment injury	Local scale event with short term impact on the environment. Minor and temporary impact on a small portion of the population of protected species	Attention from regional media with heightened concern with local community. Criticism by community or NGOs	Isolated community disruption with limited adverse impact on heritage, aesthetic, economic or recreational values	Minor legal issues. Report provided to regulatory authorities. Potential for minor fines
F	<$100K	<$1M **Project Schedule** <2 weeks	Slight injury or illness, first aid injury	Local scale event with temporary impact on environment. Behavioural responses inconsequential ecological significance to protected species	Short term local concern or complaints. Low level media or regulatory issue	Minor impact on heritage, aesthetic, economic or recreational values	Breach of internal standards. Potential scrutiny by regulatory authorities

Likelihood Level

Severity	6 Remote	5 Highly Unlikely	4 Unlikely	3 Possible	2 Likely	1 Highly Likely
A Catastrophic	6	5	4	3	2	1
B Major	7	6	5	4	3	2
C Significant	8	7	6	5	4	3
D Moderate	9	8	7	6	5	4
E Minor	10	9	8	7	6	5
F Insignificant	10	10	9	8	7	6

Critical Risk

High Risk

Moderate Risk

Low Risk

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Figure 6-1: INPEX risk matrix

Most Preferred	**Elimination**		Removal of the hazard or sensitive receptor
	Substitution		Replacement of highly hazardous materials / approaches with less hazardous materials / approaches
	Engineering	**Prevention**	Design measures that reduce the likelihood of a hazardous event occuring
		Detection	Design measures that facilitate early detection of a hazardous event
		Control	Design measures that limit the extent/escalation potential of a hazardous event
		Mitigation	Design measures that protect the environment should a hazardous event occur
		Response Equipment	Design measures or safeguards that enable clean-up / response following the realisation of a hazardous event
	Procedures & Administration		Management systems and work instructions used to prevent or mitigate environmental exposure to hazards
Least Preferred	**Sensitive Receptor Protection**		The lowest level in the hazard management hierarchy which should only be considered when all higher controls in the hierarchy have been exhausted e.g. physical barriers located at the sensitive receptor

Figure 6-2: ALARP options preferences

6.8 Assess residual risk acceptability

Potential environmental impacts and risks are only deemed acceptable once all reasonably practicable alternatives and additional measures have been taken to reduce the potential impacts and risks to ALARP.

INPEX has determined that risks rated as "Critical" are considered too significant to proceed and are therefore, in general, unacceptable. In alignment with NOPSEMA's *Environment Plan Decision Making Guideline* (GL1721 Rev5 June 2018), INPEX considers that when a risk rating of "Low" or "Moderate" applies, where the consequence does not exceed "C" (Significant) and where it can be demonstrated that the risk has been reduced to ALARP, that this defines an acceptable level of impact.

Through implementation of this EP, impacts to the environment will be managed to ALARP and acceptable levels and will meet the requirements of Section 3A of the EPBC Act (principles of ecologically sustainable development) as shown in Table 6-1.

Table 6-1: Principles of ecological sustainable development (ESD)

Principles of ESD	**Demonstration**
a) decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations;	The INPEX environmental policy (Figure 9-2), INPEX *HSE Hazard and Risk Management Standard* and the INPEX HSEQ-MS (Section 9.1) consider both long-term and short-term economic, environmental, social and equitable considerations.

Principles of ESD	Demonstration
b) if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation;	No threat of serious or irreversible environmental damage is expected from the activity. Scientific knowledge is available to support this and processes are in place to ensure that INPEX remains up-to-date with scientific publications (Section 9.13).
c) the principle of inter-generational equity - that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations;	The health, diversity and productivity of the environment shall be maintained and not impacted by the activity.
d) the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision making;	Biological diversity and ecological integrity will not be compromised by the proposed activity.
e) improved valuation, pricing and incentive mechanisms should be promoted.	N/A

Consequently, the potential environmental impacts and risks associated with implementing the activity were determined to be acceptable if the activity:

- complies with relevant environmental legislation and corporate policies, standards, and procedures specific to the operational environment
- takes into consideration stakeholder feedback
- takes into consideration conservation management documents
- does not compromise the relevant principles of ESD; and
- the predicted level of impact does not exceed the defined acceptable level, in that the environmental risk has been assessed as “Low” or “Moderate”, the consequence does not exceed “C – Significant” and the risk has been reduced to ALARP.

6.9 Definition of performance outcomes, standards and measurement criteria

As defined in Regulation 4 of the OPGGS (E) Regulations 2009, INPEX has used environmental performance outcomes and performance standards to address potential environmental impacts and risks identified during the risk assessment.

Environmental performance outcomes, standards, and measurement criteria that relate to the management of the identified environmental impacts and risks are defined as follows:

- Environmental performance outcome means a measurable level of performance required for the management of environmental aspects of an activity to ensure that environmental impacts and risks will be of an acceptable level.
- Environmental performance standard means a statement of the performance required of a control measure.
- Measurement criteria are used to determine whether each environmental performance outcome and environmental performance standard has been met.

7 IMPACT AND RISK ASSESSMENT

Following the environmental impact and risk assessment methodology described in Section 6, the aspects, hazards and threats have been systematically identified. The aspects (and associated hazards) with the potential for impact or risk in relation to the relevant identified values and sensitivities are discussed in this section and in Section 8.

7.1 Emissions and discharges

7.1.1 Light emissions

Table 7-1: Impact and risk evaluation – change in ambient light levels from navigational lighting on vessels

Identify hazards and threats	
Light emissions associated with vessel lighting (necessary for navigational and safe working condition requirements) have the potential to disturb light-sensitive marine fauna, specifically marine turtles, bird species, through localised attraction to light that may result in behavioural changes.	
Potential consequence	Severity
The particular values and sensitivities identified as having the potential to be impacted by light emissions are: • marine turtles (including the green turtle BIA at Browse Island) • marine avifauna. Behavioural changes reported in marine turtles exposed to increases in artificial lighting can include disorientation and interference during nesting (Pendoley 2005; DEE 2020). Disorientation of adult marine turtles or hatchlings has been known to result in risks to the survival of some individuals through excess energy expenditure or increased likelihood of predation (Witherington & Martin 2000; Limpus et al. 2003). The effect of light on turtle behaviour has been observed in lights up to 18 km away (DEE 2020). Browse Island (listed as a C-class reserve) is the closest turtle-nesting area (located approximately 33 km south east of WA-50-L) and is surrounded by a 20 km internesting buffer for green turtles between November and March (DEE 2017a) as described in Section 4.8.4. Once turtle hatchlings have reached the ocean, they normally maintain seaward headings by using wave propagation direction as an orientation cue. This is because waves and swells generally reliably move towards shore in shallow coastal areas, therefore swimming into waves usually results in movement towards the open sea (Lohmann & Fittinghoff-Lohmann 1992). Although light emissions from vessels may be visible within the internesting buffer at Browse Island, significant exposure or changes in ambient light levels are not expected to affect the behaviour of the marine turtle population in this area. This assessment was confirmed by the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC 2008) through the formal environmental assessment process, indicating that the risk of light spill adversely impacting any listed threatened species is low. The offshore light emissions generated from vessel lighting is not expected to have a discernible effect on adult turtles' or hatchlings' abilities to orientate to water at Browse Island and the potential for light from vessels to attract marine turtles once they are at sea is expected to be temporary with an inconsequential ecological significance (Insignificant F).	Insignificant (F)

It is stated in the Recovery Plan for Marine Turtles in Australia (DEE 2017a) that based on the long-life span and highly dispersed life history requirements of marine turtles it is acknowledged that they may be subject to multiple threats acting simultaneously across their entire life cycle, such as increases in background noise levels and vessel strike. In considering cumulative impacts of threats on small or vulnerable stocks of marine turtles, it is possible that light emissions may act as contributor to a stock level decline. As described in Section 4.8.4, WA-50-L is located within the East Asian–Australasian Flyway, an internationally recognised migratory bird pathway that covers the whole of Australia and its surrounding waters. The migration of marine avifauna through the EAA Flyway generally occurs at two times of year, northward between March and May and southward between August and November (Bamford et al. 2008; DEE 2017b). There are no BIAs for marine avifauna that overlap WA-50-L. However, the PEZ overlaps a Ramsar site at Ashmore Reef and a nationally important wetland at Mermaid Reef (Section 4.6), and a large number of BIAs for many marine avifauna species are present within the region, the closest of which relates to foraging around Ashmore Reef and Cartier Island (Figure 4-8). While not an identified BIA, the closest habitat for seabirds from the licence area is Browse Island. Browse Island is not a regionally significant habitat for seabirds, with previous surveys finding a lack of diversity of seabirds breeding there (Clarke 2010). Colonies of nesting crested terns (>1,000 birds) have been observed on Browse Island (Olsen et al. 2018). Browse Island has also been recognised, through previous INPEX stakeholder consultation with WA DBCA, as an important location for marine avifauna. Lighting from offshore vessels has been found to attract seabirds, particularly those that are nocturnally active (BirdLife International 2012). Artificial light can disorient seabirds and potentially cause injury and/or death through collision with infrastructure (DEE 2020). Fledgling seabirds may also become grounded as a result of attraction to offshore vessel lighting (Rodríguez et al. 2017). Nocturnal birds are at much higher risk of impact (Wiese et al. 2001; DEE 2019); however, there are no threatened nocturnal migratory seabirds that use the EEA Flyway (DEWHA 2010). A study by Poot et al. (2008) of offshore oil platforms in the North Sea, found that large flocks of migrating seabirds can be attracted to the lights of offshore oil platforms, particularly on cloudy nights and between the hours of midnight and dawn. Poot et al. (2008) hypothesised that when such offshore platforms are located on long-distance bird migration routes, the impact of this attraction could be considered highly significant, as many birds cross the ocean with only small additional fat reserves than required for the transit (e.g. twelve hours of fat reserves for a ten-hour flight). Any delay (e.g. resting on a platform or circling around them) may decrease the bird's resilience and potential survival. Studies conducted in the North Sea indicate that migratory birds may be attracted to offshore lights when travelling within a radius of 3 to 5 km from the light source. Outside this area their migratory paths are likely to be unaffected (Marquenie et al. 2008). There is no published literature of these impacts occurring on the NWS of WA.	

Migratory shorebirds travelling the EAA Flyway may fly over the licence area, before moving on to the mainland (south) in the spring or Indonesia/Australian External Territories (north) in the autumn. It is possible that migratory birds may use offshore vessels in order to rest. However, the possibility of this occurring on the vessels associated with the activity in WA-50-L is considered to be low due to the presence of alternative habitat for resting and foraging at Browse Island and Ashmore Reef/Cartier Island, resulting in minimal deviation from migratory pathways and limited potential for behavioural disruption. Therefore, any impact to seabirds or migratory birds from light emissions associated with vessel lighting is considered to be of inconsequential ecological significance (Insignificant F).			
Identify existing design and safeguards/controls measures			
None identified			
Propose additional safeguards/control measures (ALARP Evaluation)			
Hierarchy of control	Control measure	Used?	Justification
Elimination	Do not use lighting at night time.	No	Lighting is required by law for navigational and safety purposes.
Substitution	Exclude offshore lighting during key periods for bird migration.	No	In general, bird migrations occur over several months of the year: between March and May (northward) and between August and November (southward) (Bamford et al., 2008). Lighting of vessels is required year-round to ensure the safety of workers and the environment and cannot be eliminated for certain periods during the year.
	Exclude offshore lighting during key periods for turtle nesting/hatching seasons.	No	As WA-50-L is located 33 km from the closest turtle nesting area (Browse Island) and the effect of light on turtle behaviour has reportedly been observed with lights up to 18 km away (DEE 2020) there is no expected benefit in avoiding offshore lighting during critical periods based on the distance. Turtles present in the outer extents of the 20 km internesting buffer surrounding Browse Island may be exposed to temporary increases in ambient light levels associated with vessel lighting; however, it is not expected to result in any discernible behavioural changes. Therefore, the implementation of this control is not considered appropriate given the impact to schedule delays, and the navigational/safety requirement for 24- hour lighting.
Engineering	Reduce light intensity and/or frequencies which may attract turtles.	No	Lighting will be designed in accordance with the relevant Australian and international standards to ensure that worker and vessel safety is not compromised. The deployment of low-pressure sodium vapour lamps or other technologies which reduce / eliminate frequencies which have been shown to attract turtles (Witherington 1992; DEE 2020)

			would not result in any significant benefit regarding turtle hatchling attraction from the closest nesting rookery on Browse Island, given the distance (approximately 33 km to Browse Island) and wave-front orientation cues (rather than light cues) of hatchlings once they are in the ocean.
Procedures & administration	Implementation of a seabird management plan to prevent seabird landings on vessels due to attraction from vessel lighting.	No	A seabird management plan to prevent seabird landings on vessels and to help manage birds appropriately is a recommendation for vessels working in seabird foraging areas during breeding season (DEE 2020). However, as shown in Figure 4-8, WA-50-L does not overlap any foraging areas and the closest areas are situated around Ashore Reef/Cartier Island to the north, Adele Island to the south and Scott Reef to the west. Therefore, this control is not considered to be warranted.
Sensitive receptor protection	N/A	N/A	There are no additional practicable measures that could protect sensitive receptors from light emissions due to transient vessel lighting required for navigational and safety requirements.

Identify the likelihood
Although light may potentially be visible, given the distance from WA-50-L to the closest turtle nesting beaches (approximately 33 km to Browse Island), impacts to turtles from light emissions is Highly Unlikely (5). While impacts to seabirds from lighting of offshore vessels have been reported in the industry, they have only been recorded for facilities in the northern hemisphere. Given the distance from WA-50-L to known seabird foraging areas, the presence of alternative resting/foraging habitat (Browse Island) and that there are several other permanently moored offshore installations in the vicinity of WA-50-L, with no records published on the attraction of seabirds or negative impacts to migratory seabirds from lighting, the likelihood of impact to these receptors from vessel lighting is considered Unlikely (4).

Residual risk summary		
Based on a consequence of Insignificant (F) and a worst-case likelihood of Unlikely (4) the residual risk is Low (9).		
Consequence	Likelihood	Residual risk
Insignificant (F)	Unlikely (4)	Low (9)

Assess residual risk acceptability

Legislative requirements

Navigational lighting is required by law for the safe operation of vessels (*Navigation Act 2012* as appropriate to vessel class and AMSA's Marine Orders Part 30: Prevention of Collisions). Although there is no environmental legislation regarding the environmental management of light emissions from offshore facilities, the activity aligns with INPEX corporate policies through the reduction of environmental impacts and risks to ALARP levels.

Stakeholder consultation

During previous EP stakeholder consultation by INPEX for the Ichthys project, the DBCA confirmed to INPEX they have an interest in emissions of light that may affect DBCA managed lands or waters, or areas documented as likely to be important for wildlife conservation. INPEX have maintained ongoing consultation with DBCA as part of Ichthys operations and further information was provided to DBCA in relation to light emissions and seabirds in the Browse area. No other stakeholder concerns have been raised regarding potential impacts and risks from light emissions in WA-50-L. Conservation management plans / threat abatement plans Several conservation management plans have been consulted in the development of this EP (refer Appendix B). Light emissions have been identified as a threat for marine turtles in the Recovery Plan for Marine Turtles in Australia (DEE 2017a) and for turtle and bird species in the National Light Pollution Guidelines for Wildlife: Including Marine Turtles, Seabirds and Migratory Shorebirds (DEE 2020). Consideration has been given to the actions described in both of the above DEE publications to minimise the effects of light emissions on light-sensitive marine fauna. ALARP summary Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact. Acceptability summary Based on the above assessment, the risk of impacts is managed to acceptable levels because: • the activity demonstrates compliance with legislative requirements/industry standards • the activity takes account of stakeholder feedback • the activity is managed in a manner that is consistent with the intent of conservation management documents • the activity does not compromise the relevant principles of ESD • the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.			
Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility
N/A no controls identified			

7.1.2 Atmospheric emissions

Table 7-2: Impact and risk evaluation – atmospheric emissions from vessels

<table>
<tr><th colspan="2">Identify hazards and threats</th></tr>
<tr><td colspan="2">Atmospheric emissions will be generated through the use of combustion engines, waste incinerators and ODS containing equipment on board the vessels. Such atmospheric emissions have the potential to result in localised changes in air quality and subsequent exposure of marine avifauna to air pollutants. A range of vessels will be used during the activity ranging from large HLVs that may typically consume up to 50 m³ of fuel per day, to smaller PSVs that typically consume up to 15 m³ of fuel per day.</td></tr>
<tr><th>Potential consequence</th><th>Severity</th></tr>
<tr><td>The particular values and sensitivities identified as having the potential to be impacted by atmospheric emissions are:
• marine avifauna.

As described in Section 4.8.4, WA-50-L is located within the East Asian–Australasian Flyway, an internationally recognised migratory bird pathway that covers the whole of Australia and its surrounding waters. The migration of marine avifauna through the EAA Flyway generally occurs at two times of year, northward between March and May and southward between August and November (Bamford et al. 2008; DEE 2017b). There are no BIAs for marine avifauna that overlap WA-50-L. However, the PEZ overlaps a Ramsar site at Ashmore Reef and a nationally important wetland at Mermaid Reef (Section 4.6). Additionally, a large number of BIAs for many marine avifauna species are present within the region (Figure 4-8) the closest of which relate to foraging around Ashmore Reef and Cartier Island. While not an identified BIA, the closest habitat for seabirds from the licence area is Browse Island. Browse Island is not a regionally significant habitat for seabirds, with previous surveys finding a lack of diversity of seabirds breeding there (Clarke 2010). Colonies of nesting crested terns (>1,000 birds) have been observed on Browse Island (Olsen et al. 2018). Browse Island has also been recognised, through previous INPEX stakeholder consultation with WA DBCA, as an important location for marine avifauna.

In the absence of air quality standards or guidelines specifically for marine avifauna, human health air quality standards and guidelines have previously been used as a proxy for the assessment of atmospheric emissions from offshore production facilities and potential impacts to marine avifauna. The outcome of such assessments concluded that NO_2 concentrations may typically exceed long term (annual average) concentrations within a few kilometres of the emissions source and that short-term (1-hour average) exposure levels may be exceeded within a few hundred metres (i.e. 200-400 m) of the emission source (RPS APASA 2014a). This assessment was undertaken for a production facility and therefore any changes in air quality resulting from vessel and equipment emissions in WA-50-L associated with the activity are also predicted to be highly localised given the nature of the emissions are less than those from a production facility.</td><td>Insignificant (F)</td></tr>
</table>

If marine avifauna are exposed at all, they are only expected to be exposed to changes in air quality for short periods as they pass close to emissions sources. Chronic exposures are not considered plausible given that marine avifauna would move away (i.e. continue migration or undertake foraging activities elsewhere). Overall, the consequence of temporary, localised changes in air quality may result in short-term, sublethal effects to a small number of transient marine avifauna individuals and is therefore considered Insignificant (F).			
Identify existing design and safeguards/controls measures			
Vessels that will be involved in the activity comply with the requirements of Marine Orders – Part 97: Marine Pollution Prevention – Air Pollution, the POTS Act, the *Navigation Act 2012* and Annex VI of MARPOL 73/78 (as applicable to vessel and engine size, type and class), specifically: • marine diesel engines meet NO_X emission requirements and limits as set out by MARPOL 73/78, Annex VI, Regulation 13, and have an International Air Pollution Prevention (IAPP) certificate. • onboard incinerators (if present) will meet International Maritime Organization (IMO) standards and are identified in the vessels' IAPP certificate. Personnel operating incinerators will be trained in accordance with MARPOL 73/78, Annex VI, Regulation 16. • equipment and systems that contain ozone depleting substances (ODS) comply with MARPOL 73/78, Annex VI, Regulation 12, are identified in the vessels' IAPP certificate and an ODS record book is maintained (where applicable). • vessels >400 GT have a Ship Energy Efficiency Management Plan (SEEMP). • Vessels will use fuels with a sulfur content <0.5% m/m sulfur content.			
Propose additional safeguards/control measures (ALARP Evaluation)			
Hierarchy of control	Control measure	Used?	Justification
Elimination	Eliminate the use of vessels	No	The use of vessels to undertake the activity cannot be eliminated.
Substitution	None identified	N/A	N/A
Engineering	None identified	N/A	N/A
Procedures & administration	Preventative maintenance system	Yes	Vessel contractors have a preventative maintenance system in place to ensure diesel powered, power generation equipment is maintained and operated within original equipment manufacturers' (OEM) specification.
Identify the likelihood			
The likelihood of marine avifauna approaching and/or resting on exhaust vents on vessels during the activity and remaining in close enough proximity to be exposed to concentrations of air pollutants that result in symptoms such as irritation of eyes and respiratory tissues and breathing difficulties is considered unlikely. Marine avifauna that may pass by near the vessels during the activity are unlikely to be in close enough proximity to be exposed to the emissions sources and are therefore unlikely to have any discernible symptoms. It is considered likely that they would move away from any emissions source if they began to experience discomfort or symptoms. No marine avifauna BIAs or critical habitats are located in proximity or within WA-50-L.			

Given the presence of alternative resting/foraging habitat (Browse Island) and with the control measures described above in place, the potential for changes to air quality and associated impacts to marine avifauna are reduced. Therefore, the likelihood of the described consequences to marine avifauna occurring is considered Highly Unlikely (5).		
Residual risk summary		
Based on a consequence of Insignificant (F) and a likelihood of Highly Unlikely (5) the residual risk is Low (10).		
Consequence	Likelihood	Residual risk
Insignificant (F)	Highly Unlikely (5)	Low (10)
Assess residual risk acceptability		
Legislative requirements The activities and proposed management measures are compliant with industry standards, relevant international conventions and Australian legislation, specifically AMSA Marine Orders – Part 97: Marine Pollution Prevention – Air Pollution, the POTS Act, the *Navigation Act* 2012, and MARPOL 73/78, Annex VI. Stakeholder consultation No specific stakeholder concerns have been raised regarding potential impacts and risks associated with atmospheric emissions in WA-50-L. Conservation management plans / threat abatement plans Several conservation management plans have been consulted in the development of this EP (refer Appendix B). None of the recovery plans or conservation advice documents have specific threats relating to atmospheric emissions from vessels operating offshore. ALARP summary Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact. Acceptability summary Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because: • the activity demonstrates compliance with legislative requirements/industry standards • the activity takes account of stakeholder feedback • the activity is managed in a manner that is consistent with the intent of conservation management documents • the activity does not compromise the relevant principles of ESD • the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.		

Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility
Risks of impacts to marine avifauna from atmospheric emissions are reduced and maintained at acceptable levels through implementation of the environmental performance standards and the application of the environmental management implementation strategy.	Vessel contractors will comply with the MARPOL 73/78 (Annex VI), *Navigation Act 2012* – Marine Orders – Part 97: Marine Pollution Prevention – Air Pollution, Annex VI (as appropriate to class of vessel), specifically: • International Air Pollution Prevention (IAPP) certificate and emission of NOx (for vessels 400 GT or above).	Valid IAPP Certificate	Vessel master
	Personnel responsible for operating incinerators will be trained in incinerator operation and appropriate waste for incineration in accordance with Marine Orders Part 97, the POTS Act and Annex VI of MARPOL 73/78.	Training records for personnel responsible for operating incinerators demonstrate that they are trained in incinerator operation and appropriate waste for incineration.	Vessel master
	Vessel contractor complies with MARPOL 73/78, Annex VI, Regulation 12 - Ozone-Depleting Substances from refrigerating plants and firefighting equipment, which includes: • Maintenance of an ODS Record Book (where applicable).	ODS Record Book (where applicable) is current and maintained, as per MARPOL 73/78, Annex VI, regulation 12.	Vessel master
	Vessels >400 GT hold a valid International Energy Efficiency (IEE) certificate and a Ship Energy Efficiency Management Plan (SEEMP) compliant with the requirements of Marine Orders – Part 97, the POTS Act and MARPOL 73/78, Annex VI (as applicable to the vessel and engine size, type and class).	IEE certificate and a SEEMP that meet the requirements of Marine Orders – Part 97, the POTS Act and MARPOL 73/78, Annex VI (as applicable to the vessel, engine/propulsion size, type and class).	Vessel master
	Fuels with 0.5% (m/m) sulphur content or less will be used in vessel engines	Fuel delivery receipt indicates only low sulphur fuels are used.	Vessel master
	Contractor has a preventative maintenance system to ensure diesel powered, power generation equipment is	Records show diesel and power generation equipment is maintained in accordance with manufacturers' specifications.	Vessel master

	maintained and operated within OEM specification.		

7.1.3 Routine discharges to sea

Subsea discharges

During URF installation, pre-commissioning and commissioning activities, subsea discharges of various fluids such as FIS, hydraulic fluids and MEG will occur. Once the URF infrastructure is installed, the structural integrity of the flowlines will be tested and prepared to ensure they are suitable for operations. The principal activities are mechanical completion (Section 3.8) involving flooding, cleaning and gauging (FCG) and hydrotesting; pre-commissioning (Section 3.8.2) involving dewatering, and leaving the infrastructure in a state ready for the start of commissioning (Section 3.8.3).

During installation of flowlines there is also the potential for a wet buckle, where the flowline becomes damaged and punctured allowing for the intrusion of seawater, which would compromise the integrity of a flowline. Flowlines are subject to limits on the duration that they may be exposed to untreated seawater as a result of a wet buckle, so flooding of the flowline with FIS to prevent corrosion must be completed within a specified period after a wet buckle.

Subsea discharges to the environment may also result from isolation and desolation activities prior to tie-in operations, such as interventions on Christmas trees, MEG flushing, removal of hydrocarbons and venting hydrocarbons. Worst-case, expected volumes for various discharge activities are presented in Table 3-1.

Table 7-3: Impact and evaluation –subsea discharges

<table>
<tr><th colspan="2">Identify hazards and threats</th></tr>
<tr><td colspan="2">Subsea discharges to the marine environment during URF and SPS installation activities within WA-50-L may result in a change in ambient water quality potentially impacting transient, EPBC-listed species, fish and benthic communities. The range of subsea discharges may include:
• FIS (containing residual biocide and oxygen scavenger; may contain residual hydrocarbons)
• MEG (may contain residual hydrocarbons)
• Hydraulic control fluids from use of ROV
• Leak detection/fluid displacement fluorescein dye
• IMR discharges including marine growth removal chemicals.
The predominant discharge from subsea infrastructure is either MEG or FIS with the largest volume of 4280 m^3 based on the longest flowline. Discharges from the flowlines/SPS systems will occur approximately 2.5 m above the seabed. Discharges from risers will be via discharge pipes suspended at a depth of approximately 10–50 m below the CFP.

The majority of subsea control fluids are based on fresh water with additives, such as MEG, lubricants, wax and corrosion inhibitors, and surfactants. In some instances, MEG and FIS discharges may contain residual hydrocarbons.</td></tr>
<tr><th>Potential consequence</th><th>Severity</th></tr>
<tr><td>The particular values and sensitivities identified as having the potential to be impacted by subsea discharges are:
• EPBC listed species
• fish (demersal fish communities and commercial species)
• benthic communities.

Subsea discharges could introduce hazardous substances into the water column, albeit in low concentrations and in the majority of cases the chemicals are classified as ‘pose little or no risk to the environment’ (PLONOR). However, this could result in a reduction in water quality, and impacts to transient, EPBC-listed species; other pelagic organisms such as fish species (demersal fish community KEF or those species targeted by commercial fisheries) and benthic communities given some discharges may occur at or near the seabed.

MEG has a higher density than seawater and therefore will not rise-up through the water column, particularly given the approximate 250 m water depth. MEG is considered as PLONOR by OSPAR (2012).

Fluorescein dye is non-toxic at the concentrations to be used (50 ppm in the FIS). During discharge, the dye may cause temporary localised discoloration in the immediate vicinity of the release point; however, as the dye is water soluble, it will rapidly disperse in the marine environment.</td><td>Insignificant (F)</td></tr>
</table>

Potential exposure of transient, EPBC-listed species to subsea discharges including FIS, MEG, hydraulic control fluids, fluorescein dye and weak acetic acid from marine growth/lime-scale removal is expected to be localised to the point of release, in WA-50-L, and will disperse through natural physical oceanic processes, such as currents, tides and waves. In the absence of any known BIAs for marine fauna in the licence area, any individuals present are likely to be transiting the area for a short duration. Individual turtles associated with the 20 km green turtle internesting buffer surrounding Browse Island (the closest BIA) are not expected to be present in the vicinity of the discharge. Similarly, whale sharks present in the foraging BIA approximately 15 km south east of WA-50-L are not expected to be exposed to any subsea discharges. Considering the low volumes and low levels of associated toxicity of the subsea discharges in the dispersive open environment of the licence area, impacts are considered to be of inconsequential ecological significance to transient, EPBC listed species and are therefore considered Insignificant (F). There is the potential for individual fishes, directly adjacent to the discharge point to be exposed to the subsea discharges. Such exposure is not expected to result in any significant impacts to fishes based on the low toxicity, low volume and high dilution levels; also, the highly mobile nature and ability of fishes to move away. The potential consequence on the demersal fish community KEF and any species targeted by commercial fisheries will be short-term and highly localised with inconsequential ecological significance (Insignificant F). Discharges of FIS are likely to have depleted oxygen concentrations due to the presence of oxygen scavenger and will contain residual biocide and a non-toxic fluorescein dye used for leak detection. The active chemical components of the oxygen scavenger and biocide are sodium bisulfite (45%) and glutaraldehyde (24%), respectively. Sodium bisulfate is rated as PLONOR by OSPAR (2012) and glutaraldehyde and fluorescein both have a CHARM rating of Gold. In reacting with oxygen in pipe, sodium bisulfite converts to sodium bisulfate, a weak acid. This will cause a reduction in pH of the FIS by approximately 0.5 to 1 unit, resulting in a pH of approximately 7.4. The stability of glutaraldehyde is known to be enhanced in neutral or acidic conditions; however, degradation of glutaraldehyde will continue to occur in the presence of sodium bisulfate. The purpose of adding oxygen scavenger (sodium bisulfite) is to cause anaerobic conditions to develop in the flowline and hence limit microbial growth. Anaerobic metabolism of glutaraldehyde will result in its biodegradation and, as concentrations decrease, the toxicity will also decrease over time, especially given the potential residence time of up to 1–2 years within the flowline. Biodegradation of glutaraldehyde in anaerobic conditions is expected to occur relatively quickly with approximately 70% degraded in 100 days (McIlwaine 2002) and will result primarily in the formation of 1,5-pentanediol which is non-toxic (Leung 2000). Therefore, the toxicity of the FIS at the time of discharge is expected to be negligible due to the oxygen scavenger having been consumed and the formation of 1,5-pentanediol from the degradation of glutaraldehyde.	

Seabed surveys in the licence area indicate benthic habitats are limited to flat and featureless soft substrate areas, typical of deep continental shelf seabed and are widely distributed in the deeper parts of the Browse Basin (RPS 2007). As described in Section 4.7.3, seabed conditions in WA-50-L are suggestive of strong near-seabed currents and mobile sediments that do not favour the development of diverse epibenthic communities. The presence of sand waves are also expected to limit the development of infaunal communities in this habitat due to substrate instability associated with changes in the currents. Subsea discharges are expected to be highly influenced by natural dispersion and dilution processes associated with the currents experienced in the offshore environment. Potential impacts on benthic communities may include lethal and sub-lethal effects; however, impacts are expected to be limited both spatial and temporally due to small volumes and low toxicity. Therefore, the consequence of the exposure of benthic communities to subsea discharges (plumes of deoxygenated FIS and MEG) would be at a local scale with a temporary impact and is ranked as Insignificant (F). During the URF and SPS installation activities, many subsea discharges will occur (Table 3-1). As described previously, the discharges are generally of relatively small volumes, resulting in temporary plumes with a local scale of potential impact. Distances between the drill centres in WA-50-L (the location of many subsea discharges) range from 3.6 km at the closest to over 18 km apart. Given the dispersive environment in WA-50-L and expected high level of dilution, any exposure is expected to be limited to within the immediate vicinity of the individual discharges. Therefore, plumes associated with the subsea discharges are not be expected to overlap. Seabed conditions within the licence area are suggestive of strong near-seabed currents and mobile sediments that do not favour the development of diverse epibenthic communities. Given the limited toxicity and small volumes any temporary discharge plumes are not expected to overlap resulting in cumulative impacts to pelagic organisms or other submerged receptors from multiple subsea discharges.			
Identify existing design and safeguards/controls measures			
None identified			
Propose additional safeguards/control measures (ALARP Evaluation)			
Hierarchy of control	Control measure	Used?	Justification
Elimination	No subsea discharges to be released to the marine environment	No	Function and pressure testing of key subsea equipment including production flowlines is required to ensure safe and effective operation of the SPS. Therefore, these subsea discharges cannot be eliminated. Hydraulic fluid (water-based) discharges are inherent for the use of subsea equipment e.g. ROVs. There are no practicable ways to eliminate these small volume discharges (< 1 m^3). During pre-commissioning, commissioning and IMR activities there are no practicable ways to capture the relatively small volumes of subsea discharges and based on the chemical composition (water/glycol based) these discharges are considered to PLONOR when discharged to the marine environment.

Substitution	Use seawater or fresh water as an alternative to FIS.	No	The flowlines are constructed from a corrosion resistant alloy (CRA). If the alloy was not in place the naturally corrosive nature of seawater, any exposure or contact with the internal walls of the flowlines would cause damage, potentially leading to future integrity problems. FIS containing a biocide is therefore required to prevent bacterial growth and subsequent corrosion damage that may comprise the integrity of the SPS.
Engineering	Design subsea system to use control fluids that present a low environmental hazard.	Yes	The INPEX *Chemical Assessment and Approval Procedure* (Section 9.6.1) has been used to select the subsea control fluid and ensure that it is assessed as having a low environmental hazard and, therefore, the environmental impact will be minimised.
	FIS discharge water sampling.	No	Volumes of FIS to be discharged present limited environmental impacts (maximum volume 4280 m^3); therefore, water sampling to enable chemical characterisation of the FIS discharge, and validate the environmental impact assessment, is not deemed necessary.
Procedures & administration	Subsea flow components will be purged with MEG, to remove residual hydrocarbons before being disconnected.	Yes	By ensuring that subsea flow components are first purged with MEG, when the component is disconnected from the SPS, MEG is lost to the marine environment, rather than hydrocarbons.

Identify the likelihood

Impacts to the EPBC-listed marine fauna, fish and benthic communities in the vicinity of the subsea discharges are not expected to occur and are considered Unlikely (4). This is largely due to the water depth, absence of any known BIAs for mobile, transient EPBC listed species in the licence area and the low toxicity and low volumes of the discharged fluids. The open-ocean, highly dispersive environment in the licence area will also result in high levels of dilution further reducing the likelihood of exposure to the identified receptors.

Residual risk summary

Based on a consequence of Insignificant (F) and a worst-case likelihood of Unlikely (4) the residual risk is Low (9).

Consequence	Likelihood	Residual risk
Insignificant (F)	Unlikely (4)	Low (9)

Assess residual risk acceptability

Legislative requirements

Open-loop control valves are widely used in the industry and subsea discharges to the marine environment are considered to be standard practice. There are no relevant Australian environmental legislative requirements that relate specifically to subsea discharges. All chemicals to be discharged subsea have been selected because they present an acceptable environmental hazard using the INPEX *Chemical Assessment and Approval Procedure.*

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from subsea discharges.

Conservation management plans / threat abatement plans

Several conservation management plans have been consulted in the development of this EP (refer Appendix B). Emissions and discharges are listed as threatening processes; however, none of the recovery plans or conservation advices has specific actions relating to discharges of BOP control/hydraulic fluid discharges in remote offshore waters.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as “low”, the consequence does not exceed “C – significant” and the risk has been reduced to ALARP.

Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility
Risk of impacts to transient, EPBC-listed species, fish and benthic communities from subsea discharges are reduced and maintained at acceptable levels through implementation of the environmental performance standards and the application of the environmental management implementation strategy.	Subsea control fluids to be selected in accordance with the INPEX *Chemical Assessment and Approval Procedure* to minimise potential environmental risks.	Records demonstrate that subsea control fluids have been selected in accordance with the INPEX *Chemical Assessment and Approval Procedure*.	INPEX Environmental adviser
	Subsea flow components will be purged (100% of volume) with MEG, to remove residual hydrocarbons before being disconnected/replaced.	Records confirm subsea flow components have been purged with MEG before being disconnected/replaced.	INPEX URF manager

Sewage, grey water and food waste

Table 7-4: Impact and evaluation – vessel discharges of sewage, grey water and food waste

Identify hazards and threats			
Discharging treated sewage effluent, grey water and food waste has the potential to expose planktonic communities to changes in water quality from the introduction of nutrients. Such a decline in water quality has the potential to result in reduced ecosystem productivity or diversity. These intermittent discharges will occur in WA-50-L, which is located in the open ocean and more than 12 nm from the nearest land. The average volume of sewage and greywater expected from the vessels (including domestic waste water) generated by a person per day is approximately 230 L (based on calculations in Huhta et al. 2009), with an assumption of up to 300 persons on board (POB) vessels during the activity.			
Potential consequence			Severity
The particular values and sensitivities identified as having the potential to be impacted by sewage, grey water and food waste discharges are: • planktonic communities. A study undertaken to assess the effects of nutrient enrichment from the discharge of sewage in the ocean found that the influence of nutrients in open marine areas is much less significant than that experienced in enclosed, poorly mixed water bodies. The study also found that zooplankton composition and distribution in areas associated with sewage dumping grounds were not affected (McIntyre & Johnston 1975). When sewage effluent, grey water and food waste is discharged there is the potential for localised and temporary, changes in water quality within WA-50-L. The potential consequence on planktonic communities is a localised impact on plankton abundance in the vicinity of the point of discharge. Given the deep water (approximately 250 m) location, oceanic currents will result in the rapid dilution and dispersion of these discharges. Therefore, the consequence is considered to be of inconsequential ecological significance (Insignificant F).			Insignificant (F)
Identify existing design and safeguards/controls measures			
Vessels will manage the discharge of sewage effluent and grey water in accordance with MARPOL 73/78 Annex IV, Marine Orders 96: Marine Pollution Prevention – Sewage (as appropriate to class), which is implemented through the POTS Act. Vessels will manage the discharge of garbage in accordance with MARPOL 73/78 Annex V, Marine Orders 95: Marine Pollution Prevention – Garbage (as appropriate to class), which is implemented through the POTS Act.			
Propose additional safeguards/control measures (ALARP Evaluation)			
Hierarchy of control	Control measure	Used?	Justification
Elimination	Eliminate discharges from vessels by storage of sewage, grey water and	No	The significant financial cost and health risks associated with storing sewage, grey water and food waste on board vessels and transporting it to the mainland for the duration of operations is grossly disproportionate

	food waste on board and ship to the mainland.		to the low level of risk associated with this discharge, permitted under legislation. Additional environmental impacts would also be generated in terms of air emissions and onshore disposal.
Substitution	None identified	N/A	N/A
Engineering	None identified	N/A	N/A
Procedures & administration	Preventative maintenance system	Yes	Vessel contractors have a preventative maintenance system in place to ensure sewage treatment plant (STP) and macerator equipment is maintained and operated within OEM specification.

Identify the likelihood		
Sewage and garbage discharges for the vessels will be in accordance with legislative requirements (MARPOL 73/78 Annex IV & V, Marine Orders 95 and 96). Maceration of sewage and food waste to a particle size <25 mm prior to disposal will increase the ability of the discharges to disperse rapidly. The effects of sewage discharged to the ocean have been relatively well studied (Gray et al. 1992; Weis et al. 1989) and toxic effects generally only occur where high volumes are discharged into a small and poorly mixed waterbody. The volumes discharged within the licence area are unlikely to cause toxic effects, especially considering the rapid dilution provided by the deep water and ocean currents. Based on the expected high dispersion due to the open-ocean environment of WA-50-L, localised impacts to plankton at the point of the planned discharge are considered to be Unlikely (4).		
Residual risk summary		
Based on a consequence of Insignificant (F) and a likelihood of Unlikely (4) the residual risk is Low (9).		
Consequence	Likelihood	Residual risk
Insignificant (F)	Unlikely (4)	Low (9)
Assess residual risk acceptability		
Legislative requirements Sewage, grey water and food waste discharges are standard practice in the offshore environment and the disposal at sea is permitted under AMSA (2013) Marine Orders – Part 96: Marine Pollution Prevention – Sewage, which gives effect to MARPOL 73/78, Annex IV and Marine Orders – Part 95: Marine Pollution Prevention – Garbage, which gives effect to MARPOL 73/78, Annex V. Stakeholder consultation No stakeholder concerns have been raised regarding potential impacts and risks from planned discharges (sewage, grey water and food waste). Conservation management plans / threat abatement plans		

Several conservation management plans have been consulted in the development of this EP (refer Appendix B). Emissions and discharges are listed as threatening processes; however, none of the recovery plans or conservation advice documents has specific actions relating to discharges of sewage, grey water and food waste. The maceraters will assist in reducing impacts from the discharge stream, consistent with the intent of the conservation management documents.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.

Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility
Zero discharges of untreated sewage and grey water or unmacerated putrescible waste to the marine environment for the duration of the activity.	Manage and dispose of sewage in accordance with: MARPOL 73/78 Annex IV, Marine Orders – Part 96: Marine Pollution Prevention – Sewage as enacted in the Protection of the Sea (Prevention of Pollution from Ships) Act 1983 – Part IIIB (as appropriate to vessel class), including: • Current International Sewage Pollution Prevention Certificate (ISPPC).	ISPPC	Vessel master
	Manage and dispose of garbage in accordance with: MARPOL 73/78 Annex III, Marine Orders – Part 95: Marine Pollution Prevention – Garbage, as enacted in the Protection of the Sea (Prevention of Pollution from Ships) Act 1983 – Parts IIIA and IIIC (as appropriate to vessel class), including:	Garbage disposal record book	Vessel master

	• Garbage that has been ground or comminuted to particles <25 mm: >3 nm from the nearest land. • Garbage disposal record book maintained in accordance with Protection of the Sea Act 1983 – Part IIIC		
	Vessel contractor has a preventative maintenance system to ensure STP and macerator is maintained.	Pre-mobilisation and ongoing HSE inspection documentation demonstrate STP and macerator equipment is maintained.	Vessel master

Deck drainage, bilge and firefighting foam

Table 7-5: Impact and evaluation – vessel discharges of deck drainage, bilge and firefighting foam

<table>
<tr><th colspan="2">Identify hazards and threats</th></tr>
<tr><td colspan="2">Contaminated deck drainage and bilge discharges or failure to treat oily water to suitable OIW concentrations before discharge, have the potential to expose marine fauna to changes in water quality and/or result in impacts through direct toxicity. Deck drainage discharge volumes on vessels will be intermittent and are dependent on weather conditions and frequency of deck washing. Volumes of bilge water from engines and other mechanical sources found throughout the machinery spaces will also vary between vessels.

Vessels are equipped with fire suppression systems, which may include firefighting foam systems, as a safety critical requirement. The foam systems generally supply 3% AR-AFFF and 3% FFFP foams to be used in the event of an incident. No maintenance testing of the foam systems will occur in WA-50-L during the activity, therefore any foam discharges to sea will be the result of an incident. Foam discharges on board vessels will be routed to the open-drains system for discharge to sea.</td></tr>
<tr><th>Potential consequence</th><th>Severity</th></tr>
<tr><td>The particular values and sensitivities identified as having the potential to be impacted by deck drainage, bilge and firefighting foam discharges are:
• EPBC listed species
• fish (demersal fish communities KEF and commercial species)
• planktonic communities.

Discharges of oily water will be treated to <15 ppm (v) in accordance with MARPOL requirements. This could introduce hazardous substances (mixture of water, oily fluids, lubricants, cleaning fluids, etc.) into the water column, albeit in low concentrations. In turn, this could result in a reduction in water quality, and impacts to transient, EPBC-listed species, plankton and other pelagic organisms such as fish species (demersal fish community KEF or those species targeted by commercial fisheries).

Given the highly mobile and transient nature of marine fauna and the absence of known BIAs in the licence area, the potential exposure is likely to be limited to individuals close to the discharge point at the time of the discharge. The closest BIA to WA-50-L relates to the 20 km green turtle internesting buffer at Browse Island (33 km away). Additionally, a whale shark foraging BIA is located approximately 15 km south-east from the licence area at its closest point (Figure 4-7); however, based on the levels of whale shark abundance observed in numerous studies (as described in Section 4.8.4), the potential for whale sharks to be present within this BIA is considered very low, with no specific seasonal pattern of migration.</td><td>Insignificant (F)</td></tr>
</table>

Worst-case impacts to exposed marine fauna may include direct toxic effects, such as damage to lungs and airways, and eye and skin lesions from exposure to oil at the sea surface (Gubbay & Earll 2000). Considering the low concentrations of oil and the location of the discharges in the dispersive open ocean environment, a surface expression is not anticipated; therefore, impacts are considered to be of inconsequential ecological significance to transient, EPBC listed species and are therefore considered Insignificant (F). Planktonic communities in close proximity to the discharge point may be affected if exposed to oily water. Such exposure may result in lethal effects to plankton. The potential consequence on planktonic communities is a localised impact on plankton abundance in the vicinity of the point of discharge with inconsequential ecological significance (Insignificant F). There is the potential for individual fish to be exposed to the discharge; however, this would be limited to those fish present at the sea surface rather than those associated with the demersal fish community KEF. Such exposure is not expected to result in any significant impacts to fishes based on the low toxicity, low volume and high dilution levels; in addition, the highly mobile nature and ability of fishes to move away. The potential consequence on the demersal fish community KEF or commercially targeted fish species will be short-term and highly localised with inconsequential ecological significance (Insignificant F). Firefighting foams generally contain organic and fluorinated surfactants, which can deplete dissolved oxygen in water (Schaefer 2013; IFSEC Global 2014). However, in their diluted form (as applied in the event of a fire), these foams are generally considered to have a relatively low toxicity to aquatic species (Schaefer 2013; IFSEC Global 2014) and further dilution of the foam mixtures in dispersive aquatic environments may then occur before there is any substantial demand for dissolved oxygen (Schaefer 2013; IFSEC Global 2014). To date, limited research regarding the potential impacts of firefighting foam to the marine environment has been undertaken with respect to bioaccumulation and persistence (Suhring et al 2017). Toxicological effects from these types of foams is typically only associated with prolonged or frequent exposures, such as on land and in watercourses near firefighting training areas (McDonald et al. 1996; Moody and Field 2000). As toxicological effects from foams are associated with frequent or prolonged exposures, and any discharges during the activity are expected to be as a result of an incident only (infrequent) and rapidly disperse, it is not expected that any impacts will occur to transient, EPBC-listed species. It is also expected that effects on planktonic communities, if any, would be localised and of a short-term nature (Insignificant F). Additionally, the potential consequences are also considered to be countered by the net environmental benefit that would be achieved through mitigating the potential for a fire resulting in harm to people and the environment.	
Identify existing design and safeguards/controls measures	
Vessels are equipped with oil–water separators (OWS) which remove traces of oil from the bilge and drainage water prior to discharge to sea. Oily water is treated to a maximum concentration of 15 ppm (v) prior to discharge as specified in MARPOL 73/78, Annex I. Bilge and deck drainage water that does not meet MARPOL 73/78 discharge requirements will be recycled for retreatment or retained on board for controlled disposal at a port reception facility.	

Vessels may discharge oily water in accordance with MARPOL 73/78 Annex I, Marine Orders 91: Marine Pollution Prevention – Oil (as appropriate to class).			
Propose additional safeguards/control measures (ALARP Evaluation)			
Hierarchy of control	Control measure	Used?	Justification
Elimination	No discharges of contaminated deck drainage or bilge to sea.	No	Discharge of deck drainage, stormwater runoff, or bilge discharges cannot be eliminated. There is not sufficient space on board vessels for storage, and onshore disposal is not practicable given the distance to the mainland (18-hour transit time to the closest port facility). Further, the associated emissions and discharges associated with such frequent transfers would have a negative impact. Discharge of oil in water are permitted under legislation.
Substitution	None identified	N/A	N/A
Engineering	None identified	N/A	N/A
Procedures & administration	Vessel inspections confirming MARPOL 73/78 compliant oil–water separators (OWS) are operational and maintained.	Yes	MARPOL 73/78 requirements are standard industry practice and vessel inspections will ensure that the requirements with respect to deck drainage and bilge discharges can be demonstrated before mobilisation and during the activity.
	Spill kits will be available on-board vessels.	Yes	The availability of spill kits on board vessels (and trained personnel in the use of spill kits) will enable minor spills to be responded to in a timely manner to reduce the likelihood of spillages reaching the marine environment. Training of personnel to understand the importance of cleaning up spills, and correct techniques for spill clean-up and hydrocarbon contaminated waste disposal will be communicated through vessel-based awareness materials.

Identify the likelihood		
Deck drainage and bilge discharges are treated to a maximum concentration of 15 ppm (v) OIW prior to discharge as specified in MARPOL 73/78, Annex 1. Impacts to the abundance of plankton in the vicinity of the discharge (oily water and firefighting foam) are not expected and are considered Unlikely (4) and will be ecologically insignificant based on the naturally high spatial and temporal variability of plankton distribution in Australian tropical waters. Due to the absence of any known BIAs for mobile, transient EPBC listed species in the licence area, the likelihood of impacts from the discharge after treatment by the OWS and subsequent dilution and dispersion is considered Unlikely (4) and is not expected to result in a threat to population viability of protected species.		
Residual risk summary		
Based on a consequence of Insignificant (F) and a worst-case likelihood of Unlikely (4) the residual risk is Low (9).		
Consequence	Likelihood	Residual risk
Insignificant (F)	Unlikely (4)	Low (9)
Assess residual risk acceptability		
Legislative requirements Vessel oil–water separators (OWS) meet relevant international regulatory requirements, including MARPOL 73/78, enacted by the Protection of the Sea (Prevention of Pollution from Ships) Act 1983 in Commonwealth waters. The discharge of oil in water of <15 ppm (v) is permitted under MARPOL 73/78. Stakeholder consultation No stakeholder concerns have been raised regarding potential impacts and risks from deck drainage, bilge or firefighting foam discharges. Conservation management plans / threat abatement plans Several conservation management plans have been consulted in the development of this EP (refer Appendix B). Emissions and discharges are listed as threatening processes; however, none of the recovery plans or conservation advice documents has specific actions relating to deck drainage/bilge/firefighting foam discharges. Managing oily water discharges in accordance with legislative requirements is consistent with the intent of the conservation management documents.		

ALARP summary Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact. Acceptability summary Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because: • the activity demonstrates compliance with legislative requirements/industry standards • the activity takes into account stakeholder feedback • the activity is managed in a manner that is consistent with the intent of conservation management documents • the activity does not compromise the relevant principles of ESD • the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.			
Environmental performance outcomes	**Environmental performance standards**	**Measurement criteria**	**Responsibility**
Zero discharges of deck drainage and bilge to the marine environment if oil in water content exceeds 15 ppm.	Vessel contractors will comply with *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* – Part II (Section 9), as appropriate to the vessel class, including: • Liquids from drains will only be discharged if the oil in water content does not exceed 15 ppm. Any treated water that does not meet the <15 ppm specification will be recycled back to the source tank for retreatment or retained onboard for controlled disposal at a port reception facility.	Documented use of oil record book to record all oil disposal.	Vessel master

	Vessel contractors will comply with the *Navigation Act 2012* – Marine Orders - Part 91: Marine Pollution Prevention – Oil, including: • Vessels (of appropriate class) to have International Oil Pollution Prevention (IOPP) certificate to show that vessels have passed structural, equipment, systems, fittings, and arrangement and material conditions. • Oil water separators (OWS) tested and approved as per IMO resolutions MARPOL 73/78 (Annex I).	Record of current International Oil Pollution Prevention (IOPP) certificate. Calibration and maintenance records of the OWS.	Vessel master
No routine discharge of firefighting foam	Firefighting foams will only be deployed in the event of an emergency.	Incident log.	INPEX URF manager
Risks of impacts to marine fauna and planktonic communities from deck drainage, bilge, and firefighting foam are reduced and maintained at acceptable levels through implementation of the environmental performance standards and the application of the environmental management implementation strategy.	Spill kits will be located on vessels to allow clean-up of any spills to the deck.	Inspection records confirm spill kits are available and stocked.	Vessel master
	Personnel are made aware of deck spill response requirements.	Training and awareness materials include deck spill response requirements.	

Cooling water

Table 7-6: Impact and evaluation – vessel discharges of cooling water

<table>
<tr><th colspan="2">Identify hazards and threats</th></tr>
<tr><td colspan="2">Sea water is used as a heat exchange medium for the cooling of machinery engines on vessels. It is pumped aboard and may be treated with biocide (e.g. hypochlorite) before circulation through heat exchangers. It is subsequently discharged to the sea surface. Cooling water (CW) discharges to the marine environment will result in a localised and temporary increase in the ambient water temperature surrounding the discharge point. Elevated discharge temperatures may cause a variety of effects, including marine fauna behavioural changes and reduced ecosystem productivity or diversity through impacts to planktonic communities. CW discharge rates vary largely depending on the vessel type. However, as a worst-case, the rate of CW discharge from vessels used during the activity is estimated to be approximately 10,000 – 20,000 m^3 per day on a continuous basis. The temperature of the CW discharge will be approximately 40 °C, in contrast to ambient surface-water temperatures of 26 °C to 30 °C as recorded in the Ichthys Field (Section 4.7.4).</td></tr>
<tr><th>Potential consequence</th><th>Severity</th></tr>
<tr><td>The particular values and sensitivities identified as having the potential to be impacted by cooling water discharges are:
• EPBC listed species
• planktonic communities.

Effects of elevation in seawater temperature may include a range of behavioural responses in transient, EPBC-listed species including attraction and avoidance behaviour. There are no known BIAs or aggregation areas that would result in sedentary behaviour in WA-50-L, and EPBC listed species with the potential to be present in the licence area (within close enough proximity to the discharge to be affected) are considered to be transient in nature (Section 4.8.4). The closest BIA to WA-50-L relates to the 20 km green turtle internesting buffer at Browse Island (33 km away) between November and March. Additionally a whale shark foraging BIA is located approximately 15 km south east from the licence area at its closest point (Figure 4-7); however, based on the levels of whale shark abundance observed in numerous studies (as described in Section 4.8.4), the potential for whale sharks to be present within this BIA is considered very low, with no specific seasonal pattern of migration. The activity will occur in a water depth of approximately 250 m in a dispersive, high current environment. Therefore, potential consequences to transient, EPBC listed species are potentially localised avoidance of thermally elevated water temperatures, with an inconsequential ecological significance to protected species (Insignificant F).

Elevated seawater temperatures are known to cause alterations to the physiological (especially enzyme-mediated) processes of exposed biota (Wolanski 1994). These alterations may cause a variety of effects and potentially even mortality of plankton in cases of prolonged exposure. In view of the high level of natural mortality and the rapid replacement rate of many plankton species, UNEP (1985) indicates that there is no evidence to suggest that lethal effects to plankton from thermal discharges are ecologically significant. The potential consequence on planktonic communities is a localised impact on plankton abundance in the vicinity of the point of discharge with inconsequential ecological significance (Insignificant F).</td><td>Insignificant (F)</td></tr>
</table>

The use of biocide (hypochlorite) for the control of biofouling in considered an established and efficient technology for use in offshore environments and is used throughout the world (Khalanski 2002). The effects of chlorination on the marine environment have been summarised by Taylor (2006) who, based on a review of applications using hypochlorite as an antifoulant for the seawater cooling circuits, concluded that: • the chlorination procedure itself does cause the mortality of a proportion of planktonic organisms and the smaller organisms entrained through a cooling water system; however, only in very rare instances, where dilution and dispersion were constrained, were there any impacts beyond the point of discharge • long term exposure to chlorination residues on fish species did not impose any apparent ecotoxicological stress • studies of the impact of chlorination by-products on marine communities, population, physiological, metabolic and genetic levels, indicate that the practice of low-level chlorination on coastal receiving water is minor in ecotoxicological terms. These findings indicate that the toxicity of the CW discharge is negligible at the point of discharge, therefore impacts are limited to thermal effects.	

Identify existing design and safeguards/controls measures			
None identified			
Propose additional safeguards/control measures (ALARP Evaluation)			
Hierarchy of control	Control measure	Used?	Justification
Elimination	No discharges of CW to sea	No	Engines and machinery require cooling to operate safely and efficiently, therefore CW cannot be eliminated. Storage and containment of CW to allow cooling on board vessels prior to discharge is not considered practicable given the size/space requirements (i.e. large surface areas are required to sufficiently cool the water). Onshore disposal was also not considered practicable given the distance to the mainland, frequency of trips required, and the associated emissions and discharges generated by such transfers.
Substitution	None identified	N/A	N/A
Engineering	None identified	N/A	N/A
Procedures & administration	None identified	N/A	N/A
Identify the likelihood			
CW discharges are expected to rapidly disperse in the open-ocean environment of WA-50-L. These discharges may result in temporary, localised and ecologically insignificant avoidance behaviour in transient, EPBC-listed species in response to elevated water temperatures. However, in the			

absence of any known BIAs within the licence area the likelihood of CW discharges resulting in a threat to the population viability of protected species is considered to be Unlikely (4). Localised impacts to the abundance of plankton within the vicinity of the CW discharges are considered to be Unlikely (4) based on the naturally high spatial and temporal variability of plankton distribution in Australian tropical waters.		
Residual risk summary		
Based on a consequence of Insignificant (F) and a likelihood of Unlikely (4) the residual risk is Low (9).		
Consequence	Likelihood	Residual risk
Insignificant (F)	Unlikely (4)	Low (9)
Assess residual risk acceptability		

Legislative requirements

The discharge of return seawater from cooling water systems to the marine environment is considered to be standard practice in industry and there are no relevant Australian environmental legislative requirements that relate specifically to the discharge of cooling water. Ichthys offshore facility CW discharge modelling (using a higher discharge temperature and greater volumes of CW discharged) predicted a maximum 1.6 ºC at 100 m from discharge point. Therefore, the CW discharge plume from any vessels is expected to be considerably lower than the IFC requirement (no more than 3 °C above the ambient seawater temperature at 100 m from the discharge point) based on the lower CW temperature and volumes discharged from vessels.

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from CW discharges.

Conservation management plans / threat abatement plans

Several conservation management plans have been consulted in the development of this EP (refer Appendix B), none of the recovery plans or conservation advice documents have specific threats or actions relating to discharges of cooling water in remote offshore waters.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls have been identified that can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the risk of impacts is managed to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD

• the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.			
Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility
N/A no controls identified			

Desalination brine

Table 7-7: Impact and evaluation – vessel discharges of desalination brine

<table>
<tr><td colspan="4">Identify hazards and threats</td></tr>
<tr><td colspan="4">Potable water will be generated on the vessels using a RO plant which is supplied with sea water. Potable water is primarily supplied to the accommodation and domestic services areas. It is also supplied for other purposes such as the eyewash and safety shower systems and utilities water systems. Desalination brine produced from the RO process will be discharged to sea on a continuous basis. Discharging desalination brine has the potential to cause changes in water salinity. The estimated volume of brine discharge is expected to be in the order of 250 m^3 per day for a vessel with salinity in the order 50 parts per thousand (ppt) in comparison to ambient seawater with a salinity of 34-35 ppt (Section 4.7.4).</td></tr>
<tr><td colspan="3">Potential consequence</td><td>Severity</td></tr>
<tr><td colspan="3">The particular values and sensitivities identified as having the potential to be impacted by desalination brine discharges are:
• planktonic communities.
The discharge of desalination brine has the potential to result in increased salinity within the receiving environment. Exposure to increased levels of salinity has the potential to result in impacts to planktonic communities. Azis et al. (2003) reported that effects on planktonic communities in areas of high mixing and dispersion, such as those found in the licence area, are generally limited to the point of discharge only.
Given the water depths in WA-50-L (approximately 250 m) and the dynamic marine environment (i.e. tides and currents) it is expected that the brine discharge would rapidly disperse relatively close to the point of discharge. Therefore, the effects of a temporary and highly localised increase in salinity are not expected to result in any significant ecological impacts to planktonic communities (Insignificant F).</td><td>Insignificant (F)</td></tr>
<tr><td colspan="4">Identify existing design and safeguards/controls measures</td></tr>
<tr><td colspan="4">None identified</td></tr>
<tr><td colspan="4">Propose additional safeguards/control measures (ALARP Evaluation)</td></tr>
<tr><td>Hierarchy of control</td><td>Control measure</td><td>Used?</td><td>Justification</td></tr>
<tr><td>Elimination</td><td>Eliminate brine discharges from vessels</td><td>No</td><td>The significant financial cost and health risks associated with providing fresh water to vessels from the mainland via vessel transfer or transiting directly to port for resupply is grossly disproportionate to the low level of risk associated with this discharge. Steaming time to the closest port facilities for resupply is approximately 18 hours. This would also generate additional environmental impacts in terms of air emissions and increased demands to the onshore supply.</td></tr>
</table>

Substitution	None identified	N/A	N/A
Engineering	Use of a diffuser on vessels to increase mixing in the receiving environment.	No	Given the water depth and oceanic currents in WA-50-L and the small volumes of discharges, retrospective installation of a diffuser on all vessels is not considered practicable, given the insignificant consequence from brine discharges.
Procedures & administration	None identified	N/A	N/A

Identify the likelihood
Direct effects on plankton from desalination brine discharges may occur in WA-50-L near the point of discharge but are not expected to result in an ecological impact to planktonic communities in the wider region. Therefore, the likelihood of impact to planktonic communities from these planned discharges is considered Highly Unlikely (5).
Residual risk summary
Based on a consequence of Insignificant (F) and a likelihood of Highly Unlikely (5) the residual risk is Low (10).

Consequence	Likelihood	Residual risk
Insignificant (F)	Highly Unlikely (5)	Low (10)

Assess residual risk acceptability

Legislative requirements

The discharge of desalination brine to the marine environment is considered to be standard practice in industry and there are no relevant Australian environmental legislative requirements that relate specifically to the discharge of desalination brine.

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from desalination brine discharges.

Conservation management plans / threat abatement plans

Several conservation management plans have been consulted in the development of this EP (refer Appendix B), none of the recovery plans or conservation advice documents have specific threats or actions relating to discharges of desalination brine in remote offshore waters.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls have been identified that can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the risk of impacts is managed to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.

Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility
N/A no controls identified			

7.2 Waste management

Table 7-8: Impact and evaluation – waste management

Identify hazards and threats	
Vessels engaged in URF installation activities will generate a variety of non-hazardous and hazardous wastes which will not be intentionally discharged to the marine environment. Unsecured or incorrectly stored waste may be windblown or displaced into the ocean where it has the potential to negatively affect marine ecosystems. Wastes can cause contamination of the ocean resulting in changes to water quality (e.g. through the leaching of chemicals from wastes that are displaced) which can cause changes to ecosystem productivity and diversity. Additionally, certain types of waste can cause injury to marine fauna through entanglement or may affect the health of marine fauna if waste materials are ingested.	
Potential consequence	**Severity**
The particular values and sensitivities identified as having the potential to be impacted by improper waste management are: • planktonic communities • EPBC listed species. Improper management of wastes may result in pollution and contamination of the environment. There is also the potential for secondary impacts on marine fauna that may interact with wastes, such as packaging and binding, should these enter the ocean. These include physical injury or death of marine biota (as a result of ingestion, or entanglement of wastes). In the event of an accidental release of waste overboard, the particular values and sensitivities identified as having the potential to be impacted include transient, EPBC listed species and planktonic communities. A change to water quality has the potential to impact planktonic communities found at the sea surface. Impacts associated with the accidental loss of hazardous waste materials to the ocean as a result of leaching from waste would be localised and limited to the immediate area. These are further likely to be reduced due to the dispersive open ocean offshore environment. While plankton abundance in close proximity to the accidental loss location, or leaching waste items may be reduced, this is expected to be of insignificant ecological consequence (Insignificant F). Marine fauna can become entangled in waste plastics, which can also be ingested when mistaken as prey (Ryan et al. 1988), potentially leading to injury or death. For example, due to indiscriminate foraging behaviour, marine turtles have been known to mistake plastic for jellyfish (Mrosovsky et al. 2009). Seabirds foraging on planktonic organisms, generally at, or near, the surface of the water column may eat floating plastic (DEE 2018). Other items (e.g. discarded rope) have also been found to entangle fauna, such as birds and marine mammals. The accidental loss of waste to the ocean may result in injury or even death to individual transient EPBC listed species, but this is not expected to result in a threat to population viability of a protected species (Insignificant F).	Insignificant (F)
Identify existing design and safeguards/controls measures	

<table>
<tr><td colspan="4">Vessels manage waste in accordance with MARPOL 73/78 Annex V, which is implemented through the Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (Cwlth) specifically the requirement to have a garbage management plan.</td></tr>
<tr><th colspan="4">Propose additional safeguards/control measures (ALARP Evaluation)</th></tr>
<tr><th>Hierarchy of control</th><th>Control measure</th><th>Used?</th><th>Justification</th></tr>
<tr><td>Elimination</td><td>None identified</td><td>N/A</td><td>N/A</td></tr>
<tr><td>Substitution</td><td>None identified</td><td>N/A</td><td>N/A</td></tr>
<tr><td>Engineering</td><td>None identified</td><td>N/A</td><td>N/A</td></tr>
<tr><td rowspan="2">Procedures & administration</td><td>HSE inspection of vessel and waste contractors</td><td>Yes</td><td>HSE inspection conducted pre-mobilisation and ongoing during the activity will confirm correct storage, labelling and handling of wastes including presence of netting to prevent windblown waste</td></tr>
<tr><td>Waste management processes communicated to personnel.</td><td>Yes</td><td>Waste management processes can be communicated to personnel through awareness materials such as inductions, posters, toolboxes and labelling.</td></tr>
<tr><th colspan="4">Identify the likelihood</th></tr>
<tr><td colspan="4">Given the proposed safeguards in place, the absence of any known BIAs and the dispersive open ocean environment in the licence area, impacts to transient EPBC-listed species and planktonic communities are considered Unlikely 4) in the event of an accidental loss of waste to the ocean.</td></tr>
<tr><th colspan="4">Residual risk summary</th></tr>
<tr><td colspan="4">Based on a consequence of Insignificant (F) and a worst-case likelihood of Unlikely (4) the residual risk is Low (9).</td></tr>
</table>

Consequence	Likelihood	Residual risk
Insignificant (F)	Unlikely (4)	Low (9)

<table>
<tr><th>Assess residual risk acceptability</th></tr>
<tr><td>Legislative requirements

The existing preventative and mitigation measures outlined to prevent accidental release of hazardous and non-hazardous wastes are consistent with, and typical of, good industry practice. Procedures for managing waste (i.e. handling, storage, transfer and disposal) will be outlined in the vessel garbage management plan, in accordance with MARPOL Annex V requirements.

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from improper waste management.

Conservation management plans / threat abatement plans</td></tr>
</table>

Several conservation management plans have been consulted in the development of this EP (refer Appendix B). Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris was listed in August 2003 as a key threatening process under the EPBC Act as detailed in the 'Threat abatement plan for impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans' (DEE 2018). The entanglement and ingestion of marine debris is also identified as a threat in the 'Recovery Plan for Marine Turtles in Australia" (DEE 2017a). Specific actions which contribute to the long-term prevention of marine debris (Objective 1 of the 'Threat abatement plan for marine debris on vertebrate marine life' (DEE 2018)) have been adopted including compliance with applicable legislation in relation to the improvement of waste management practices, such as MARPOL 73/78, Annex V,

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.

Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility
Zero unplanned discharge of wastes into the marine environment.	Implementation of garbage management plan.	Incident report of waste lost overboard.	Vessel master
Risks of impacts to marine fauna and planktonic communities from unsecured, or incorrectly stored waste are reduced and maintained at acceptable levels through implementation of the environmental performance standards and the application of the environmental management implementation strategy.	Vessel waste management plans are in place and comply with MARPOL 73/78 (Annex II and III) requirements (as appropriate to vessel class) for waste management (including recording of amounts).	Garbage record book.	Vessel master
	Pre-mobilisation HSE inspection of vessel includes assessment of waste management practices.	Pre-mobilisation and ongoing HSE inspection documentation.	INPEX Environmental Adviser
	Waste management awareness materials communicated to site personnel.	Awareness materials on waste management procedures.	INPEX Environmental Adviser

7.3 Noise and vibration

7.3.1 Receptor sensitivity and sound exposure criteria

Sudden exposure of noise-sensitive marine fauna to very high sound levels or exposure for prolonged periods to high sound levels can result in injury or a permanent threshold shift (PTS) or temporary threshold shift (TTS) in hearing. Sound level thresholds above which PTS/TTS or behavioural disturbance may occur vary widely between species and potentially between individuals of the same species.

Sound exposure thresholds and criteria derived from the scientific literature that are considered to potentially cause PTS/TTS and behavioural disturbance in marine mammals, turtles and fish are summarised in Table 7-9 below. It is noted that no sounds generated from activities in WA-50-L will be sufficiently high to cause injury, PTS or TTS from sudden exposure. However, the potential for PTS/TTS from prolonged exposure is evaluated.

A range of behavioural changes can occur in marine fauna in response to sound pressure levels. Onset of behavioural disturbance to cetaceans has been reported to occur and sound levels low as 120 dB re 1 μPa (Southall et al. 2007). This may include minor responses, such as a momentary pause in vocalisation or reorientation of an animal to the source of the sound, or avoidance responses (Southall et al. 2007). The US National Marine Fisheries Service propose a behavioural response threshold of 160 dB re 1 μPa for impulsive sound sources and 120 dB re 1 μPa for continuous sound sources (NMFS 2014).

Marine turtles are not reported to use sound for communication; however, it is suggested that they may use sound for navigation, avoiding predators and finding prey (Dow Piniak 2012). For received sound pressure levels above 166 dB re 1 μPa for impulsive sounds, turtles have shown some increased swimming activity and above 175 dB re 1 μPa can become more agitated (McCauley et al. 2000). The 166 dB re 1 μPa level is used as the threshold level for a behavioural disturbance response to impulsive sound by turtles (McCauley et al. 2000; NSF 2011). Popper et al. (2014) use a relative risk scale (high, moderate, low) for effects to turtles at three distance categories, 'near' (tens of metres), 'intermediate' (hundreds of metres) and 'far' (kilometres).

Popper et al. (2014) provide thresholds for injury and TTS in different types of fish and use a similar relative risk scale as turtles to indicate the potential for behavioural disturbance to fish and sharks at different distances from the source.

Table 7-9: Sound exposure thresholds and assessment criteria

Receptor	Effect	Sound Exposure Thresholds and Criteria	
		Impulsive Sound	**Non-impulsive Sound**
Low-frequency cetaceans (e.g. large baleen whales)	PTS *	219 dB re 1 μPa (pk) † 183 dB re 1 μPa²·s (SEL_{24h}) ‡	199 dB re 1 μPa²·s (SEL_{24h}) ‡
	TTS *	213 dB re 1 μPa (pk) † 168 dB re 1 μPa²·s (SEL_{24h}) ‡	179 dB re 1 μPa²·s (SEL_{24h}) ‡
Mid-frequency cetaceans (e.g. dolphins and toothed whales)	PTS *	230 dB re 1 μPa (pk) † 185 dB re 1 μPa²·s (SEL_{24h}) ‡	198 dB re 1 μPa²·s (SEL_{24h})‡
	TTS *	224 dB re 1 μPa (pk) † 170 dB re 1 μPa²·s (SEL_{24h}) ‡	178 dB re 1 μPa²·s (SEL_{24h}) ‡
All cetaceans	Behavioural response §	160 dB re 1 μPa sound pressure level (SPL)	120 dB re 1 μPa (SPL)

Receptor	Effect	Sound Exposure Thresholds and Criteria	
		Impulsive Sound	Non-impulsive Sound
Turtles	Recoverable injury #	(N) High (I) Low (F) Low	(N) Low (I) Low (F) Low
	TTS #	(N) High (I) Low (F) Low	(N) Moderate (I) Low (F) Low
	Behavioural response **	166 dB re 1 µPa (SPL)	N/A
	Behavioural response #	(N) High (I) Moderate (F) Low	(N) High (I) Moderate (F) Low
Fish with swim bladders not involved in hearing	Recoverable injury #	207 dB re 1 µPa (pk) 203 dB re 1 µPa^2·s (SEL_{24h})	(N) Low (I) Low (F) Low
	TTS #	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low
	Behavioural response #	(N) High (I) Moderate (F) Low	(N) Moderate (I) Moderate (F) Low
Fish without swim bladders, including sharks	Recoverable injury #	207 dB re 1 µPa (pk) 203 dB re 1 µPa^2·s (SEL_{24h})	(N) Low (I) Low (F) Low
	TTS #	186 dB re 1 µPa^2·s (SEL_{24h})	(N) Moderate (I) Low (F) Low
	Behavioural response #	(N) High (I) Moderate (F) Low	(N) Moderate (I) Moderate (F) Low

[*] Dual metric thresholds for impulsive sounds: use whichever results in the largest area of impact for calculating PTS onset.
[†] Peak sound pressure levels (pk) (derived from NMFS 2018) are unweighted within the generalized frequency hearing range of marine mammals.
[‡] Cumulative SEL thresholds (derived from NMFS 2018) are frequency-weighted for cetaceans according to the low, mid and high frequency functional hearing categories. The recommended accumulation period is 24 hours.

Receptor	Effect	Sound Exposure Thresholds and Criteria	
		Impulsive Sound	**Non-impulsive Sound**
[§] NMFS (2014) Marine Mammals: Interim Sound Threshold Guidance. [#] Sound exposure thresholds derived from Popper et al. (2014). 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 from the source), intermediate (I) (hundreds of metres from the source), and far (F) (kilometres from the source). [**] McCauley (2000), NSF (2011).			

Table 7-10: Impact and risk evaluation – underwater noise

Identify hazards and threats	
Marine fauna may be exposed to underwater noise emissions during the activity from vessels, the MBES survey and potentially from vibro-driving of piles (which is a contingent activity). Operating vessels have the potential to expose sound sensitive marine fauna to localised changes in underwater noise levels with vessel engines and dynamic positioning thrusters capable of generating continuous (non-impulsive) sound at levels between 108 and 182 dB re 1 µPa at 1 m at dominant frequencies between 50 Hz and 7 kHz (Simmonds et al. 2004; McCauley 1998). Higher sound levels are typically associated with the use of the thrusters (Jiménez-Arranz et al. 2017), such as when a vessel is using dynamic positioning on station. Management of vessel interactions with marine fauna is described separately in Section 7.4.2. MBES may be used along the flowline alignments for hydrographic surveying of the seabed. The MBES will operate in a high-frequency range of 70–400 kHz with a sound source output of between 200 dB and 225 dB re 1µPa @ 1m peak level. The MBES will produce a highly focussed beam of sound directed towards the seabed. The directional beam and very high sound frequencies result in rapid sound attenuation and very limited horizontal sound propagation. Vibro-driving may be used to install piles for structural foundations including ZRBs, in the event that the piles encounter resistance in the seabed sediments and cannot be installed under gravity alone (the base-case). Up to 40 piles may be required, based on 20 ZRBs per flowline, although not all piles may require to be vibro-driven. Piles will consist of steel pipes with a 700 mm diameter, which will be installed to a target depth of 9 – 11 m below the seabed. The duration of vibro-driving is expected to be 2 hours per pile, with breaks of approximately 6 hours between each pile while the vessel moves to the next location. Sound generated from vibro-driving of piles is continuous in character and sound levels are typically much lower than impact pile driving sound levels. Most of the sound energy occurs between 100 Hz and 2kHz, with strong tones and associated harmonics potentially occurring with the driving frequency, typically ranging between 10 and 60 Hz (Government of South Australia 2012). INPEX commissioned ERM and JASCO Applied Sciences (JASCO) to review measured sound levels from vibro-driving operations in a variety of environments and for a range of pile diameters. Source levels varied depending upon the dimensions of the piles and the substrate into which they were driven. Source levels ranged from approximately 160 dB re 1µPa (SPL) to a maximum of 180 dB re 1µPa (SPL) at 10 m from the source for piles driven into gravel, sand and clay sediments (similar to the shallow sedimentary geology in WA-50-L) and for steel pipe piles with a significantly larger diameter than those proposed for the URF installation activities (Bueler et al. 2015; URS 2007; Warner 2014; David Evans and Associates 2011). The upper limit of reported sound levels of 180 dB re 1µPa (SPL) at 10 m from the pile has been conservatively adopted for the purposes of this assessment.	
Potential consequence	**Severity**
The particular values and sensitivities identified as having the potential to be impacted by underwater noise are: • EPBC listed species (cetaceans, turtles and sharks) • fish (including commercial species).	Insignificant (F)

The potential occurrence of EPBC listed cetaceans, turtles and sharks in WA-50-L is summarised in Section 4.8.4. No BIAs for these species overlap WA-50-L. A limited number of commercially significant fish stocks may be present in WA-50-L that may be exposed to underwater noise emissions (Section 4.9.3). Given the deep waters, commercially significant fish stocks in WA-50-L are primarily limited to highly mobile pelagic species such as tuna and billfish although some deep-water demersal species such as ruby snapper may be present at these depths. The water depths, relatively bare substrate and absence of suitable habitats mean the licence area is not considered to be of any particular significance for spawning or aggregation of commercially targeted demersal species (Section 4.9.3). <u>Evaluation of potential consequence – vessels</u> Gradual exposure to continuous noise sources, such as vessel engines, is generally regarded as being less harmful and less likely to startle or stress marine fauna than rapid-onset impulsive noise sources (Hamernik et al. 1993; Hamernik et al. 2003; Southall et al. 2007). Based on the expected sound emissions associated with the operation of vessels during the activity in WA-50-L, the source levels (ranging from 108 to 182 dB re 1 µPa SPL at 1 m) are too low to result in injury, PTS or TTS impacts to marine fauna. Measured sound levels reported for medium-sized vessels comparable to the installation and light construction vessels that may be used in the activity indicate that behavioural disturbance to cetaceans from continuous sound above the 120 dB re 1 µPa SPL threshold is limited to within less than 1 km (Jiménez-Arranz et al. 2017). Using an acoustical spreading equation adapted from Duncan & Parsons (2011) (based on intermediate spreading, between spherical and cylindrical) and taking into account the water depth of WA-50-L, sound levels are predicted to fall below the 120 dB re 1 µPa SPL threshold within a maximum of 1.5 km. As such, when vessels are using dynamic positioning, cetaceans may temporarily avoid the water surrounding the vessel. Levels exceeding the 166 dB re 1 µPa SPL threshold reported by McCauley (2000) and NSF (2011) may be limited to within just a few tens of metres from the vessel. The qualitative criteria in Popper et al. (2014) also indicate that behavioural impacts to turtles and fish will generally be limited to within tens or hundreds of metres. Therefore, when vessels are using dynamic positioning, temporary avoidance or other changes in the behaviours of cetaceans, turtles, whale sharks and fish may occur within the waters immediately surrounding the vessel. TTS effects are not normally associated with vessel noise, given the often transient nature of vessel movements as well as the often transient nature of marine fauna. The limited potential for TTS is reflected by the accumulated SEL, estimated using the conversion SPL + 10log10(time), which indicates that the potential for TTS effects is limited to less than 300 m for cetaceans) and within tens of metres for turtles and fishes. However, this is based on thrusters operating continuously and sound energy accumulated gradually over a 24-hour period and it is unlikely that animals will remain within such close proximity for 24 hours. The calculated SEL is also unweighted (accounts for sound energy across all frequencies) and is therefore likely to slightly overestimate the sound exposures weighted to the auditory ranges of cetaceans. Ultimately, the potential for TTS is limited only to animals that remain within the immediate proximity of the vessel for several hours at a time. Given that marine fauna are expected to be transient in the deep waters of WA-50-L and the absence of significant habitat for commercially targeted fishes, no animal is expected to remain within close proximity to the vessel for a period long enough for TTS to occur.	

Exposure to vessel noise is not expected to result in alteration of behaviours that is of ecological significance, particularly in the absence of any known BIAs or important habitats in the licence area. As such any impacts are considered to be Insignificant (F). <u>Evaluation of potential consequence – MBES</u> MBES is a high-frequency, low-energy geophysical survey tool, which is reported to be significantly less intrusive than high-energy geophysical survey instruments. As described in Section 3.3, sound source levels produced by the MBES range from 200–225 dB re 1 µPa at 1 m in the 70 – 400 kHz frequency range. However, the very high-frequency pulses of sound are produced in highly directional and narrow beams, directed at the seabed. The pulses of sound are of such high frequency that they rapidly attenuate outside of the beam (Zykov 2013). The high operating frequencies of MBES places the dominant sound frequencies above the auditory range of most marine fauna species. Only some dolphin species and high-frequency cetaceans such as beaked whales (which are not known to occur in WA-50-L) may be able to detect a small amount of sound energy from some MBES instruments (MacGillivray et al. 2013; Zykov 2013). The propagation of the very high frequency sounds from MBES cannot be reliably estimated using normal sound propagation equations. Modelling of MBES equipment has been undertaken by Zykov et al. (2013) and McPherson & Wood (2017). The studies indicate that the single pulse and accumulated sound exposures outside of the MBES beam are below the threshold levels for injury, PTS or TTS to cetaceans, turtles, fish and sharks. It is not expected that fauna would persist in close proximity to the MBES long enough for impacts to occur. Based on the relative risk criteria proposed by Popper et al. (2014) and recognising the rapid attenuation of high-frequency sound, behavioural effects (in animals that can detect the high-frequency signals) are likely limited to within tens of metres. Therefore, no impacts to these species' groups are expected. Hearing impairment or significant behavioural impacts to marine fauna from MBES surveys have not been reported previously. Therefore, the consequence is considered to be Insignificant (F). <u>Evaluation of potential consequence – Vibro-driving</u> Similar to vessel noise, the sound produced by vibro-driving of piles will be non-impulsive, with source levels up to 180 dB re 1 µPa SPL at 1 m. These levels are too low to result in injury, PTS or TTS impacts to marine fauna from sudden exposure. Using the acoustical spreading equation adapted from Duncan & Parsons (2011), sound levels are predicted to fall below the 120 dB re 1 µPa SPL threshold for behavioural response in cetaceans within approximately 1.2 km and below the 166 dB re 1 µPa SPL threshold reported by McCauley (2000) and NSF (2011) for turtles within just a few tens of metres from the pile. The qualitative criteria in Popper et al. (2014) also indicate that behavioural impacts to turtles and fish from continuous sound sources will generally be limited to within tens or hundreds of metres. Therefore, temporary avoidance or other changes in the behaviours of cetaceans, turtles, whale sharks and fish may occur within the waters immediately surrounding the pile and vibration hammer.	

SELs accumulated over a 24-hour period will not result in PTS in cetaceans or injury in turtles and fishes beyond the immediate location of the pile and vibration hammer. Given animals are mobile and will not remain next to the pile for hours at a time, such effects are not considered realistic. The potential for TTS effects in cetaceans is limited to just 30 m from the pile based on SEL accumulated over the 2-hour duration of the driving of a single pile, and within approximately 150 m when accounting for sound accumulated over 24 hours of vibro-driving activities (whereby vibro-driving occurs over with 6-hour intervals in between each pile). The potential for TTS in turtles and fishes over the full 24-hour period is limited to within just tens of metres. As with the vessel noise estimations, the SEL estimation is unweighted and is therefore likely to overestimate the sound energy relevant to the auditory ranges of cetaceans. Given that marine fauna are expected to be transient in the deep waters of WA-50-L and the absence of significant habitat for commercially targeted fishes, no animal is expected to remain within close proximity to the vessel for a period long enough for TTS to occur. It is noted that vibro-driving on the seabed will occur at the same time as the construction vessel uses its dynamic positioning system at the surface. The two activities will result in two separate sound sources (one on the seabed and one at the surface), each creating separate sound fields that may result in localised disturbances to marine fauna. It is acknowledged that sound from the two continuous sound sources will combine to some degree with distance from the activities. However, even accounting for a doubling of SPL, the potential for TTS is limited to within 300 m for cetaceans and less than 100 m for turtles and fishes. Behavioural disturbance from the combined sound sources is expected to be limited to less than 2.5 km for cetaceans and within tens or hundreds of metres for turtles and fishes. Given the temporary and intermittent nature of the vibro-driving activity, the localised and short-term nature of effects, and that no known BIAs or important habitats occur in the licence area, any impacts occurring during vibro-driving activities are considered to be Insignificant (F).			
Identify existing design and safeguards/controls measures			
N/A – none identified			
Propose additional safeguards/control measures (ALARP Evaluation)			
Hierarchy of control	Control measure	Used?	Justification
Elimination	Eliminate the use of vessels	No	The use of vessels to undertake the activity cannot be eliminated. Survey durations kept to a minimum.
	Eliminate the use of MBES	No	MBES is required to adequately map the seafloor for flowline alignments. Installation cannot be safely undertaken without first completing these surveys. Other instrumentation does not typically provide the same resolution as is required from MBES surveys. Given that the potential risk from MBES surveys is already low, it is not practicable to eliminate (or substitute) the use of MBES.
	Eliminate the use of vibro-driving	No	Vibro-driving is only a contingency activity. It will only be used if the piles cannot be installed under gravity. Vibro-driving produces significantly lower source levels than impact driving and so it is

			often used as a more environmentally acceptable method of pile driving. Given that the potential risk from vibro-driving is already low, it is not practicable to eliminate vibro-driving as a contingency option.
Substitution	None identified	N/A	N/A
Engineering	None identified	N/A	N/A
Procedures & administration	Implementation of environmental awareness program for site personnel	Yes	Before work commences, site personnel will be informed through an environmental awareness program of the need to avoid harm to marine fauna.
	Marine fauna observations and shut-down procedures during MBES or vibro-driving activities.	No	Shut-down procedures are typically applied during some noise generating activities to prevent injury/PTS or reduce the risk of TTS effects in marine fauna. Given that the MBES survey and vibro-driving will not result in injury or hearing impairment from sudden exposures, and behavioural effects will be localised, this control does not provide any significant environmental benefit. In addition, visual observations at the surface may have limited relevance to animals in relation to vibro-driving activities on the seabed. Therefore, this control option is not practicable.
	Soft start procedures	No	MBES instruments do not have the capability for soft-starts (ramp up of noise levels). In addition, MBES will not result in injury or hearing impairment, and behavioural effects will be highly localised. The option of implementing soft-starts for the vibration hammer has been considered. It is possible to implement soft-starts by initiating the vibration hammer for a matter of seconds at reduced energy, followed by a short waiting period (e.g. 1 minute) and then this is repeated before normal vibro-driving operations commence. Therefore, soft-starts are technically feasible. However, such measures would not provide any additional environmental benefit; TTS effects from 24 hours of exposure is limited to within 150 m of the hammer and soft-starts will not make a measurable difference to accumulated SELs that may be received over several hours. In addition, irrespective of implementing soft-start procedures or not, localised behavioural/startle responses are expected from animals in close proximity to the hammer. No ecologically significant impacts are expected. Therefore, this control option is not adopted as it provides no benefit for the additional time and effort that would be spent implementing it.

Identify the likelihood		
With the above described controls in place and in the absence of any BIAs or important habitats in WA-50-L, the likelihood of impacts to marine fauna from noise emissions generated from vessel operations, MBES and vibro-driving of piles are considered Unlikely (4). Despite the distances to important marine habitats, transient marine fauna individuals (particularly green turtles at Browse Island) may be present within the licence area. Due to the increased sound source levels and expected propagation distances associated with survey equipment noise emissions may be audible; however, impacts to marine fauna are considered Unlikely (4).		
Residual risk summary		
Based on a consequence of Insignificant (F) and a worst-case likelihood of Unlikely (4) the residual risk is Low (9).		
Consequence	Likelihood	Residual risk
Insignificant (F)	Unlikely (4)	Low (9)
Assess residual risk acceptability		
Legislative requirements None identified Stakeholder consultation No stakeholder concerns have been raised regarding potential impacts and risks from underwater noise or vibration. Conservation management plans / threat abatement plans Several conservation management plans have been consulted in the development of this EP (Appendix B). Anthropogenic noise has been identified as a threat to pygmy blue whales in the Conservation Management Plan for the Blue Whale (DoE 2015). Noise interference has also been identified as a threat to marine turtles (DEE 2017a). The above listed controls to be adopted during the activity are in alignment with the actions identified in the various conservation management documents. ALARP summary Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact. Acceptability summary Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because: • the activity demonstrates compliance with legislative requirements/industry standards • the activity takes into account stakeholder feedback • the activity is managed in a manner that is consistent with the intent of conservation management documents • the activity does not compromise the relevant principles of ESD		

• the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.			
Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility
N/A no controls identified			

7.4 Biodiversity and conservation protection

7.4.1 Introduction of invasive marine species (IMS)

Table 7-11: Impact and evaluation – Introduction of invasive marine species

Identify hazards and threats	
IMS are non-indigenous marine plants or animals that have been introduced into a region beyond their natural range and have the ability to survive, reproduce and establish founder populations. IMS are widely recognised as one of the most significant threats to marine ecosystems worldwide. Shallow coastal marine environments in particular, are thought to be amongst the most heavily invaded ecosystems, which largely reflects the accidental transport of IMS by international shipping to marinas and ports where the preferred artificial hard structures are commonly found. Vessels used for the activity may be mobilised either domestically or from overseas. This has the potential to act as a pathway for IMS to be translocated into offshore Commonwealth waters, if unmanaged, via the discharge of high-risk ballast water containing IMS (DAWR 2017) and/or via the presence of IMS within biofouling communities on vessels and/or subsea equipment. Vessels on domestic journeys (e.g. support vessels transiting between WA-50-L and WA mainland) may if unmanaged, act as a pathway through the uptake and subsequent discharge of high-risk ballast water containing IMS and/or IMS recruitment on submerged vessel hulls while in the vicinity of confirmed IMS sources. Such sources could include other offshore infrastructure i.e. other vessels or platforms that may have support vessel sharing arrangements; and artificial substrates such as jetties and wharves already colonised by mature IMS, such as in Broome Port. The introduction and establishment of IMS into the marine environment may result in impacts to benthic communities and associated receptors dependent on these including fishing.	
Potential consequence	**Severity**
The particular values and sensitivities identified as having the potential to be impacted by the introduction of an invasive marine species are: • benthic communities • fisheries (commercial (including aquaculture)/traditional/recreational)). The introduction and subsequent establishment of IMS could result in changes to the structure of benthic communities leading to a change in ecological function due to predation of native marine organisms and/or competition for resources. Once IMS establish, spread and become abundant in coastal waters some species can have major ecological, economic, human health and social/cultural consequences (Carlton 1996, 2001; Pimental et al. 2000; Hewitt et al. 2011). Benthic communities, shallow water coastal environments in WA marine parks and reserves (the closest of which is Browse Island) and fisheries (commercial (including aquaculture)/ traditional/recreational) all have the potential to be impacted by IMS.	Moderate (D)

Shallow water, coastal marine environments are susceptible to the establishment of invasive populations, with most IMS associated with artificial substrates in disturbed shallow water environments such as ports and harbours (e.g. Glasby et al. 2007; Dafforn et al. 2009a, 2009b). Aside from ports and harbours, other shallow water, pristine environments also at risk include offshore island and shoals such as those found in the PEZ in WA marine parks and reserves as presented in Section 4.4. Many of these marine parks and reserves contain sensitive benthic habitats with a potential to be impacted by invasive populations. In order for an IMS to pose a biosecurity risk once present at a recipient location, viable IMS propagules and/or individuals must be able to transfer from the colonised area (e.g. a vessel hull), survive in the surrounding environment, find a suitable habitat, and establish a self-sustaining population. Vessel operations are a mechanism for such transfer of IMS propagules either through the uptake and discharge of high-risk ballast water containing IMS and/or via the presence of IMS within biofouling communities on hulls or submerged equipment. IMS propagules may also be transferred via natural dispersion. Natural dispersal mechanisms could involve a mobile life-history stage (such as actively swimming adults or larval stages) with sufficient swimming capacity and/or larval durations to directly reach suitable habitats in coastal waters. Natural dispersal from offshore locations for IMS with shorter pelagic dispersal capabilities to coastal areas is also theoretically possible via intermediate steps (stepping stone dispersal), where intermediate populations establish in suitable habitats closer inshore, and subsequent generations then spread towards coastal regions. With consideration of the habitat preferences of IMS (shallow water environments), the closest shallow water habitat to the licence area is Browse Island, located approximately 33 km away. However, it is neither disturbed nor contains artificial structures that IMS are reported to prefer. Vessels transiting between WA-50-L and Darwin or Broome port have the potential to act as vectors for the transfer of IMS propagules to sensitive benthic habitats in the PEZ and this may result in local to medium scale impacts to benthic communities with a consequence rating of Moderate (D). The successful introduction of IMS into fishing grounds/areas of aquaculture may result in changes to benthic habitats with the potential to alter faunal assemblages, resulting in decreased ecological diversity or ecosystem health. In turn this may result in an economic loss of revenue. Other fishing activities that may be impacted include traditional fishing known to occur at Dambimangari IPA and Uunguu IPA (Section 4.9.3) and recreational fishing that is known to occur around Broome Port. This may result in regional community disruption with a moderate impact on economic or recreational values with a consequence rating of Moderate (D).	
Identify existing design and safeguards/controls measures	
Vessels have an anti-fouling coating applied that is in accordance with the prescriptions of the International Convention on the Control of Harmful Anti-fouling systems on ships, 2001, and the *Protection of the Sea (Harmful Antifouling Systems) Act 2006* (Cwlth) (as appropriate to vessel class).	
Propose additional safeguards/control measures (ALARP Evaluation)	

Hierarchy of control	Control measure	Used?	Justification
Elimination	Eliminate vessel use to avoid the spread of IMS	No	Vessels are the only form of transport that can undertake the activity.
Substitution	Only use local vessels already operating in Australian waters.	No	Although using only local vessels may be possible for certain aspects of the activity, it may not be possible for specialist vessels such as HLVs. The potential cost and time needed to source capable vessels locally is disproportionate to the minor environmental gain potentially achieved. Additional to this, there are known locations within Australia which harbour IMS and could potentially act as a source for the further spread of IMS within Australian regions. Therefore, substituting to the use of a locally available vessels only will not provide any environmental benefit.
Engineering	None identified	N/A	N/A
Procedures & administration	Complete a biofouling risk assessment (including immersible equipment) for vessels mobilised from international waters, and implement mitigation measures commensurate to the risk, as appropriate to ensure the mobilisation of the vessel poses a low risk of introducing IMS.	Yes	The completion of a biofouling risk assessment and the implementation of associated biofouling reduction and management measures reduce the likelihood of IMS translocation and subsequent potential for transfer and establishment. This approach is in accordance with the National Biofouling Management Guidelines for the Petroleum Production and Exploration Industry (Marine Pest Sectoral Committee 2018) A biofouling risk assessment is a desktop-based evaluation to determine the likelihood, and hence theoretical risk of a vessel acting as a vector for the transfer of marine pests. It does not attempt to identify whether or not a vessel is actually carrying a pest species, but rather ranks vessels on a relative scale of High, Uncertain or Low/Acceptable risk, to identify which vessels may require further detailed investigation and/or management actions to reduce potential risk. The assessment, undertaken by an independent third-party IMS expert on behalf of INPEX, relies on the provision of accurate information from the vessel operator, which may include, but is not limited to, the following:

			• vessel specifications: vessel name, type, size and Flag State, etc. • movements: port of origin, voyage history, destination, transport method, evidence of recent dry-docking and/or inspection, etc. • anti-fouling coating: type (i.e. biocidal/non-biocidal), age, service life, application area, record of Antifouling Systems Certificate, etc. • inspection/cleaning: inspection and cleaning history including any relevant independent biofouling inspection reports, etc. • seawater systems: marine growth prevention systems present and functioning, maintenance records, evidence of chemically or manually cleaned seawater systems including last treatment date and chemicals used etc. • duration of stay: at overseas or interstate locations, and duration in WA coastal waters etc. Outcomes of the biofouling risk assessment may identify the need to implement mitigation measures such as limitations of time spent in coastal waters/or alongside and managing interactions with supply vessels, through to inspection and cleaning of hulls and submerged areas.
	Complete a biofouling risk assessment for a vessels (including immersible equipment) mobilised <u>domestically</u> from other regions in Australia, and implement mitigation measures commensurate to the risk, as appropriate to ensure the mobilisation of the vessels poses a low risk of introducing IMS.	Yes	If a domestically sourced vessel is used, a biofouling risk assessment will be completed by INPEX with the process to be followed presented in Figure 9-4. The assessment will include aspects of the vessels history with respect to IMS risk e.g. vessels origin from within Australian waters and previous locations of operation (including whether these Australian locations have reported IMS occurrences), periods out-of-water and inspections/cleaning undertaken, age of anti-fouling coatings, presence and condition of internal treatment systems etc.

			While undertaking the INPEX biofouling risk assessment for domestic movements, in any instances where potential risks are identified e.g. no anti-fouling coating or extended stays in Port, the process requires INPEX to engage an independent IMS expert and if required a further risk assessment (as described above for international vessels) may be undertaken. This control and implementation of any associated management measures will reduce the likelihood of IMS translocation and subsequent potential for transfer and establishment. * The process shown in Figure 9-4 was developed in conjunction with WA DPIRD.
	Vessels operating within Australian seas will manage ballast water discharge using one of the following approved methods of management including (DAWR 2017): • an approved ballast water management system (BWM Convention D-2 standard) • ballast water exchange conducted in an acceptable area * (BWM Convention D-1 standard) • use of low risk ballast water (e.g. fresh potable water, water taken up on the high seas, water taken up and discharged within the same place) (BWM Convention D-1 standard) • retention of high-risk ballast water on board the vessel • discharge to an approved ballast water reception facility **Acceptable area is as defined in the Biosecurity (Ballast Water and Sediment) Determination 2017. For high risk ballast water an acceptable*	Yes	The discharge of high-risk ballast water has the potential to translocate IMS from a donor region to a recipient region. Vessels operating within Australian seas will comply with the Australian Ballast Water Requirements, Version 7 (DAWR 2017). Specifically, discharge of high-risk* ballast water into Australian seas is prohibited, unless it has been managed for discharge using one of the approved management methods as specified by DAWR (2017). Note ballast water exchange (BWM Convention D-1 standard) a method for managing ballast water is being phased out, in favour of methods that are required to meet the BWM Convention D-2 standard. As this will occur during the life of the EP, this has been considered separately below. * DAWR (2017) defines high-risk ballast water as any ballast water that has not been managed in accordance with an approved method, and has been taken up: • within 12 nautical miles of any land mass or in water less than 50 metres deep • within 500 metres of an offshore installation, or • in an Australian port and then intended to be discharged in the Australian territorial seas.

	area for ballast water exchange is defined as (DAWR 2017): • Vessels servicing an offshore installation: at least 500 m from the facility, and no closer than 12 nm from the nearest land • All other vessel movements: at least 12 nm from the nearest land and in water at least 50 m deep; not within 12 nm of the Great Barrier Reef or Ningaloo Reef ballast water exchange exclusion areas.		
	All vessels that use ballast water exchange as their primary ballast water management, and that are built prior to 08 September 2017 will comply with International Convention for the Control and Management of Ships' Ballast Water and Sediments in 2004 (BWM Convention) D-2 Standard by: • their first Oil Pollution Prevention Certificate (IOPPC) renewal survey if the previous survey was between 08 September 2014 and 8 September 2017. • their second IOPPC renewal survey if the previous renewal survey was before 08 September 2014. Where a vessel is not subject to IOPP certificate renewal surveys it will comply with the D-2 Standard by 08 September 2024.	Yes	During the life of the EP vessels that use ballast water exchange (BWM D-1 Standard) exchange as their primary ballast water management method are required to phased out this management method in favour of methods that meet the BWM Convention D-2 Standard. The BWM Convention D-2 Standard specifies the maximum number of viable organisms allowed to be discharged, including specified indicator microbes harmful to human health. To ensure that vessel meet the requirements under the BWM Convention (enacted by the Biosecurity Act) in the prescribed timeframes, INPEX will confirm the date that applicable/affected vessels must be compliant with the D-2 standard by, as determined by their IOPPC survey or in the case of vessels not requiring a survey by 2024.

	All vessels that use ballast water exchange as their primary ballast water management, and that are built on or after 08 September 2017 will comply with BWM Convention D-2 Standard at the commencement of the activity.	Yes	All vessels that use ballast water exchange as their primary ballast water management, and that are built after 08 September 2017 are required to comply with the BWM Convention D-2 Standard.
	Vessels will have an approved ballast water management plan and valid ballast water management certificate, unless an exemption applies or is obtained.	Yes	Vessels operating in Australian seas that are designed or constructed to carry ballast water are required to carry and implement an approved vessel specific ballast water management plan. The format of the plan must be in accordance with Ballast Water Management Convention and Resolution MEPC.127 (53). The ballast water management plan outlines the duties of personnel on board for carrying out ballast operation and operational procedures for the vessel. A ballast water management certificate certifies that the vessel has an approved ballast water management plan.
	Vessels will have a biofouling management plan and maintain a biofouling record book.	Yes	A biofouling management plan provides operational guidance for the planning and actions required to manage vessel biofouling, in addition to outlining measures for the control and management of vessel biofouling in accordance with the IMO Guidelines for the Control and Management of Ship' Biofouling to Minimize the Transfer of Invasive Aquatic Species (2012 Edition). The biofouling management plan will be written by an independent IMS expert.
Identify the likelihood			
Vessels mobilised from international waters or domestic vessels are not considered a likely source for the introduction and establishment of IMS during due to the controls and procedures in place to manage ballast water exchange and biofouling risks. As such, there is a low potential for biofouling to occur and act as a potential inoculum for the establishment and subsequent spread of IMS. Adherence to the Australian ballast water management requirements including the use of an approved ballast water management method also reduces the potential for the spread of IMS (Highly Unlikely 5).			

Support vessels may use Broome or Darwin Port as a supply base. The presence of jetties and wharves in the port, providing substrate for IMS, mean that the port could act as a source of IMS inoculum. However, resupply is typically undertaken within a relatively short timeframe (approximately 48 hours) therefore the potential for vessels to become colonised by biofouling communities is reduced. Guidance from DPIRD (Vessel Check Biofouling Risk Assessment Tool) acknowledges that the attachment of biofouling may occur in as short a time frame as 24 hours, however as a 'rule of thumb', 7 days is considered to provide a pragmatic balance between logistical factors versus the risk of a vessel being contaminated with an IMS. With the described controls in place, the potential spread of IMS via support vessels during the activity is considered to be Highly Unlikely (5). Overall, the likelihood of introducing IMS is considered to be Highly Unlikely (5) due to the remote location of the URF installation activity (>12 nm from the nearest coastal waters), the short-term duration and the inability of IMS to establish based on water depths within the licence area (approximately 250 m).		
Residual risk summary		
Based on a consequence of Moderate (D) and a worst-case likelihood of Highly Unlikely (5) the residual risk is Moderate (8).		
Consequence	Likelihood	Residual risk
Moderate (D)	Highly Unlikely (5)	Moderate (8)
Assess residual risk acceptability		
Legislative requirements Vessel ballast water will be managed in accordance with the intent of the *Australian Ballast Water Requirements Version 7* (DAWR 2017) and the *Biosecurity Act 2015.* Biofouling will be managed through vessel and equipment risk assessments and mitigation measures, in accordance with the *National Biofouling Management Guidelines for the Petroleum Production and Exploration Industry* (Marine Pest Sectoral Committee 2018). Stakeholder consultation The DA (now the DAWE) advised INPEX during the stakeholder engagement process that where domestic conveyances become exposed through interactions with persons, goods or conveyances outside of Australian Territorial Sea, they automatically become subject to biosecurity control upon their return. INPEX provided DA with a copy of INPEX's Domestic Biofouling risk assessment process and the controls developed above are considered to address the concerns of the DA. Conservation management plans / threat abatement plans Several conservation management plans have been consulted in the development of this EP (refer Appendix B). IMS have been identified as a threat in many conservation management plans, with actions focusing on the prevention of their introduction. The control measures described are consistent with the actions described in the conservation management documentation. ALARP summary		

The level of environmental risk is assessed as Moderate, therefore a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.

Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility
Prevent introduction and establishment of IMS as a result of the petroleum activity (including through ballast water and biofouling from vessels).	Vessels (of appropriate class) will have an antifouling coating applied in accordance with the prescriptions of the International Convention on the Control of Harmful Anti-fouling Systems on Ships (2001) and the *Protection of the Sea (Harmful Antifouling Systems) Act 2006* (Cwlth).	Vessels (of appropriate class) have a current International Anti-fouling Systems certificate or a Declaration on Anti-fouling Systems.	Vessel master
	A biofouling risk assessment will be completed by an independent IMS expert for all vessels, including immersible equipment, prior to mobilisation from international waters. Where required, mitigation measures commensurate to the risk will be implemented to ensure the vessel mobilisation poses a low risk of introducing IMS.	Vessel-specific biofouling risk assessment and any records of mitigation measures implemented confirming the vessel presents a low risk.	Vessel master
	A biofouling risk assessment will be completed for the all vessels, including immersible equipment, prior to mobilisation from any Australian port. Where required, mitigation measures	Vessel-specific biofouling risk assessment and any records of mitigation measures implemented confirming the vessel presents a low risk.	Vessel master

	commensurate to the risk will be implemented to ensure the vessel mobilisation poses a low risk of introducing IMS.		
	Vessels operating within Australian seas will manage ballast water discharge using one of the following approved methods of management including (DAWR 2017): • an approved ballast water management system or • exchange of ballast water exchange conducted in an acceptable area or • use of low risk ballast water (e.g. fresh potable water, water taken up on the high seas, water taken up and discharged within the same place) or • retention of high-risk ballast water on board the vessel or • discharge to an approved ballast water reception facility or • use of low risk ballast water (e.g. fresh potable water, water taken up on the high seas, water taken up and discharged within the same place).	Vessels inspection documentation and annual verification reports confirm through ballast water records that an approved ballast water management option has been used.	Vessel master
	All vessels that use ballast water exchange as their primary ballast water management, and that are built prior to 08 September 2017 will comply with BWM Convention Regulation D-2 standard by: • their first Oil Pollution Prevention Certificate (IOPPC) renewal survey if the previous survey was between 08 September 2014 and 08 September 2017. • their second IOPPC renewal survey if the previous renewal survey was before 08 September 2014.	Vessels inspection documentation confirms the date each affected/applicable vessels must be compliant with the D-2 standard by, as determined by their IOPPC survey. Annual verification reports confirm affected/applicable vessel compliance with BWM Convention D-2 Standard, once triggered.	Vessel master

	Where a vessel is not subject to IOPP certificate renewal surveys it will comply with the Regulation D-2 Standard by 08 September 2024.		
	All vessels that use ballast water exchange as their primary ballast water management, and that are built on or after 08 September 2017 will comply with BWM Convention Regulation D-2 Standard at commencement of the activity.	Applicable/affected vessels inspection documentation (i.e. ballast water management plan, certificate and ballast water management records) and annual verification reports confirm compliance with BWM Convention D-2 Standard for any vessel built after 08 September 2017.	Vessel Master
	Vessels will have: • an approved ballast water management plan, unless an exemption applies or is obtained • a valid ballast water management certificate, unless an exemption applies or is obtained.	• Ballast water management plan or record of exemption (if not automatic exemption) • Valid ballast water management certificate or record of exemption (if not an automatic exemption).	Vessel Master
	Vessels will have a biofouling management plan prepared by an independent IMS expert to include elements of performance described in the IMO Guidelines for the Control and Management of Ship Biofouling to Minimize the Transfer of Invasive Aquatic Species (2012 Edition).	• Biofouling record book	Vessel Master

7.4.2 Interaction with marine fauna

Table 7-12: Impact and risk evaluation – Physical presence of vessels and interaction with marine fauna (vessel strike)

Identify hazards and threats	
The physical presence and use of vessels in the licence area has the potential to result in collision (vessel strike) with marine fauna.	
Potential consequence	**Severity**
The particular values and sensitivities identified as having the potential to be impacted by vessel strike are: • EPBC listed species. Vessels undertaking URF installation activities in WA-50-L have the potential to interact with transient, EPBC-listed species; specifically, marine mammals, whale sharks and turtles. This may result in injury or death of marine fauna from vessel strike. Collisions between vessels and cetaceans occur more frequently where high vessel traffic and cetacean habitat overlap (Dolman & Williams Grey 2006). Vessel speed has been demonstrated as a key factor in collisions with marine fauna such as cetaceans and turtles, and it is reported that there is a higher likelihood of injury or mortality from vessel strikes on marine mammals when vessel speeds are greater than 14 knots (Laist et al. 2001; Vanderlaan & Taggart 2007). The potential for vessel strike applies to all marine mammals, whale sharks and turtle species; however, humpback whales are considered to have a higher potential likelihood due to their extended surface time. The potential for collision during the activity is however reduced as the licence area is located hundreds of kilometres offshore, away from critical habitats such as humpback BIA areas (migration and calving) as shown in Figure 4-4 (located approximately 120 km south-east from WA-50-L at its closest point). The reaction of whales to approaching ships is reported to be quite variable. Dolman and Williams Grey (2006) indicate that some cetacean species, such as humpback whales, can detect and change course to avoid a vessel. Humpback whales are subject to a Conservation Advice (Appendix B) which requires the assessment of vessel strike on humpback whales and encourages the implementation of mitigation measures and vessel strike incident reporting to the National Ship Strike Database. As such, control measures are included below, to align with the Conservation Advice and address vessel strike on humpback whales. Another marine mammal with a BIA in the region (approximately 60 km to the west of WA-50-L (Figure 4-4)) is the blue whale, which is also subject to a conservation management plan (Appendix B). The conservation management plan identifies that, since 2006, there have been two records of likely ship strikes of blue whales in Australia. In 2009 and 2010, there were blue whale stranding's in Victoria, near the Bonney Upwelling with suspected ship strike injuries visible. Where blue whales are feeding at or near the surface, they are more susceptible to vessel strike. However, the open ocean environment allows for whales to invoke avoidance behaviour in threatening situations. The Blue Whale Conservation Management Plan highlights that minimising vessel collision is one of the top four priorities and requires assessment of vessel strike on blue whales, assures that incidents are reported in the National Ship Strike Database, and that control measures proposed will align with these priorities.	Minor (E)

Whale sharks do not breach the surface as cetaceans do; however, they are known to swim near to the water surface; hence, are susceptible to vessel strike. The foraging area for whale sharks (BIA) is located approximately 15 km south-east of WA-50-L and whale sharks are also subject to a conservation advice (Appendix B) which notes that the threat to the recovery of the species includes strikes from vessels. Turtles transiting the region are also at risk from vessel strike when they periodically return to the surface to breathe and rest. Only a small portion (3–6%) of their time is spent at the surface, with routine dive times lasting anywhere between 15 and 20 minutes nearly every hour. The presence of vessels has the potential to alter the behaviour of individual turtles. Some turtles have been shown to be visually attracted to vessels, while others show strong avoidance behaviour (Milton et al. 2003). Within the PEZ, marine turtle BIAs are known to occur (Figure 4-6). Following publication of the Recovery Plan for Marine Turtles in Australia, in 2017, habitats critical for the survival of the genetically distinct, 'Scott Reef – Browse Island' green turtle population has been identified. The closest identified habitat to WA-50-L, relates to an internesting area consisting of a 20 km buffer around Browse Island between November and March each year. The BIA does not overlap the licence area which is located approximately 33 km from Browse Island. During the internesting periods studies have shown that green turtles tend to stay relatively close to their nesting beach, approximately 7 km as reported by Pendoley (2005) and generally within 10 km (Waayers et al. 2011). Therefore, any impacts are expected to be localised and of minor consequence at the population level for these mobile and broad-ranging species. Given the expansive open ocean environment of the licence area, the potential for the displacement of cetaceans by operational activities is considered to be low. Additionally, there are no recognised feeding or breeding grounds for cetaceans or turtles within WA-50-L. While there is potential for a small number of individual marine fauna to be impacted by vessels associated with the activity, any potential vessel strike to marine fauna is likely to be limited to isolated incidents. As reported by the DEE (2017a), although the outcome can be fatal for individual turtles, vessel strike (as a standalone threat) has not been shown to cause stock level declines. In the event of the death of an individual whale or turtle, it would not be expected to have a significant effect at the population level (Minor E). With reference to the Recovery Plan for Marine Turtles in Australia (DEE 2017a) based on the long-life span and highly dispersed life history requirements of marine turtles it is acknowledged that they may be subject to multiple threats acting simultaneously across their entire life cycle, such as increases in background light and noise levels. In considering cumulative impacts of threats on small or vulnerable stocks of marine turtles, it is likely that vessel strike may act as contributor to a stock level decline.	

Identify existing design and safeguards/controls measures
Implementation of EPBC Regulations 2000 – Part 8 Division 8.1 (Regulation 8.05).

Propose additional safeguards/control measures (ALARP Evaluation)

Hierarchy of control	Control measure	Used?	Justification
Elimination	Eliminate the use of vessels	No	Vessels are the only form of transport that can undertake the activity.

			In the absence of any critical habitats in WA-50-L, altering the timing of the activity is not deemed warranted.
Substitution	None identified	N/A	N/A
Engineering	None identified	N/A	N/A
Procedures & administration	Vessel speed restrictions or separation distances maintained for turtles	No	It is reported that turtles generally stay close to their nesting beaches during the internesting period, so only individuals would be likely to be present in the licence area given the distance from Browse Island (33 km). Additionally, turtles reportedly spend a small portion (3–6%) of their time at the surface, this makes turtle observations by crew from the bridge of a vessel very difficult given that turtles are considerable smaller whales or whale sharks. On this basis, reducing vessel speeds and maintaining separation distances is not considered to be an effective control and will not be implemented.
	Vessel speed restrictions or separation distances maintained for whale sharks	Yes	As whale sharks swim near the sea surface, vessel strike is a possibility, given the closest BIA is located 30 km east of the licence area. In the absence of any current guidance for petroleum/commercial vessels, controls for vessels tour operators in Ningaloo (i.e. Whale Shark Wildlife Management Program No. 57) have been considered. Therefore, to be conservative, INPEX will adopt separation distances and vessel speed restrictions for whale sharks.
	Implementation of environmental awareness program for site personnel.	Yes	Before work commences, site personnel will be informed through an environmental awareness program of the need to avoid harm to marine fauna.
Identify the likelihood			
Records from 2011 (most recently available data) showed that between six and nine vessel strikes with cetaceans, including non-fatal cases, had been reported in Australian waters in the previous three years, with only a minority occurring in WA (IWC 2011). This suggests that, despite the growing presence of oil & gas activities on the NWS/Timor Sea, and the steady increase (approximately 10% per year) in humpback whale numbers, whale populations have not been affected by collisions with oil & gas vessels. An internesting BIA for green turtles at Browse island (20 km buffer, DEE 2017a) has identified habitat critical for survival between November and March each year, however internesting turtles are likely to stay within 10 km of their nesting beach. Nevertheless, support vessel routes will not encroach on the 20 km buffer unless in adverse sea conditions, as they shall remain beyond the 12 nm territorial sea limit (12 nm equates to approximately 22 km). During weather events i.e. sheltering during cyclone events, support vessel may seek shelter in lee of Browse Island for safety reasons. The duration of such activities is expected to be limited to 12-48 hours and therefore the likelihood of interactions with marine turtles is further reduced.			

The controls described above are commensurate with the level of risk and given the slow vessel speeds, the absence of any known BIAs or critical habitats in WA-50-L the likelihood of a vessel strike causing injury or death to a transient, EPBC-listed species is considered to be Highly Unlikely (5).			
Residual risk summary			
Based on a consequence of Minor (E) and a likelihood of Highly Unlikely (5) the residual risk is Low (9).			
Consequence	Likelihood	Residual risk	
Minor (E)	Highly Unlikely (5)	Low (9)	
Assess residual risk acceptability			
Legislative requirements EPBC Regulations 2000 – Part 8, Division 8.1 (Regulation 8.05) will be implemented with regards to vessel speeds and separation distances. Stakeholder consultation No stakeholder concerns have been raised regarding potential impacts and risks from the physical presence of vessels and potential for vessel strike associated with the petroleum activity. Conservation management plans / threat abatement plans Several conservation management plans have been consulted in the development of this EP (Appendix B). Actions identified in the Blue Whale Conservation Management Plan and conservation advice documents for humpback whales and whale sharks regarding vessel strike incident reporting will be implemented. ALARP summary Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact. Acceptability summary Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because: • the activity demonstrates compliance with legislative requirements/industry standards • the activity takes into account stakeholder feedback • the activity is managed in a manner that is consistent with the intent of conservation management documents • the activity does not compromise the relevant principles of ESD • the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.			
Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility

Zero incidents of injury/mortality of cetaceans and turtles from vessel collision for the duration of the URF installation activity.	EPBC Regulations 2000 – Part 8 Division 1 Interacting with cetaceans including: • Vessels will not travel greater than 6 knots within 300 m of a cetacean (caution zone) • Vessels will not approach closer than 50 m to a dolphin and/or 100 m of a whale (with the exception of bow riding).	Records of any breaches of vessel/cetacean interaction requirements outlined in the EBPC Regulations 2000 reported.	Vessel master
	Vessels will not travel faster than 8 knots within 250 m of a whale shark and not approach closer than 30 m from ahead of a whale shark's direction of travel.	Records of any breaches.	Vessel master
	Awareness materials for site personnel for avoiding harm to marine fauna.	Record of provision of awareness materials to site personnel.	INPEX Environmental Adviser

7.5 Seabed disturbance

Table 7-13: Impact and risk evaluation – Seabed disturbance

<table>
<tr><th colspan="2">Identify hazards and threats</th></tr>
<tr><td colspan="2">As described in Section 3, various equipment and subsea infrastructure will be installed in WA-50-L as part of the expansion to the SPS for the Ichthys LNG Project. URF activities have the potential to physically disturb the seabed in WA-50-L and such disturbance to benthic communities has the potential to result in reduced ecosystem productivity or diversity.

Disturbance to the seabed may occur during the activity either by:
• permanent placement of subsea infrastructure on the seabed (e.g. flowlines, manifolds, mattresses, etc.)
• temporary placement of some subsea infrastructure on the seabed prior to repositioning
• sediment displacement e.g. excavation, levelling or water-jetting of seabed sediments to align with infrastructure design criteria
• temporary disturbance from the use of suction start-up piles or start-up anchors during flowline installation
• temporary disturbance during structural foundation installation (vibro-driving of piles)
• temporary set-down of equipment on the seabed (e.g. ROV, tooling baskets, etc.)
• temporary mooring installed in WA-50-L for stand-by vessels.

The expected total disturbance footprint associated with the URF installation activities is 0.28 km^2.

The use of the ROVs (2 – 3 m^2), IMR related equipment e.g. leak detection systems (4 – 5 m^2) and ROV tooling baskets (2 -3 m^2) may be temporarily positioned on the seabed during the URF installation activities. These items will be retrieved at the end of the activity.

During the URF installation activities, vessels may use temporary moorings which may be installed in the vicinity of the Ichthys Field to reduce marine diesel consumption while vessels are on stand-by. Temporary moorings would likely consist of a single clump weight or drag embedment anchor, a length of chain and cable to a buoy, which would be retrieved at the end of the URF installation activity. The expected area of physical disturbance to the seabed associated with a temporary mooring is approximately 15-30 m^2.</td></tr>
<tr><th>Potential consequence</th><th>Severity</th></tr>
<tr><td>The particular values and sensitivities identified as having the potential to be impacted by seabed disturbance are:
• benthic communities.</td><td>Insignificant (F)</td></tr>
</table>

Physical disturbance of the seabed may cause temporary disturbance to benthic habitats and loss of associated infauna and epifauna. As described in Section 4.7.3, seabed habitat surveys have been undertaken in the Ichthys Field, Echuca and Heywood Shoals located approximately 79 km and 96 km from WA-50-L respectively. The results of the surveys observed that seabed topography was relatively flat and featureless (INPEX 2010) with no obstructions or features on the seafloor, such as boulders, reef pinnacles or outcropping hard layers (Fugro Survey Pty Ltd. 2005; RPS 2007). The observed habitat generally supported a diverse infauna dominated by polychaetes and crustaceans typical of the broader region and this was reflected in survey results which indicated that the epibenthic fauna was diverse but sparsely distributed (RPS 2008). Benthic habitats within WA-50-L comprise of soft substrate, typical of deep continental shelf seabed habitats which are widely distributed in deeper parts of the Browse Basin (RPS 2007), and commonly found throughout the NWMR (Baker et al. 2008). Survey data also confirmed the seabed in WA-50-L has heavily rippled sediments suggestive of strong near seabed currents and a lack of seabed features. In general, deep-sea infaunal assemblages are poorly studied on the NSW but are likely to be widely distributed in the region including WA-50-L (INPEX 2010). The total disturbance footprint from the URF installation activities is expected to be approximately 0.28 km^2, which in the context of WA-50-L, covering an area of approximately 570 km^2, represents the disturbance of approximately 0.05% of the production licence area. The activity may result in the mortality of sessile fauna within this footprint and potentially the mortality of benthic infauna associated with the habitat. However, it is considered that potentially impacted benthic habitats and associated biota are well represented in the region. Therefore, any disturbance and loss of habitat will represent a very small fraction of the widespread available habitat. Following removal of the temporarily positioned equipment e.g mooring and ROV baskets, the soft sediments will be left disturbed; however, benthic habitats would remain viable and are expected to recolonise through the recruitment of new colonists from planktonic larvae in adjacent undisturbed areas. Displacement of sediments may occur during equipment and mooring deployment, and through sediment excavation/levelling/water-jetting. This may result in temporary, localised plumes of suspended sediment and subsequent deposition of sediment resulting in smothering of marine benthic habitat and benthic communities in the immediate vicinity. Parts of the ancient coastline KEF, particularly where it exists as a rocky escarpment, are thought to provide biologically important habitats in areas otherwise dominated by soft sediments (DSEWPaC 2012a). It is considered that the hard substrate of the escarpment is likely to support a range of sponges, corals, crinoids, molluscs, echinoderms and other benthic invertebrates (DSEWPaC 2012a). The ancient coastline KEF is located, approximately 20 km south of WA-50-L at its closest point. Therefore, benthic communities associated with the KEF are not expected to be impacted as any silt plumes generated would have dissipated over this distance in the presence of near-seabed currents and it is not expected that sedimentation/smothering impacts would occur to benthic communities. This is also expected to be the case for Echuca and Heywood Shoals located 79 km and 96 km away respectively. The potential consequence on benthic communities is a localised impact from physical disturbance within the footprint of the URF installation activities, which is expected to be limited given the predicted sparse cover of benthic communities and expected recovery through recolonisation. Therefore, it is assessed to be of inconsequential ecological significance (Insignificant F).	

<table>
<tr><td colspan="4">Several commercially significant fish stocks, considered as key indicator species, may be present in the waters of WA-50-L (Table 4-6). Although they may be present, given the deep waters and absence of suitable habitats, WA-50-L is not considered to offer spawning or aggregation habitat (Section 4.9.3). Disturbance to seabed habitats from the activity is therefore not expected to affect fish spawning habitats (Insignificant F).</td><td></td></tr>
<tr><td colspan="5">Identify existing design and safeguards/controls measures</td></tr>
<tr><td colspan="5">None identified</td></tr>
<tr><td colspan="5">Propose additional safeguards/control measures (ALARP Evaluation)</td></tr>
<tr><td>Hierarchy of control</td><td>Control measure</td><td>Used?</td><td colspan="2">Justification</td></tr>
<tr><td>Elimination</td><td>No anchoring by vessels</td><td>Yes</td><td colspan="2">Vessels will use temporary moorings in WA-50-L to save fuel while on standby. Some installation vessels will maintain position through the use of DP systems and will not anchor in WA-50-L unless in the case of an emergency.</td></tr>
<tr><td>Substitution</td><td>None identified</td><td>N/A</td><td colspan="2">N/A</td></tr>
<tr><td>Engineering</td><td>None identified</td><td>N/A</td><td colspan="2">N/A</td></tr>
<tr><td>Procedures & administration</td><td>None identified</td><td>N/A</td><td colspan="2">N/A</td></tr>
<tr><td colspan="5">Identify the likelihood</td></tr>
<tr><td colspan="5">Given the controls in place, the likelihood of impacting benthic communities in WA-50-L, is considered to be Possible (3). Any temporary impacts are considered to be ecologically insignificant to the wider diversity and productivity of benthic communities in the region, including the ancient coastline KEF, based on the relatively small area potentially impacted i.e. total disturbance footprint relative to the widespread available habitat and expected recovery.</td></tr>
<tr><td colspan="5">Residual risk summary</td></tr>
<tr><td colspan="5">Based on a consequence of Insignificant (F) and a likelihood of Possible (3) the residual risk is Low (8).</td></tr>
</table>

Consequence	Likelihood	Residual risk
Insignificant (F)	Possible (3)	Low (8)
Assess residual risk acceptability		
Legislative requirements Although there is no specific environmental legislation or guideline regarding the environmental management of subsea installation activities with respect to impacts on benthic communities, these activities align with INPEX corporate policies through the reduction of environmental impacts and risks to ALARP levels. Stakeholder consultation No stakeholder concerns have been raised regarding potential impacts and risks from seabed disturbance caused by anchoring and moorings associated with the activity. Conservation management plans / threat abatement plans Several conservation management plans have been consulted in the development of this EP (Appendix B). The recovery plan for sawfish and river sharks specifies habitat degradation and modification as a principle threat and details actions to reduce impacts on critical sawfish and river shark habitats. There are no critical habitats for sawfish or river sharks within WA-50-L and therefore no specific actions relating to seabed disturbance from anchoring/mooring activities apply. ALARP summary Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact. Acceptability summary Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because: • the activity demonstrates compliance with legislative requirements/industry standards • the activity takes into account stakeholder feedback • the activity is managed in a manner that is consistent with the intent of conservation management documents • the activity does not compromise the relevant principles of ESD		

- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.

Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility
No anchoring to take place in areas which support sensitive primary producer benthic habitat.	Vessels will not anchor in WA-50-L, unless in case of an emergency.	Incident reports	Vessel master

7.6 Social and cultural heritage protection

7.6.1 Physical presence - disruption to other marine users

Table 7-14: Impact and risk evaluation – Physical presence of vessels resulting in disruption to marine users

<table>
<tr><td colspan="2">Identify hazards and threats</td></tr>
<tr><td colspan="2">The physical presence of the vessels in WA-50-L has the potential to cause disruption to other marine users, including shipping operators and fisheries through the reduction of space available to conduct shipping and fisheries activities in the licence area. The potential, albeit temporary, interference with and/or exclusion of other users may result in a loss of revenue for commercial users including fisheries.</td></tr>
<tr><td>Potential consequence</td><td>Severity</td></tr>
<tr><td>The particular values and sensitivities identified as having the potential to be impacted by disruption from the physical presence of vessels are:
• Shipping operators and commercial, traditional, and recreational fisheries.

Other marine users in the vicinity of WA-50-L may be impacted by vessel presence because of the loss of navigable space available to conduct their activities. The implications of such disruptions include changes to sailing routes and journey times, or reduced ability to fish in an area. The worst-case consequence from a loss of access to an area could result in economic losses and/or potential reduction in employment levels.

A review of AMSA's vessel traffic data for the Browse Basin in May 2019 confirmed the absence of any major shipping lanes within the licence area (Figure 4-9). A large proportion of the high-density vessel traffic in and around WA-50-L is related to supply vessels supporting the offshore developments (INPEX Ichthys facility and Shell Prelude FLNG facility) that routinely transit between the offshore facilities and the ports of Darwin and Broome on the mainland. Therefore, in some areas of WA-50-L heavy vessel traffic will occur. In addition to vessel traffic, INPEX's Ichthys offshore facility (CPF and FPSO) are permanently moored within WA-50-L, with 500 m exclusion zones in place, also contributing to a loss of navigable space in the licence area.

Individual vessels may have to slightly alter their sailing routes to avoid the URF vessels in WA-50-L, potentially leading to longer journey times; however, given the presence of the permanently moored facilities in the licence area that other marine users are aware of, any disruption is expected to cause minor impact and not result in any economic losses. Therefore, the consequence is considered to be insignificant (F).</td><td>Insignificant (F)</td></tr>
</table>

Several Commonwealth and State managed fisheries overlap the licence area and PEZ (Section 4.9.3). In many instances, although the area of the fishery overlaps WA-50-L, no fishing effort actually occurs in the licence area based on the water depth, water temperature and lack of suitable habitat. Of the fisheries overlapping WA-50-L, the North West Slope Trawl Fishery is the only active fishery; however, it reportedly fishes at low levels with only negligible trawl fishing occurring in the Ichthys Field (AFMA 2020c). Based on the low level of identified commercial fishing activity and the relatively small spatial area occupied by the vessels in comparison to the entire extent of the fishing grounds available to commercial operators, the potential loss of navigable space in which a fishing operator could conduct their activities is considered to be insignificant (F). WA-50-P is situated within the MoU box for Indonesian traditional fishing (DSEWPaC 2012) as shown on Figure 4-2. Therefore, Indonesian fishing vessels may be present in the area when transiting between fishing grounds at Scott Reef and Browse Island; however, transit routes are not expected to overlap WA-50-L as Scott Reef and Browse Island are located south of the licence area. Therefore, interference and disruption are not expected, and impacts are expected to be insignificant (F). Recreational fishing may also operate off the WA coast during certain times of the year. Generally, there is little recreational fishing that occurs within WA-50-L because of its distance from land, lack of features of interest and deep waters. Therefore, the potential for loss of access to the recreational fishing industry as a result of vessel physical presence is considered to be of Insignificant consequence (F).	

Identify existing design and safeguards/controls measures
Stakeholder consultation with relevant stakeholders Vessels fitted with lights, signals, an automatic identification system (AIS) transponders and navigation equipment as required by the *Navigation Act 2012*.

Propose additional safeguards/control measures (ALARP Evaluation)			
Hierarchy of control	Control measure	Used?	Justification
Elimination	Eliminate the use of vessels	No	The use of vessels to undertake the activity cannot be eliminated.
Substitution	Alter timing to avoid peak fishing periods	No	The area that stakeholders are excluded from to avoid vessels is relatively small when compared to the area available to other marine users. In conjunction with low fishing activity in the area, as confirmed through stakeholder consultation, altering the timing of the activity is not deemed necessary or considered an effective control.
Engineering	None identified	N/A	N/A

Procedures & administration	Australian Hydrographic Office (AHO) will be informed of the proposed location of the activity prior to commencement.	Yes	By informing AHO of the location of the vessels, it can update navigation charts, therefore reducing the risk of accidental third-party interactions with areas of increased vessel activity in WA-50-L.
	Issue notice to mariners	Yes	By informing AHO start date of the activity, information will be included in the promulgation of fortnightly Notice to Mariners. Notice to Mariners provide commercial shipping operators with information regarding activities or hazards in the region and will include details of the relevant vessels.
	Notification to AMSA's Joint Rescue Coordination Centre (JRCC)	Yes	The AMSA JRCC will be advised of the activity details for promulgation of radio-navigation warnings 24-48 hours before operations commence and upon completion of the activity.

Identify the likelihood		
Reduction of available navigable space, as a result of URF installation activities in WA-50-L, will have an insignificant impact to shipping and fishing operators. The likelihood of loss of access/space in the open ocean resulting in an economic loss or reduction in employment levels is considered to be Highly Unlikely (5). During stakeholder engagement for the EP, shipping operators were not considered as relevant stakeholders to be consulted, as the petroleum activity is outside of any shipping routes/channels. Relevant stakeholders, including fisheries, were consulted throughout the development of this EP. Commercial fisheries will continue to be informed and updated on operational activities being undertaken by INPEX. On this basis, with the controls in place, impacts to economic values from loss of revenue for fisheries due to lack of access to fishing grounds with potential reduction in employment levels is considered Highly Unlikely (5).		
Residual risk summary		
Based on a consequence of Insignificant (F) and a likelihood of Highly Unlikely (5) the residual risk is Low (10).		
Consequence	Likelihood	Residual risk
Insignificant (F)	Highly Unlikely (5)	Low (10)
Assess residual risk acceptability		
Legislative requirements		

Marine Safety Information (MSI) notifications will be issued via AMSA, while the Australian Hydrographic Office (AHO) will issue a Notice to Mariners. All vessels will be equipped with navigation equipment as required by the *Navigation Act 2012*.

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from the physical presence of vessels in WA-50-L. During stakeholder consultation AMSA requested that all relevant notifications be adopted as controls in this EP and therefore, these requirements have been adopted.

Conservation management plans / threat abatement plans

Several conservation management plans have been consulted in the development of this EP (Appendix B). None of the recovery plans or conservation advice documents are relevant to the physical presence of vessels disrupting shipping or fishing operators.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.

Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility
Relevant persons (i.e. shipping operators and commercial, traditional, and recreational fisheries) will be identified and any concerns raised will be assessed	Disruption to fishing/shipping and other marine users will be managed by identifying and conducting ongoing stakeholder consultation on an as required basis during the activity.	Stakeholder engagement records demonstrating assessment of stakeholder feedback received and INPEX response (or resolution).	INPEX Environmental Adviser

and those of merit resolved.	The Australian Hydrographic Service (AHO) will be notified no less than four working weeks before operations commence for the promulgation of related notices to mariners (via datacentre@hydro.gov.au).	Records of document transmittal to AHO.	INPEX URF manager
	Notification will be provided to AMSA's Joint Rescue Coordination Centre (JRCC) for promulgation of radio-navigation warnings 24-48 hours before operations commence, including following information (via rccaus@amsa.gov.au, ph: 1800 641 792 or +61 2 6230 6811): • Vessel details, including name, call sign and Maritime Mobile Service Identity (MMSI) • Satellite communications details, including INMARSAT-C and satellite telephone • Area of operation • Requested clearance from other vessels • Notification of operations start and end.	Records of document transmittal to AMSA JRCC.	INPEX Environmental Adviser
	Vessels will be fitted with lights, signals, AIS transponders and navigation and communications equipment, as required by the *Navigation Act 2012.*	Records confirm that required navigation equipment is fitted to vessels to ensure compliance with the *Navigation Act 2012.*	Vessel master

7.7 Loss of containment

The activity will require the handling, use and storage of chemicals and hydrocarbon materials which may include, but are not limited to:

- fuels (e.g. diesel/HFO)
- hydraulic oil
- subsea/hydraulic control fluids
- grease.

Undertaking the activity introduces the potential for loss of containment events. These events may be classified as Level 1, Level 2 or Level 3 incidents, in accordance with Table 2.1 of the OPEP (Appendix D).

INPEX defines an emergency condition as:

"an unplanned or uncontrolled situation that harms or has the potential to harm people, the environment, assets, Company reputation or Company sustainability and which cannot, through the implementation of Company standard operating procedures, be contained or controlled."

An evaluation of the environmental impacts and risks associated with emergency conditions is included in Section 8 of this EP.

A summary of the loss of containment events (and emergency conditions) associated with this EP is presented in Table 7-15. Incident levels are indicative only and classifications have been assigned for the purposes of enabling the risk evaluation to be undertaken. In the event of a spill, the incident level will be classified as described in the OPEP (Appendix D).

Table 7-15: Representative loss of containment events and emergency conditions identified for the petroleum activity

Scenario		Basis of volume calculation	Type	Indicative incident level	Section addressed
Source	Threat				
Management of chemicals and hydrocarbons products on board	Inappropriate use /handling/ spills Failure of hydraulic hoses on equipment	Failure of tote tank, estimated to be in the order of 1 m^3 Failure of hydraulic hoses, estimated to be in the order of < 1 m^3	Various – may include grease, wax, hydraulic fluids	1	Accidental release – Table 7-16
Cargo transfers	Dropped objects	5.5 m^3 – based on the volume of a tote tank which, if lost during cargo transfer, has the potential to result in a full loss of contents	Various	1	Accidental release – Table 7-16

Scenario		Basis of volume calculation	Type	Indicative incident level	Section addressed
Source	**Threat**				
Chemical transfers	Spill during bulk transfer	24 m^3 – based on loss of largest iso tank	MEG/pre-commissioning fluids	1	Accidental release - Table 7-16
Hydrocarbon transfers	Spill during vessel bunkering	10 m^3 – based on hose failure during transfer	Group II – diesel or Group IV HFO	1	Accidental release – Table 7-16
Emergency conditions (refer to Section 8)					
Vessels	Collision	750 m^3 – based on DNV (2015) – Clean Design requirements for double-hull / fully protected internal tanks, and maximum tank size of 1500 m^3, combined with AMSA (2015) vessel collision guidance - 50% loss of tank protected by double hull.	Group II – diesel	2	Vessel collision – Section 8.2
		750 m^3 – based on DNV (2015) – Clean Design requirements for double-hull / fully protected internal tanks, and maximum tank size of 1500 m^3, combined with AMSA (2015) vessel collision guidance - 50% loss of tank protected by double hull.	Group IV – HFO	2	Vessel collision – Section 8.2
Loss of containment – rupture/ damage to Ichthys subsea production system (SPS)	Dropped objects	350 m^3 - based on a 30-minute release of Brewster condensate from a small leak in the condensate rich MEG line (worst-case SPS line) at the seabed.	Group I – condensate/ dry gas	2	Loss of containment from SPS – Section 8.3

7.7.1 Accidental release

Table 7-16: Impact and evaluation – loss of containment: accidental release

Identify hazards and threats	
Several loss of containment events were identified during the HAZID (Table 7-15), including minor spills on board (<1 m^3); loss of tote tank during cargo transfer (5.5 m^3); failure of hydraulic hoses (<1 m^3); loss of hydrocarbon fuels during bunkering of vessels (approximately 10 m^3) and loss of MEG/pre-commissioning fluids during bulk transfer (approximately 24 m^3). Specific predictive modelling was not undertaken for the potential loss of containment events. This was based on the low worst-case volumes ranging from < 1 -24 m^3, and that any predicted impacts are expected to be localised to the point of release. Given the properties of the chemicals involved (predominantly MEG and Group II hydrocarbons), which tend to be less persistent in the environment, any spills will rapidly disperse at the sea surface. An accidental release overboard resulting in a spill that reaches the marine environment has the potential to result in localised changes to water quality, resulting in impacts to marine fauna and planktonic communities at the sea surface, but no impact on deeper water communities or benthic habitats would be expected.	
Potential consequence	**Severity**
The particular values and sensitivities identified as having the potential to be impacted by an accidental release are: • EPBC listed species • fish (commercial species). Potential accidental releases overboard from loss of containment events may result in the exposure of marine fauna and plankton near the sea surface, to a range of chemicals and Group II hydrocarbons. Foreseeable loss of chemicals to the marine environment would be of small volumes ranging from <1 – 2 m^3 up to < 24 m^3 of MEG or other pre-commissioning fluids. MEG is considered to pose little or no risk to the environment (PLONOR) by OSPAR (2012). Therefore, impacts would generally be of low consequence (Insignificant F). Therefore, the focus of this assessment is based on the loss of diesel during bunkering. Given the anticipated volumes (worst case 10 m^3), potential exposure is expected to be localised to the point of discharge in WA-50-L and in some instances a portion of the spilled volume is expected to be at least partially captured within the vessel drainage system. Upon release to the marine environment hydrocarbons will disperse through natural physical oceanic processes, such as currents, tides and waves, and photochemical and biological degradation. Therefore, any surface expression is expected to weather and dissipate in a relatively short time with limited potential for exposure to surfacing marine fauna or plankton at the sea surface.	Insignificant (F)

In the absence of any known BIAs for marine fauna in the licence area, any individuals present are likely to be transiting the area for a short duration. The closest BIA to WA-50-L relates to the 20 km green turtle internesting buffer at Browse Island (33 km away). Additionally, a whale shark foraging BIA is located approximately 15 km south east from the licence area at its closest point (Figure 4-7); however, based on the levels of whale shark abundance observed in numerous studies (as described in Section 4.8.4), the likelihood of whale shark presence within this BIA is considered very low, with no specific seasonal pattern of migration. Given the low volumes, limited duration of exposure due to expected weathering and dispersion in an open ocean environment, the level of consequence is expected to present a local scale event of inconsequential ecological significance (Insignificant F). As a consequence of their presence close to the water surface, plankton may be exposed to any entrained/dissolved components of any hydrocarbons spilled at the sea surface, particularly in high energy seas where the vertical mixing of oil through the water column would be enhanced. The effects of oil on plankton have been well studied in controlled laboratory and field situations. The different life stages of a species often show widely different tolerances and reactions to oil pollution. Usually, eggs, larval and juvenile stages will be more susceptible than adults (Harrison 1999). Post-spill studies on plankton populations are few, but those that have been conducted, typically show either no effects or temporary minor effects (Kunhold 1978). Given the high temporal and spatial variability in plankton communities, and the small size of the area impacted by an accidental release, the potential consequence in regard to planktonic communities is considered to be Insignificant (F).	

Identify existing design and safeguards/controls measures			
Marine vessels >400 GT will carry SOPEPs approved under MARPOL 73/78 Annex I, Regulation 37 and SMPEPs approved under MARPOL 73/78 Annex II, Regulation 17 if the vessel is >150 GT and carrying noxious liquid substances in bulk (noting that the SOPEP and SMPEP may be combined into a single document).			
Propose additional safeguards/control measures (ALARP Evaluation)			
Hierarchy of control	Control measure	Used?	Justification
Elimination	Eliminate the use of chemicals and hydrocarbons on board vessels.	No	Chemicals and hydrocarbons are required for safe and efficient operations and cannot be eliminated. In the case of diesel and HFO, they are required as fuel and cannot be eliminated.
	No bunkering.	No	Bunkering of fuel is a requirement during the activity as vessel tank capacities mean that supplies need to be replenished. Steaming time to the closest port facilities for bunkering is approximately 18 hours. This would generate additional environmental impacts in terms of air emissions. This would also result in significant delays to the schedule.
	No cargo transfers.	No	Cargo transfers cannot be eliminated, as this is the only practicable option for supplying the vessels in an offshore location.
Substitution	None identified	N/A	N/A
Engineering	Prevent onboard spills through appropriate storage of hydrocarbons	Yes	Through bunding of storage areas and good housekeeping practices, the storage and management of hydrocarbon and

	and chemicals including their associated waste constituents.		chemical products and associated wastes can reduce the potential risk of a loss of containment event occurring.
	Reduce potential volumes of spilled chemicals/hydrocarbons reaching the marine environment by ensuring spill containment and recovery equipment, such as spill kits, are available for responding to minor spillage of hydrocarbons and chemicals on board.	Yes	The availability of spill kits on board vessels (and trained personnel in the use of spill kits) will enable minor spills to be responded to in a timely manner to reduce the likelihood of spillages reaching the marine environment.
	Dry break, breakaway couplings or similar technology will be installed and used during bulk transfer and hydrocarbon bunkering operations.	Yes	The use of dry break and breakaway couplings during transfers and bunkering, as specified by the contractors transfer procedures, will reduce the potential volume of any spills.
Procedures & administration	Implement bulk transfer/hydrocarbon procedures that specify keeping of hose registers, and operational requirements (e.g. minimum lighting conditions, communications, visual monitoring).	Yes	The transfer of chemicals and fuel will occur in accordance with strict conditions for preventing spills to the marine environment.
	Hydraulic equipment on board vessels will be subject to routine servicing and inspection to ensure it is fit for purpose.	Yes	Routine servicing and inspection of hydraulic equipment will ensure it is fit for purpose and minimise the potential for leaks and spills to deck as a result of corrosion, and wear and tear of hydraulic hoses.
	SIMOPS interface plan implemented to reduce the risk of dropped objects.	Yes	The SIMOPS interface plan will be used to ensure that the risk of dropping hazardous materials during transfers is reduced and controls put in place where necessary.
	Implement the INPEX *Chemical Assessment and Approval Procedure.*	Yes	The INPEX *Chemical Assessment and Approval Procedure* (Section 9.6.1) will be used to preferentially select chemicals that will be intentionally discharged to the marine environment. The procedure promotes the use of chemicals presenting low environmental hazards; thereby, reducing potential environmental impacts associated with their discharges.
Identify the likelihood			
Based on the small volumes, expected weathering of spilled chemicals, absence of any important habitats within WA-50-L for marine fauna and in conjunction with the controls in place the likelihood of a loss of containment event causing harm to the identified receptors is considered to be Unlikely (4).			

Residual risk summary		
Based on a consequence of Insignificant (F) and a likelihood of Unlikely (4) the residual risk is Low (9).		
Consequence	Likelihood	Residual risk
Insignificant (F)	Unlikely (4)	Low (9)

Assess residual risk acceptability

Legislative requirements

The activities and proposed management measures are compliant with industry standards and relevant Australian legislation, specifically concerning prevention pollution, including the POTS Act.

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from accidental release/loss of containment. Spill response activities and notifications to relevant stakeholders have been identified and included in INPEX spill response processes.

Conservation management plans / threat abatement plans

Several conservation management plans (Appendix B) identify oil or chemical spills as key threatening processes, through both direct/acute impacts, as well as indirect impacts through habitat degradation. The prevention of loss of containment events and reducing impacts to the marine environment through the preventative controls in place and spill response preparedness, demonstrates alignment with the various conservation management plans.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as “low”, the consequence does not exceed “C – significant” and the risk has been reduced to ALARP.

Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility
No incidents of spills reaching the marine environment during transfer, handling or storage of chemicals, hydrocarbons and liquid waste products.	Vessels >400 GT will have SOPEPs compliant with Marine Orders – Part 91, the POTS Act, and Annex I of MARPOL 73/78 (oil) on board.	SOPEPs on board.	Vessel master
	Vessels >150 GT and carrying noxious liquid substances in bulk, will have SMPEPs compliant with Marine Orders – Part 93, the POTS Act, and Annex II of MARPOL 73/78 (noxious liquid substances) on board.	SMPEPs on board.	Vessel master
	Bunded areas or other secondary containment will be available and used for the storage and handling of hydrocarbons and chemicals (including waste products).	Inspection records confirm bunding or other secondary containment is available and used for the storage of hydrocarbons and chemicals (including waste products).	Vessel master
	Spill kits will be located on vessels to allow clean-up of any spill to the deck.	Inspection records confirm spill kits are available and stocked.	Vessel master
	Site personnel are made aware of deck spill response requirements.	Records of awareness materials include deck spill response requirements provided.	Vessel master
	SIMOPS interface plan implemented.	Records confirm SIMOPS plan developed and implemented.	INPEX URF manager
	Bunkering procedures will be implemented for all bulk hydrocarbon and chemical transfers, specifically: • use of dry-break, breakaway couplings or similar technology • visual monitoring of hoses, couplings and the sea surface will be undertaken during refuelling and offloading operations. • radio contact will be maintained between vessels during refuelling and transfer operations.	Bunkering records. Training records of personnel involved in the bunkering of chemicals.	Vessel master

	Chemicals to be discharged to the marine environment will be subject to the INPEX *Chemical Assessment and Approval Procedure* before they can be used.	Records of assessment of production chemicals to be discharged are retained in a chemical database.	INPEX Environmental adviser

8 EMERGENCY CONDITIONS

An evaluation of potential spill sources identified during the environmental hazard identification (HAZID) workshops determined various potential emergency conditions related to the activity (Table 7-15). The emergency conditions are summarised in Table 8-1.

Table 8-1: Potential emergency conditions

Scenario		**Hydrocarbon type**	**Release location**
Source	Threat		
Vessels	Collision (750 m^3)	Group II – diesel Group IV - HFO	Surface
Rupture/damage to live infrastructure (SPS) [1]	Dropped object (350 m^3)	Group I – condensate	Subsea

8.1 PEZ and EMBA based on oil spill modelling

As described in Section 4, the PEZ has been derived to inform the outer boundary of potential exposure for oil spill planning and scientific monitoring purposes using low thresholds described in NOPSEMA bulletin #1 (NOPSEMA 2019a). The low thresholds used may not be ecologically significant as hydrocarbon exposure has the potential to result in both acute and chronic impacts to marine flora and fauna, depending on the sensitivity of organisms exposed and the concentration of exposure.

A summary of the range of concentrations of different hydrocarbon exposure thresholds adopted to conservatively identify the PEZ and EMBA (area where potential environmental impact may occur) is described in Table 8-2. These thresholds include surface, entrained, dissolved and shoreline accumulation thresholds to account for the different partitioning and fate of oils released in different scenarios as outlined in Table 8-1.

Table 8-2: Hydrocarbon exposure threshold for impact and risk evaluation

Threshold		**Description**
Surface hydrocarbon exposure	PEZ 1 g/m^2	To define the outer extent of potential exposure, a low surface exposure threshold of 1 g/m^2 has been used to provide an indication of the furthest extent at which a visible sheen may be observed on the sea surface. It is considered too low for ecological impact assessment purposes and is used for oil spill planning and scientific monitoring purposes (water quality) as per NOPSEMA (2019a).

[1] A dropped object has the potential to rupture or damage the SPS. The impact and risks associated with this scenario are evaluated in Section 8.3; however, the mitigative controls in relation to oil spill response activities are outside of the scope of this EP as described in Section 1.2 of this EP.

Threshold		Description
		The low exposure threshold also provides an indication of socioeconomic receptors, such as oil and gas industry and fishing activities that may be affected by safety concerns associated with a light surface expression.
	EMBA 10 g/m^2	The surface oil threshold of 10 g/m^2 to assess environmental impacts is based on research by French-McCay (2009) who has reviewed the minimum oil thickness (0.01 mm) required to impact on thermoregulation of marine species, predominantly seabirds and furred mammals. Seabirds are particularly vulnerable to oil spills because their feathers easily become coated and they feed in the upper water column. Other tropical marine megafauna species are unlikely to suffer from comparable physical oil coating because they have smooth skin. Applying the threshold for the scenarios outlined for this EP therefore, represents a conservative measure to define the EMBA. This threshold has been applied to various industry oil spill impact assessments by French-McCay (2002, 2003) and is recommended in the AMSA guidelines (AMSA 2015b).
Entrained hydrocarbon exposure	PEZ 10 ppb	The low exposure threshold of 10 ppb has been used to inform the outer extent of potential exposure to entrained hydrocarbons in the water column. It is considered too low for ecological impact assessment and is used for oil spill planning and scientific monitoring purposes (water quality) as per NOPSEMA (2019).
	EMBA 100 ppb	Condensate (subsea release) The biological impact of entrained oil cannot be determined directly using available ecotoxicity; however, it can be derived from tests using either water-soluble fraction (WSF) of oil or oil-in-water dispersions (OWD). OWD are prepared by highly turbulent shaking of oil in water, which are allowed to separate before use, so that the test organisms are exposed to the dissolved fractions, as well as any very fine entrained oil droplets that remain in suspension. However, results are conservative because entrained droplets are less biologically available to organisms through tissue absorption than the dissolved fraction (Tsvetnenko 1998).

Threshold		**Description**
		To provide an estimate of the magnitude of toxicity effects from oil exposure to marine biota across a wide taxonomic range, a review was undertaken of global ecotoxicology data for numerous species (115 for fish, 129 for crustaceans, and 34 for other invertebrates) by French-McCay (2002). These were based on both WSF and OWD tests. Under low-turbulence conditions, the total polycyclic aromatic hydrocarbon (PAH) LC_{50} for species of average sensitivity ranges from about 300–1,000 ppb. Under higher turbulence, such as a subsea release, the total PAH LC_{50} decreased to about 64 ppb (French-McCay 2002). Comparatively, the lowest no observed effect concentration (NOEC) level for unweathered Browse condensate from the north-west region was found to be 20 ppm, based on a fish imbalance and tiger-prawn toxicity test (Woodside 2014). In addition to potential toxicity impacts, entrained oil droplets (although less bioavailable) may present smothering impacts to submerged receptors. Physical and chemical effects of the entrained oil droplets have been demonstrated through direct contact with receptors through physical coating of gills and body surfaces, and accidental ingestion (NRC, 2005). To be conservative, a 100 ppb entrained threshold is proposed for a subsea release of condensate to account for any ecological impacts (toxicity and smothering) in the EMBA.
	500 ppb	Diesel and HFO (surface release) A review of Group II (diesel) hydrocarbon toxicity to the marine environment reported that a contact threshold of 500 ppb was found to be highly conservative for a range of species including crustaceans, molluscs, echinoderms and fish (NERA Reference Case 2018:1003 and references within). Weathering/fate modelling of Group IV (HFO) spills indicated that these oil types will be highly resistant to entrainment into the water column, even under strong wind conditions. In addition to potential toxicity impacts, entrained oil droplets (although less bioavailable) may present smothering impacts to submerged receptors. Physical and chemical effects of the entrained oil droplets have been demonstrated through direct contact with receptors through physical coating of gills and body surfaces, and accidental ingestion (NRC, 2005). To be conservative a 500 ppb entrained threshold is proposed for a surface release of marine diesel and HFO to account for any ecological impacts (toxicity and smothering) in the EMBA.

Threshold		Description
Dissolved hydrocarbon exposure	PEZ -	As dissolved hydrocarbons are the soluble component of entrained hydrocarbons, the conservative low exposure threshold used for entrained hydrocarbons at 10 ppb encompasses the dissolved component to identify the furthest extent of potential exposure used for oil spill planning and scientific monitoring purposes (water quality) as per NOPSEMA (2019).
	EMBA 50 ppb	Condensate (subsea release) The 99% species protection threshold of 50 ppb for PAH (ANZG 2018) has been selected to indicate the zones where acute exposure could potentially occur over shorter durations, following a spill.
	500 ppb	Diesel and HFO (surface release) For marine diesel, the surface release of the hydrocarbon tends to reduce its potential for solubility and so the level of toxicity decreases. Diesel also contains a high proportion of monocyclic aromatic hydrocarbons, which are typically less toxic than PAHs with the majority of toxicity caused by PAHs (French-McCay 2002). A threshold up to 1,000 ppb is recommended by French-McCay (2002). The NERA (2018) reference case for a surface diesel release states that a dissolved aromatic contact threshold of 500 ppb for diesel is highly conservative. Weathering/fate modelling of Group IV (HFO) spills indicated that these oil types have a low solubility coefficient in water and therefore are not expected to dissolve in the water column. Therefore, to be conservative a 500 ppb dissolved hydrocarbon threshold is proposed for a surface release of marine diesel and HFO to account for any ecological impacts in the EMBA.
Shoreline accumulation:	PEZ 10 g/m^2	Certain industries, such as tourism may be affected by visible sheen on sandy beaches, therefore a shoreline accumulation of 10 g/m^2 has been included for information purposes to inform the PEZ, that may indicate potential socioeconomic impact as per NOPSEMA (2019). However, it is considered too low for ecological impact assessment purposes.
	EMBA 100 g/m^2 (where threshold for surface or entrained/dissolved hydrocarbon exposure at that shoreline is also exceeded).	A shoreline accumulation threshold of 100 g/m^2 is recommended from the review by French-McCay (2009) based on exposure to birds and smothering of invertebrates in intertidal habitats. This threshold is also proposed to be an acceptable minimum thickness that does not inhibit recovery and is best remediated by natural coastal processes (AMSA 2015b).

As described in Section 4, the spatial extent of the PEZ, used as the basis for the EPBC Protected Matters Database search (Appendix B), was determined using stochastic spill modelling by applying the low thresholds. The EMBA used as the basis for the impact and risk evaluation presented in this section of the EP, was determined by applying the defined impact exposure thresholds detailed in Table 8-2.

The stochastic spill modelling results from the worst-case spill scenarios (Table 7-15) namely, a loss of Group II (diesel), Group IV (HFO) fuels from a vessel collision and a Group I release from loss of containment of the SPS, during all seasons (summer, winter and transitional) and under different hydrodynamic conditions (e.g. currents, winds, tides, etc.) were overlaid.

Overlaying of multiple stochastic spill modelling results provides a highly conservative representation of the PEZ and EMBA from all potential loss of containment events to ensure that the EPBC Protected Matters Database search identifies all potential receptors. As such, the actual area that may be affected from any single spill event would be considerably smaller than that represented by the PEZ and EMBA.

The furthest extent of the PEZ and EMBA within this EP is driven by a combination of the outer extent of floating oil at the sea surface from the Group IV (HFO) spill scenario, and entrained oil from the Group II (diesel) spill scenario.

A summary of the modelling outputs (used to inform the PEZ and EMBA) for all scenarios are provided in Table 8-4, Table 8-5 and Table 8-8, with the impact and risk evaluations presented in Table 8-6 and Table 8-9.

8.2 Vessel collision

8.2.1 Location

Spill modelling (APASA 2014a; APASA 2014b) was undertaken for both a Group II and Group IV, instantaneous surface release in WA-50-L.

The release location for both modelling studies was approximately 29 km north-west of Browse Island. The release point provides indicative information only as an exact location for a vessel collision cannot be predicted.

8.2.2 Volume and duration

As presented in Table 7-15, AMSA (2015a) guidance has been consulted to identify appropriate spill volumes to be assessed in this EP.

Within the AMSA guidance, two options to calculate the maximum credible spill volumes are presented and include:

- oil tanker - 100% of volume of largest wing tank (i.e. not double hulled) or 50% of tank protected by double hull
- other vessel - volume of largest fuel tank.

The AMSA (2015a) guidance, specifically Table 10, does not take into consideration a new class of "other vessel", which represent vessels that have protected tanks due to a double hull (as is included for 'oil tankers'). The DNV (2015) Environmental Class, specifically "Clean Design", provides an engineering code which specifies the requirements for fully protected internal tanks (double hull), up to a maximum of 1500 m^3 per tank.

Therefore, the maximum credible spill volume for the activities covered by this EP is 750 m^3, calculated as 50% loss of the largest internal tank (1500 m^3) of a 'Clean Design' vessel. The 750 m^3 maximum volume has been cross-checked against a review of vessel tank sizes likely to be used in the activity, and all vessels are either "Clean Design" or have largest single fuel tanks below this volume.

For conservatism, this EP presents oil spill modelling results for the two identified spill scenarios (962 m^3 diesel and 776 m^3 HFO) both of which exceed than the maximum credible spill volume (750 m^3) applicable to the vessels operating under this EP.

The diesel spill was modelled as an instantaneous spill, with spill trajectory and fate tracked for 21 days. The HFO spill was also modelled as an instantaneous spill; however, the spill trajectory and fate were tracked for a period of 70 days.

8.2.3 Hydrocarbon properties

Properties associated with the Group II and Group IV hydrocarbons used in the modelling studies are presented in Table 8-3.

Table 8-3: Hydrocarbon (Group II and IV) properties

Hydrocarbon type	**Density at 15 ˚C (g/cm^3)**	**Viscosity – centipoise (cP) – at 40 ˚C**	**Characteristic**	**Volatile (%)**	**Semi-volatile (%)**	**Low volatility (%)**	**Residual (%)**
			Boiling point (˚C)	<180	180–265	265–380	>380
Diesel fuel oil	0.8291	4.0	% of total	6	34.6	54.4	5
Heavy fuel oil	975	3180		1	4.9	11.3	82.8

Diesel is a mixture of volatile and persistent hydrocarbons with low percentages of highly volatile and residual components. When exposed to the atmosphere, around 50% of the mass would be expected to evaporate in around 24 - 72 hours. Around 25% is likely to be lost through decay, leaving approx. 25% remaining as residual oil on the sea surface that would be expected to persist in the marine environment until further decayed (APASA 2014a). The influence of entrainment will regulate the degree of mass retention in the environment, with increasing wind speed resulting in increased entrainment (APASA 2014a).

The simulated weathering tests that were performed for HFO indicate that around 5 percent of the oil (by mass) is predicted to evaporate in the first day and only 7–8 percent after 30 days on the water surface. No further evaporation is then expected. Also, due to the relatively high density and viscosity of HFO, a surface spill of this fuel will have a strong tendency to remain afloat with almost no susceptibility to entrainment by wind generated waves. HFO is predicted to emulsify readily, taking up approximately 45 percent by volume as water, with emulsification occurring more rapidly under more energetic/windy conditions (APASA 2014b). Diesel modelling results from other INPEX vessel collision studies (RPS 2019) has indicated that dissolved oils from a diesel spill do not exceed the 99% species protection threshold of 50 ppb for PAH (ANZG 2018) deeper than 50 m below sea surface and entrained oils are limited to the top 25 m of the water column.

8.2.4 Modelling results

Modelling results are summarised in Table 8-4 (diesel) and Table 8-5 (HFO), and include results taken for three modelled seasons throughout the year; March to August, September to November, and December to February. For each season, 100 modelled replicates were run and therefore the results summarised represent 300 possible spill scenarios.

Table 8-4: Vessel collision Group II (diesel) 962 m^3 modelling results summary (APASA 2014a)

Floating and shoreline accumulations				
Maximum extent (km) - **floating oil** (>1 g/m^2)	Maximum extent (km) - **floating oil** (>10 g/m^2)	Minimum **time** (hours) for floating oil shoreline contact at >10 g/m^2	Worst case **concentration** (g/m^2) of accumulated oil on shoreline (where concentration has exceeded >10 g/m^2)	Worst case **volume**(m^3) of accumulated oil on shoreline
252 km	138 km	Browse Island – 28 hours Kimberley MP – 109 hours All other locations recorded no contact with surface films >10 g/m^2	Ashmore Reef – 144 g/m^2 Browse Island – 3313 g/m^2 Cartier Island – 765 g/m^2 Scott Reef – 260 g/m^2	Ashmore Reef – 6.3 m^3 Browse Island – 62.6 m^3 Cartier Island – 11.2 m^3 Scott Reef – 2.4 m^3

Entrained and dissolved hydrocarbons			
Worst case **entrained oil** concentrations at submerged receptors (ppb)	Maximum extent (km) – **entrained oil** ≥ 500 ppb (EMBA)	Minimum time (hours) to receptor waters ≥ 500 ppb **entrained oil**	Worst case **dissolved oil** concentrations at any receptor (ppb)
545 ppb Ashmore Reef 1107 ppb Barracouta Shoal 1531 ppb Browse Island 245 ppb Cartier Island 818 ppb Echuca Shoal 734 ppb Fantome Shoals 537 ppb Heywood Shoals 1127 ppb Kimberley MP 539 ppb Sahul Banks 648 ppb Scott Reef	154 km (March to August) 123 km (September to November) 230 km (November to December)	Ashmore Reef – 382 hours Barracouta Shoal – 250 hours Browse Island – 44 hours Echuca Shoal – 68 hours Fantome Shoals – 390 hours Heywood Shoal –73 hours Kimberley MP – 288 hours Sahul Banks – 494 hours Scott Reef – 399 hours	3 ppb Ashmore Reef 31 ppb Barracouta Shoal 58 ppb Browse Island 14 ppb Cartier Island 13 ppb Echuca Shoal 5 ppb Fantome Shoals 24 ppb Heywood Shoal 9 ppb Kimberley MP 3 ppb Sahul Banks 8 ppb Scott Reef

Table 8-5: Vessel collision Group IV (HFO) 776 m³ modelling results summary (APASA 2014b)

Floating and shoreline accumulations				
Maximum extent (km) - **floating oil** (>1 g/m²)	Maximum extent (km) - **floating oil** (>10 g/m²)	Minimum **time** (hours) for floating oil shoreline contact at >10 g/m²	Worst case **concentration** (g/m²) of accumulated oil on shoreline (where concentration has exceeded >10 g/m²)	Worst case **volume** (m³) of accumulated oil on shoreline
1150 km	490 km	Ashmore Reef MP – 237 hours Browse Island – 33 hours Cartier Island MP – 161 hours Cassini island – 192 hours Kimberley MP – 162 hours Lalang-garram / Camden Sound MP – 397 hours Scott Reef South – 129 hours	Adele Island – 577 g/m² Ashmore Reef – 3544 g/m² Bigge Island – 862 g/m² Browse Island – 13834 g/m² Cartier Island – 8948 g/m² Cassini island – 5818 g/m² Clerke Reef – 1300 g/m² Imperieuse Reef – 2322 g/m² Indonesia east – 3086 g/m² Kimberley MP – 853 g/m² Lalang-garram / Camden Sound MP – 2991 g/m² Montalivet Island – 903 g/m² Pulau Roti – 3086 g/m² Scott Reef South – 6586 g/m² Tiwi Islands – 1063 g/m² Troughton Island – 2974 g/m²	Adele Island – 1.9 m³ Ashmore Reef –94.8 m³ Bigge Island – 56.6 m³ Browse Island – 217.8 m³ Cartier Island – 69.0 m³ Cassini island – 178.8 m³ Clerke Reef – 19.1 m³ Imperieuse Reef – 18.1 m³ Indonesia east – 186.2 m³ Kimberley MP – 200.9 m³ Lalang-garram / Camden Sound MP – 169.9 m³ Montalivet Island – 23.7 m³ Pulau Roti – 184.3 m³ Scott Reef South – 86.9 m³ Tiwi Islands – 246.7 m³ Troughton Island – 36.4 m³

Entrained and dissolved hydrocarbons			
Worst case **entrained oil** concentrations at submerged receptors (ppb)	Maximum extent – **entrained oil** ≥ 500 ppb (EMBA)	Minimum time (hours) to receptor waters ≥ 500 ppb **entrained oil**	Worst case **dissolved oil** concentrations at any receptor (ppb)
Predicted exposure to entrained and dissolved hydrocarbons at all locations was reported to be < 10 ppb.			

8.2.5 Impact and risk evaluation

Table 8-6: Impact and evaluation – Vessel collision resulting in a Group II (diesel) or Group IV (HFO) spill

Identify hazards and threats	
Group II or Group IV hydrocarbons that reach the marine environment have the potential to result in changes to water quality through surface, entrained, dissolved and shoreline hydrocarbon exposure. The thresholds for impacts associated with surface, entrained/dissolved, and shoreline, hydrocarbon exposures are described in Table 8-2. The outcome of predictive oil spill modelling from a vessel collision scenario for diesel and HFO is presented in Table 8-4 and Table 8-5 respectively. The corresponding consequence assessments have been undertaken for each scenario.	
Potential consequence – Group II surface hydrocarbons	**Severity**
The values and sensitivities with the potential to be affected by surface hydrocarbon exposure from a surface diesel release due to a vessel collision include: • commercial, recreational and traditional fisheries including aquaculture (within 252 km from the release location based on 1 g/m^2 visible sheen threshold) • transient, EPBC-listed species (within 138 km from the release location based on 10 g/m^2 impact threshold) • planktonic communities (within 138 km from the release location based on 10 g/m^2 impact threshold). The values and sensitivities associated with commercial, recreational and traditional fisheries including aquaculture may be impacted by a visible sheen on the sea surface. Although the visible sheen is predicted to possibly extend up to 252 km from the release location in WA-50-L, it would not be a continuous surface expression. Modelling predicted that due to high levels of volatility, the majority of any diesel released at the surface would evaporate within the first 24-72 hours (APASA 2014a), further reducing the potential size of any surface expression. Exclusion zones may impede access to fishing areas at a local scale, and nets and lines could become oiled (ITPOF 2011). There are low levels of commercial, recreational and traditional fishing activities in WA-50-L, and no aquaculture (Section 4.9.3 and 4.9.4). Based on the low level of reported commercial fishing in the licence area, any socioeconomic impacts are expected to be localised to within 252 km of the release location and temporary in nature given the expected evaporation and rapid dispersion of Group II hydrocarbons at the sea surface. Therefore, the consequence is considered to be Insignificant (F). There are no known BIAs or aggregation areas within WA-50-L. However, there are several marine fauna BIAs located in areas predicted to be exposed to diesel surface expressions above the 10 g/m^2 exposure threshold (within 138 km of the release location in WA-50-L). These include a 20 km internesting buffer at Browse Island for green turtles, blue whale foraging/migration located approximately 60 km west of WA-50-L and the humpback whale migration corridor located 120 km south east from WA-50-L. A range of other marine fauna may also be present within this area albeit on a transient basis including dugong foraging at Ashmore Reef; and several marine avifauna BIAs centered around Ashmore Reef, Cartier Island, Scott Reef and Adele Island.	Minor (E)

As air-breathers, marine mammals, if they surface, are vulnerable to exposure to hydrocarbon spill impacts through the inhalation of evaporated volatiles. Effects include toxic effects, such as damage to lungs and airways, and eye and skin lesions from exposure to oil (WA DoT 2018a). Vapours from the diesel spill are considered the most significant risk to cetacean health, as their exposure can be significant. Vapours, if inhaled, have the potential to damage the mucous membranes of the airways and the eyes. Inhaled volatile hydrocarbons are transferred rapidly to the bloodstream and may accumulate in tissues, such as in the brain and liver, resulting in neurological disorders and liver damage (Gubbay & Earll 2000). Blue whales and humpback whales (baleen whales), that may filter feed near the surface, would be more likely to ingest oil than gulp-feeders, or toothed-whales and dolphins. Spilled hydrocarbons may also foul the baleen fibres of baleen whales, thereby impairing food-gathering efficiency, or resulting in the ingestion of hydrocarbons, or prey that has been contaminated with hydrocarbons (Geraci & St. Aubin 1988). Marine turtles can be exposed to hydrocarbons if they surface within the spill, resulting in direct contact with the skin, eyes, and other membranes, as well as the inhalation of vapours or ingestion (Milton et al. 2003). Floating oil is considered to have more of an effect on reptiles than entrained/dissolved oil because reptiles hold their breath underwater and are unlikely to directly ingest dissolved oil (WA DoT 2018a). Other aspects of turtle behaviour, including a lack of avoidance behaviour, indiscriminate feeding in convergence zones, and large, pre-dive inhalations, make them vulnerable (Milton et al. 2003; WA DoT 2018a). In addition, hatchlings spend more time on the surface than older turtles, thus increasing the potential for contact with oil slicks (Milton et al. 2003). As described in Section 4.8.4, WA-50-L is located within the East Asian–Australasian Flyway. The migration of marine avifauna through the EAA Flyway generally occurs at two times of year, northward between March and May and southward between August and November (Bamford et al. 2008; DEE 2017b). There are no BIAs for marine avifauna that overlap WA-50-L. However, the EMBA overlaps a Ramsar site at Ashmore Reef and a nationally important wetland at Mermaid Reef. Additionally, the PEZ includes other nationally important wetlands along the Kimberley coastline (Section 4.6). Marine avifauna have the potential to directly interact with hydrocarbons on the sea surface, in the course of normal foraging activities. Direct contact with surface hydrocarbons may result in dehydration, drowning and starvation and is likely to foul feathers, which may result in hypothermia (Matcott et al. 2019). Birds resting at the sea surface and surface-plunging birds are considered particularly vulnerable to surface hydrocarbons. Impacts may include damage to external tissues, including skin and eyes, and internal tissue irritation in lungs and stomachs (WA DoT 2018a). Toxic effects may also result where hydrocarbons are ingested, as birds attempt to preen their feathers (Jenssen 1994; Matcott et al. 2019). The predicted extent of surface hydrocarbons at >10 g/m^2 may extend to approximately 138 km from the spill location. However based on the rapid evaporation of volatile components (during light wind conditions), rapid entrainment (during increased wind conditions) (APASA 2014a) and the expected weathering resulting in reduced levels of toxicity, any impacts to EPBC-listed species are expected to be on a local scale, with short-term impacts on a small portion of the population of a protected species (Minor E). Plankton may potentially be exposed to hydrocarbons on the sea surface. However, the majority of impacts would be toxicity related, associated with entrained/dissolved hydrocarbons exposure. As such, these impacts are discussed in the entrained consequence subsection below.	
Potential consequence – Group IV surface hydrocarbons	**Severity**

The values and sensitivities with the potential to be affected by surface hydrocarbon exposure from a surface HFO release due to a vessel collision include: • commercial, recreational and traditional fisheries including aquaculture (within 1150 km from the release location based on 1g/m^2 visible sheen threshold) • transient, EPBC-listed species (within 490 km from the release location based on 10 g/m^2 impact threshold) • planktonic communities (within 490 km from the release location based on 10 g/m^2 impact threshold) • emergent benthic primary producer habitats such as intertidal corals, macroalgae and seagrasses (within 490 km from the release location based on 10 g/m^2 impact threshold). As described above, the values and sensitivities associated with commercial, recreational and traditional fisheries including aquaculture may be impacted by a visible sheen on the sea surface. Although the visible sheen is predicted to possibly extend up to 1150 km from the release location in WA-50-L, it would not be a continuous surface expression. When released at the sea surface, HFO is more persistent than diesel. Modelling predicted HFO could remain floating on the sea surface for a period of weeks to months, although during this time it would be subject to several natural processes e.g. evaporation, degradation and photooxidation. This would further reduce the potential size of any surface expression (APASA 2014b). Due to HFO properties, it is likely that the surface hydrocarbons would become emulsified in water, representing a larger volume. This may potentially impede access to fishing areas for a short-medium term, and nets and lines could become heavily oiled (ITPOF 2011). Commercial fisheries that transect the PEZ predominantly operate in the shallower waters of the PEZ, with generally low levels of fishing activity reported (refer to Section 4.9.3). Traditional fishing, particularly at Browse Island and along the Kimberley coast at Dambimangari IPA and Uunguu IPA, including on intertidal reef platforms, could be affected by impacts to fish and benthic habitats from smothering from weathered/emulsified floating oil. Recreational day-fishing is generally concentrated around the population centres of Broome, Derby and Wyndham, as well as other readily accessible coastal settlements which are generally at the edge of, or outside of the PEZ, and therefore unlikely to be impacted by this type of spill. Despite the expected weathering of HFO at the sea surface by evaporation, photo-oxidation and biodegradation, socioeconomic impacts on commercial, traditional and recreational fisheries could be short-to-medium term, with a consequence of Moderate (D). There are no known BIAs or aggregation areas within WA-50-L. However, there are several marine fauna BIAs located in areas predicted to be exposed to HFO surface expressions above the 10 g/m^2 exposure threshold (within 490 km of the release location in WA-50-L). These include a 20 km internesting buffer at Browse Island for green turtles, blue whale foraging/migration located approximately 60 km west of WA-50-L and the humpback whale migration corridor located 120 km south east from WA-50-L. A range of other marine fauna may also be present within this area albeit on a transient basis including dugong foraging at Ashmore Reef; and several marine avifauna BIAs centered around Ashmore Reef, Cartier Island, Scott Reef and Adele Island.	Moderate (D)

As described for a diesel spill, marine mammals, reptiles and avifauna at the surface are vulnerable to exposure to hydrocarbon spill impacts through the inhalation of evaporated volatiles resulting in toxicity effects (WA DoT 2018a), however this would be limited for HFO spills. The dominant impact pathway associated with fresh and weathered HFO at the sea surface are generally caused by smothering and coating of animals. Spilled Group IV hydrocarbons may foul the baleen fibres of baleen whales, thereby impairing food-gathering efficiency, or resulting in the ingestion of hydrocarbons, or prey that has been contaminated with hydrocarbons (WA DoT 2018a). Weathered oil residues, particularly from a Group IV spill event, may persist for long periods, causing a potential risk to the feeding systems of baleen whales. Due to natural weathering processes, the duration of a surface expression may be prolonged, and more persistent in the marine environment than a Group II spill. Turtles exposed to weathered hydrocarbons at the sea surface may be impacted due to direct contact with the skin, eyes, and other membranes. Another aspect of turtle behaviour is indiscriminate feeding, potential resulting in indirect impacts from feeding on contaminated prey or tar balls that have formed from the weathered HFO slick. Within the EMBA, a Ramsar site is located at Ashmore Reef and a nationally important wetland at Mermaid Reef. An HFO surface expression may be present for a period of weeks to months therefore presenting a risk to marine avifauna with respect to toxic effects from birds preen their feathers (Jenssen 1994; Matcott et al. 2019). The predicted extent of surface hydrocarbons at > 10 g/m^2 may extend to approximately 490 km from the spill location. A Group IV (HFO) spill will be more persistent than a Group II (diesel) spill. Weathering of HFO on the sea surface will reduce toxicity over time and the hydrocarbons on the surface will become patchy rather than continuous. Due to the potential size and persistence of a surface expression from a large HFO spill, there is the potential for short-to-medium term, local-to-medium scale impacts to EPBC-listed species; however, no threat to overall population viability is expected. Therefore, the consequence is considered to be Moderate (D). Plankton may potentially be exposed to hydrocarbons on the sea surface. As HFO remains floating, has low toxicity and modelling indicates will not entrained/dissolve, impacts to plankton are considered Insignificant (F). Emergent benthic communities, such as coral reefs at Browse Island, Scott Reef, Ashmore Reef, Cartier Island and Cassini Island may be impacted by exposure to surface hydrocarbons following a release of HFO at the sea surface. Physical oiling of coral tissue can cause a decline in metabolic rate and may cause varying degrees of tissue decomposition which can lead to death (Negri & Heyward 2000). Seagrasses and macroalgae are generally not emergent, and therefore impacts would be very limited, as they are typically not exposed to floating oil. Based on the above impact assessment, the consequence from a large HFO surface spill into emergent benthic primary producer habitats is considered to be Moderate (D).	
Potential consequence – Group II entrained/dissolved hydrocarbons	**Severity**

Predictive oil spill modelling (APASA 2014a) reported that entrained oil concentrations exceeding the 500 ppb impact threshold could travel up to 230 km (November to December), 154 km (March to August) or 123 km (September to November) from the release location in WA-50-L. The time to contact various submerged receptors, presented in Table 8-4, was predicted to be 44 hours at Browse Island in the worst-case. All submerged receptors contacted above the 500 ppb threshold are also listed in Table 8-4, and include Browse Island (1531 ppb), the waters of the Kimberley MP (1127 ppb) and Barracouta Shoal (1107 ppb) as the worst-case examples. No other receptors were predicted to be exposed >500 ppb in any season. Dissolved oil modelling results (APASA 2014a) indicated the maximum dissolved oil concentration was predicted at Browse island (58 ppb). All other locations contacted by dissolved oil were below 31 ppb, which is below the impact threshold of 500 ppb and also below the 99% species protection threshold of 50 ppb for PAH (ANZG 2018). Therefore, no receptors are exposed above the impact threshold. The values and sensitivities with the potential to be exposed above the entrained hydrocarbon impact threshold (>500 ppb) from a surface diesel release due to a vessel collision include; • commercial, traditional and recreational fisheries including aquaculture • KEFS (fish communities) • planktonic communities • benthic primary producer habitats / benthic habitats (coral reef/macro algae/seagrass) • transient, EPBC-listed species (BIAs - marine mammals, whale-sharks, turtles and avifauna). The values and sensitivities associated with commercial, traditional and recreational fisheries including aquaculture (seafood quality and employment) could be impacted due to entrained/dissolved oil. The impact to fish communities from exposure to entrained and dissolved hydrocarbons is primarily associated with toxicity, which is typically associated with the dissolved hydrocarbon component. Adult fish exposed to entrained hydrocarbons are likely to metabolise the hydrocarbons and excrete the derivatives, with studies showing that fish have the ability to metabolise petroleum hydrocarbons. These accumulated hydrocarbons are then released from tissues when fish are returned to hydrocarbon free seawater (Reiersen & Fugelli 1987). Chronic impacts to juvenile fish, larvae, and planktonic organisms may occur if exposed to entrained/dissolved hydrocarbon plumes potentially resulting in lethal or sub-lethal effects or impairment of cellular functions (WA DoT 2018a). Juvenile fish and larvae may experience increased toxicity upon such exposure to plumes, because of the sensitivity of these life stages, with the worst impacts predicted to occur in smaller species (WA DoT 2018a). Pelagic fish and sharks are highly mobile in nature, and therefore they are not expected to remain within entrained/dissolved hydrocarbon plumes for extended periods, limiting the potential for acute impacts or risks associated with the exposure. There is a whale shark foraging BIA (approximately 15 km south-east of WA-50-L). Potential effects to whale sharks include damage to the liver and lining of the stomach and intestines, as well as toxic effects on embryos (Lee 2011). As whale sharks are filter-feeders they are expected to be highly vulnerable to entrained hydrocarbons (Campagna et al. 2011).	Minor (E)

Site attached fish, such as reef fish within the vicinity of the spill may be exposed to entrained hydrocarbons above the 500 ppb threshold (Table 8-4). Due to the limited depth of such exposure (predicted to the top 30m for a vessel collision diesel spill based on recent INPEX modelling), demersal fish communities (such as the continental slope demersal fish community KEF described in Section 4.2.1) and fish associated with other deeper benthic habitats and KEFs will not be exposed above impact thresholds. Therefore, the values and sensitivities associated with fisheries 9commercail, traditional, recreational, aquaculture), fish communities including the whale shark BIA and KEFs, are not expected to be exposed to any significant impacts. As such, the consequence of entrained/dissolved hydrocarbons is considered expected to be on a local scale, with short-term impacts (Minor E). Chronic impacts to juvenile fish, larvae, and planktonic organisms may occur if exposed to entrained/dissolved hydrocarbon plumes potentially resulting in lethal or sub-lethal effects or impairment of cellular functions (WA DoT 2018a). Juvenile fish and larvae may experience increased toxicity upon such exposure to plumes, because of the sensitivity of these life stages, with the worst impacts predicted to occur in smaller species (WA DoT 2018a). In the event of a vessel collision resulting in a diesel spill, impacts on plankton are expected to be highly localised, with short-term impacts, due to the limited exposure (top 30 m of the water column), and the limited temporal duration of the slick at the sea surface (24-72 hours). However, if a shallow entrained/dissolved plume reached a coral-spawning location, such as Browse Island or Scott Reef, during a spawning event, localised short-to-medium term impacts could occur. Therefore, the consequence is considered to be Minor (E). Benthic communities, including benthic primary producers, such as coral reefs, macro algae and seagrass could be exposed to entrained hydrocarbons above impact thresholds. Shallow-water communities are generally at greater risk of exposure than deep-water communities (NRC 1985; WA DoT 2018a, RPS 2019). Exposure of entrained hydrocarbons to shallow subtidal corals has the potential to result in lethal or sublethal toxic effects, resulting in acute impacts or death at moderate-to-high exposure thresholds (Loya & Rinkevich 1980; Shigenaka 2001; WA DoT 2018a), including increased mucus production, decreased growth rates, changes in feeding behaviours and expulsion of zooxanthellae (Peters et al. 1981; Knap et al. 1985). Adult coral colonies, injured by oil, may also be more susceptible to colonisation and overgrowth by algae or to epidemic diseases (Jackson et al. 1989). Lethal and sublethal effects of entrained and dissolved oils have been reported for coral gametes at much lesser concentrations than predicted for adult colonies (Heyward et al. 1994; Harrison 1999; Epstein et al. 2000). Goodbody-Gringley et al. (2013) found that exposure of coral larvae to oil and dispersants negatively impacted coral settlement and survival, thereby affecting reef resilience. Entrained hydrocarbons have the potential to affect seagrasses and macroalgae through toxicity impacts. The hydrophobic nature of hydrocarbon molecules allows them to concentrate in membranes of aquatic plants. Hence the thylakoid membrane (an integral component of the photosynthetic apparatus) is susceptible to oil accumulation, potentially resulting in reduced photosynthetic activity (Runcie & Riddle 2006). However, a layer of mucilage present on most species of seagrass prevents the penetration of toxic aromatic fractions (Burns et al. 1993). Although seagrass and macroalgae may be subject to lethal or sublethal toxic effects, including mortality, reduced growth rates, and impacts to seagrass flowering, several studies have indicated rapid recovery rates may occur even in cases of heavy oil contamination (Connell et al, 1981; Burns et al. 1993; Dean et al. 1998; Runcie & Riddle 2006). For algae, this could be attributed to new growth being produced from near the base of the plant while the distal parts (which would be exposed to the oil contamination) are lost. For seagrasses this may be because 50–80% of their biomass is in their rhizomes, which are buried in sediments, thus less likely to be adversely impacted by hydrocarbons (Zieman et al. 1984). It has been reported by Taylor & Rasheed (2011) that seagrass meadows were not significantly affected by an oil spill when compared to a non-impacted reference seagrass meadow.	

In addition to potential toxicity impacts, entrained oil droplets (although less bioavailable) may present smothering impacts to submerged receptors. Physical and chemical effects of the entrained oil droplets have been demonstrated through direct contact with receptors through physical coating (NRC, 2005). Based on the above impact assessment and expected recovery, the consequence to benthic habitats is considered to be Minor (E). Marine mammals, marine reptiles and marine avifauna could also be impacted through entrained hydrocarbon exposure, primarily through ingestion during foraging activities (WA DoT 2018a). There are no known BIAs or aggregation areas within WA-50-L. However, the EMBA overlaps a large number of BIAs for a number of different marine fauna species (Section 4.8.4). A Ramsar site (Ashmore Reef) and a wetland of conservational significance (Mermaid Reef) are also present within the EMBA (Section 4.6), these sites provide important habitat for marine avifauna. In addition to potential toxicity impacts, entrained oil droplets (although less bioavailable) may present smothering impacts to EPBC-listed species. Physical and chemical effects of the entrained oil droplets have been demonstrated through direct contact with receptors through physical coating of gills and body surfaces, and accidental ingestion (NRC, 2005). Any entrained plume is expected to be spatially and temporally limited in extent. As such, impacts to EPBC-listed species are expected to be on a local scale, with short-term impacts on a small portion of the population of a protected species, with the consequence considered to be Minor (E). In summary, the potential extent of entrained hydrocarbon with a concentration >500 ppb may result in localized, short-term exposure to the identified values and sensitivities. There would be limited potential for cumulative impacts as a result of interactions between surface, entrained/dissolved hydrocarbon impacts on the food web and through bioaccumulation up the food chain, as key aggregation areas such as benthic primary producer habitats which supports EPBC listed species will not be exposed above impact thresholds. On this basis, the potential consequence from cumulative impacts associated with entrained hydrocabons from a vessel collision is considered to be Minor (E).	
Potential consequence – Group IV entrained/dissolved hydrocarbons	**Severity**
Predicted exposure to entrained and dissolved hydrocarbons at all locations was reported to be < 10 ppb.	N/A
Potential consequence – Group II shoreline hydrocarbons	**Severity**
As presented in Table 8-4, shorelines within the EMBA were predicted to receive shoreline accumulations of hydrocarbons from a diesel spill. Minimum times to contact ranged from 28 to 109 hours at Browse Island and shorelines in the Kimberley MP respectively. No other locations were directed contacted by surface films of > 10 g/m^2. The maximum concentration received on a shoreline was at Browse Island (3313 g/m^2). Other locations contacted above the 100 g/m^2 impact threshold were Cartier Island, Ashmore Reef and Scott Reef. No other locations received concentrations above the impact threshold. At the locations contacted, the volumes of oil on shorelines ranged from 2.4 m^3 at Scott Reef, to a maximum of 62.6 m^3 at Browse Island (APASA 2014a).	Moderate (D)

The minimum reported time to contact for all seasons was 28 hours at Browse Island and several days for the Kimberley MP. Given these predicted minimum times to reach shorelines, the spill is expected to have undergone some level of physical and biological weathering processes, such as evaporation of volatile/toxic components, photo-oxidation and biodegradation, with predictive modelling reporting that the majority of the spill would evaporate within 24-72 hours (APASA 2014a; Stout et al. 2016). Impacts to ecological receptors from exposure to weathered diesel are far less than those associated with exposure to fresh diesel, which has higher levels of toxicity (Milton et al. 2003; Hoff & Michel 2014; Woodside 2014; Stout et al. 2016). Therefore, impacts from weathered diesel are generally limited to smothering and coating associated with the waxy flakes and residues which generally have low levels of adhesion. Intertidal habitats and marine fauna known to use shorelines are most at risk from shoreline accumulations, due to smothering of intertidal habitats (such as emergent coral reefs) and coating of marine fauna (WA DoT 2018a). Consequently, the particular values and sensitivities with the potential to be exposed to shoreline accumulated hydrocarbons are: • benthic primary producer habitats/shoreline habitats (intertidal only) • EPBC-listed species (BIAs - turtles and avifauna). Benthic primary producer habitats exposed at spring low tides are the most vulnerable to smothering. However, as spills disperse, intertidal communities are expected to recover (Dean et al. 1998). Direct contact of hydrocarbons to emergent corals, such as at Browse Island, can cause smothering, resulting in a decline in metabolic rate and may cause varying degrees of tissue decomposition and death. A range of impacts may also result from toxicity, including partial mortality of colonies, reduced growth rates, bleaching, and reduced photosynthesis (Negri & Heyward 2000; Shigenaka 2001). The rate of recovery of coral reefs depends on the level or intensity of the disturbance, with recovery rates ranging from 1 or 2 years, to decades (Fucik et al. 1984, French-McCay 2009). A Ramsar site (Ashmore Reef) and a wetland of conservational significance (Mermaid Reef) are present within the EMBA. These coastal sites generally include intertidal mudflats and mangroves that provide important foraging, resting and breeding habitats for migratory and shoreline bird species. Given the predicted times to contact and significant expected weathering of any hydrocarbons accumulating on shorelines, any impacts to benthic habitats are expected to be localised and of short to medium term with a consequence of Minor (E).	

Marine turtles that utilise shoreline habitats can be exposed to hydrocarbons externally, through direct contact; or internally, by ingesting oil, consuming prey containing oil, or inhaling volatile compounds (Milton et al. 2003). Shoreline hydrocarbons can impact turtles at nesting beaches when they come ashore, with exposure to skin and cavities, such as eyes, nostrils, and mouths. Eggs may also be exposed during incubation, potentially resulting in increased egg mortality and detrimental effects on hatchlings. Hatchlings may be particularly vulnerable to toxicity and smothering, as they emerge from the nests and make their way over the intertidal area to the water (Milton et al. 2003). There are a number of foraging, nesting and internesting BIAs for turtles within the EMBA that have the potential to be exposed to shoreline accumulations above the impact threshold concentration (100 g/m^2). Potential impacts may occur on nesting populations, which may affect species recruitment at a local population level particularly in relation to the green turtles at Browse Island with a small, localised range of habitat (DEE 2017a). Given the modelling results, there is the potential for local-to-medium-scale impacts with medium-term effects on nesting populations of turtles at individual nesting beaches/locations. At locations with longer times for shoreline contact, there is a high potential for hydrocarbons to become more weathered. Weathered oil has been shown to have little impact on turtle egg survival, while fresh oil may have a significant impact (Milton et al. 2003). Therefore, given the predicted times to shoreline contact and potential for weathering, the potential consequence is considered to be Moderate (D). Birds coated in hydrocarbons can suffer from damage to external tissues including skin and eyes, as well as internal tissue irritation in their lungs and stomachs (Jenssen 1994; Matcott et al. 2019). Toxic effects may also result where the product is ingested, either through birds' attempts to preen their feathers (Jenssen 1994; Matcott et al. 2019) or ingested as weathered waxy flakes/residues present on shorelines. However, waxy residues are generally considered to be of lower toxicity (Stout et al. 2016; Woodside 2014). Shorebirds foraging and feeding in intertidal zones are at potential risk of exposure to shoreline hydrocarbons, potentially causing acute effects to numerous marine avifauna BIAs, and species present at Ramsar/wetland sites as described above. It is also possible that birds exposed to surface hydrocarbons may be displaced (i.e. fly away) and use nearby shorelines to recover, thereby, potentially increasing their exposure to shoreline hydrocarbons. In the event of a shoreline contact following a loss of well containment, there is the potential for short–to-medium-term impacts on the environment while local populations recover; however, it is not expected that the overall population viability for any protected species would be threatened. Therefore, the potential consequence associated with shoreline hydrocarbon exposure is considered to be Moderate (D). In summary, shoreline accumulation (> 100 g/m^2) may result in exposure to the identified values and sensitivities. There would likely also be cumulative impacts as a result of interactions between surface, entrained/dissolved and shoreline hydrocarbon impacts on the food web and through bioaccumulation up the food chain potentially impacting a small portion of a population of protected species. On this basis, the potential consequence associated with shoreline accumulation from the identified spill events is considered to be Moderate (D).	
Potential consequence – Group IV shoreline hydrocarbons	

<table>
<tr><td>As presented in Table 8-5, shorelines within the EMBA were predicted to receive shoreline accumulations of hydrocarbons from an HFO spill. Minimum times to contact ranged from 33 to 397 hours at Browse Island and shorelines in Lalang-garram/Camden Sound MP respectively. Other locations directed contacted by surface films of > 10 g/m^2 are presented in Table 8-5. The maximum concentration received on a shoreline was at Browse Island (13834 g/m^2). Other locations contacted above the 100 g/m^2 impact threshold include but are not limited to Ashmore Reef, Cartier Island, Cassini Island, Tiwi islands, Pulau Roti and Scott Reef. At the shoreline locations contacted, the volumes of oil on shorelines ranged from 1.9 m^3 at Adele Island, to a maximum of 246.7 m^3 at Tiwi Islands (APASA 2014a).

It is recognised that a Group IV spill will be more persistent in the marine environment than a Group II spill. As described for the Group II hydrocarbon shoreline hydrocarbon assessment, intertidal habitats and marine fauna known to use shorelines are most at risk from shoreline accumulation, due to smothering of intertidal habitats (such as emergent coral reefs and sandy beaches) and coating of marine fauna. Consequently, the nature of impacts received by the values and sensitivities, if exposed to shoreline accumulations from an HFO spill will be the same as assessed for the diesel spill presented above, with the exception of mangrove communities that may have shoreline accumulations (Tiwi Islands and Indonesian coastline) described below.

Based on higher concentrations and quantities received on shorelines, and the greater level of persistence in the marine environment, the potential consequence to all values and sensitivities associated with shoreline accumulation from an HFO spill is considered to be Significant (C).

An additional value and sensitivity with the potential to be exposed to shoreline accumulated hydrocarbons from an HFO spill is:

• benthic primary producer habitats/shoreline habitats (mangroves)

Mangrove communities present along the Indonesian coastline and the Tiwi islands, could potentially be exposed to shoreline oil accumulation, with potential impacts, including defoliation and mortality (Burns et al. 1993; Duke et al. 2000). The recovery of mangroves from shoreline oil accumulation can be a slow process, due to the longterm persistence of oil trapped in anoxic sediments and subsequent release into the water column. (Burns et al. 1993).

Lighter oils are reported to penetrate more deeply into mangrove forests than heavier and more weathered oils (Hoff & Michel 2014); therefore, in the time taken for a spill to reach mangroves on the Tiwi Islands or the Indonesian coastline, it is considered that the hydrocarbons will have weathered and generally be less toxic in nature; however, still above the threshold that could cause impacts. Based on the above impact assessment, the consequence is considered to be Moderate (D).</td><td colspan="3">Significant (C)</td></tr>
<tr><td colspan="4">Identify existing design safeguards/controls</td></tr>
<tr><td colspan="4">Marine vessels >400 tonne (t) will carry SOPEPs approved under MARPOL 73/78 Annex 1, Regulation 37.

Vessels fitted with lights, signals, an automatic identification system (AIS) transponders and navigation equipment as required by the Navigation Act 2012.</td></tr>
<tr><td colspan="4">Propose additional safeguards/control measures (ALARP evaluation)</td></tr>
<tr><td>Hierarchy of control</td><td>Control measure</td><td>Used?</td><td>Justification</td></tr>
</table>

Elimination	Eliminate vessels.	No	Vessels are the only form of transport that can undertake the activity.
Substitution	None identified.	N/A	N/A
Engineering	All vessels used will have dynamic positioning equipment.	No	While the main installation vessels will have dynamic positioning capability, not all support vessels are required to have DP capability.
Procedures and administration	Australian Hydrographic Office (AHO) will be informed of the proposed location prior to the activity commencing.	Yes	By informing AHO of the location of the activity, it can update navigation charts, to inform third parties of the location of the infrastructure, reducing the risk of accidental third-party interactions with areas of increased vessel activity.
	Incident management, and emergency response plans in place.	Yes	To ensure the INPEX IMT are prepared and informed, an INPEX Australia Incident Management Plan (0000-AH-PLN-60005), INPEX Australia Crisis Management Plan (0000-AH- PLN-60004) and URF installation contractor Emergency Response Plan (ERP) will be in place and implemented, and personnel trained in their relevant plans.
	Emergency response preparedness will be maintained.	Yes	To ensure that INPEX is prepared to respond to a marine diesel or HFO spill originating from a vessel collision event, oil spill and source control response preparedness will be maintained in accordance with Section 8.6 and Section 9.10 of this EP.
	INPEX will provide all available support to AMSA in AMSA's performance of its combat (control) agency responsibilities for vessel-based spill events.	Yes	INPEX has signed a MOU with AMSA for oil spill preparedness and response (AMSA/INPEX 2013). This MoU acknowledged AMSA's responsibility under the NatPlan as the control agency for vessel-based spill scenarios, and INPEX has acknowledged that it will support AMSA to implement the NatPlan.
	INPEX will provide all available support to WA DoT in their performance as control agency for a spill which reaches WA waters, resulting from a vessel collision.	Yes	WA DoT is the control agency for all spills entering WA waters, regardless of the source of the spill. WA DoT has issued the State Hazard Plan – Marine Environmental Emergencies (WA DoT 2018b) which specifies the WA DoT expectations (detailed in Section 2.2.1 of the OPEP). In summary, the WA DoT will require INPEX to work in partnership to ensure an adequate response is provided across the entire incident as reflected in the INPEX IMT organisation chart (Figure 9-5). This may include:

			• WA DoT nominating officers to facilitate aligned communications, shared situational awareness and coordinated response actions with the INPEX IMT. • WA DoT establishing an Incident Control Centre in Fremantle and INPEX providing a number of Emergency management support personnel to work within the WA DoT IMT (The INPEX IMT would still function and lead the response in Commonwealth waters and liaise with WA DoT IMT).
	Stakeholder engagement plan.	Yes	As required by the OPGGS (E) Regulations 2009, INPEX has implemented a stakeholder engagement plan to inform stakeholders of the description of the activities, schedule, regulatory requirements, and details for directing enquiries and feedback (refer Section 5). Through implementation of the engagement plan other marine users are kept informed of potential interactions with vessels.
	Issue notice to mariners	Yes	By informing AHO start date of the activity, information will be included in the promulgation of fortnightly Notice to Mariners. Notice to Mariners provide commercial shipping operators with information regarding activities or hazards in the region and will include details of the relevant vessels.
	Notification to AMSA's Joint Rescue Coordination Centre (JRCC)	Yes	The AMSA JRCC will be advised of the activity details for promulgation of radio-navigation warnings 24-48 hours before operations commence and upon completion of the activity.
Identify the likelihood			
Likelihood	Reported industry statistics indicate vessel failures are considered rare with 37 collisions reported out of a total of 1200 marine incidents in Australian waters between 2005 and 2012 (most recent data) (ATSB 2013). A ship collision risk assessment was undertaken to support the INPEX Ichthys Project. The study determined collision frequencies and impact energies for passing (third-party) vessels, infield vessels and offloading tankers. The annual frequency of a collision with a passing vessel – i.e. one not within the control of INPEX – imparting at least 150 megajoules (sufficient impact energy) is 3.5×10^{-7}, or once every 2.9 million years. On this basis and given the controls that have been identified to minimise the potential for vessel collision and subsequent loss of containment, the likelihood of the consequence occurring is considered Highly Unlikely (5).		

Residual risk	The worst-case consequence for all applicable hydrocarbon exposure mechanisms (surface, entrained and dissolved) to both diesel and HFO has a rating of Significant (C), with a likelihood of Highly Unlikely (5) the residual risk is ranked as Moderate (7).		
Residual risk summary			
Consequence		Likelihood	Residual risk
Significant (C)		Highly Unlikely (5)	Moderate (7)
Assess residual risk acceptability			

Legislative requirements

The activities and proposed management measures are compliant with industry standards and with relevant Australian legislation, specifically concerning navigational safety requirements, including AMSA *Marine Orders – Part 30: Prevention of Collisions, Issue 8* (Order No. 5 of 2009).

Stakeholder consultation

Stakeholders have been engaged throughout the development of the EP. Where relevant, the controls in place have been developed in consultation with relevant stakeholders (e.g. WA DoT, AMSA). The controls in place are considered to manage risks associated with a vessel collision to ALARP.

Conservation management plans / threat abatement plans

Several conservation management plans (refer Appendix B) identify oil spills as a key threatening process, through both direct/acute impacts of oil, as well as indirect impacts through habitat degradation (which is a potential consequence of an oil spill). The prevention of vessel collisions and reducing impacts to the marine environment through oil spill response preparedness and response (refer OPEP, Appendix D), demonstrates alignment with the various conservation management plans.

ALARP summary

As the level of environmental risk is assessed as Moderate, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as “moderate”, the consequence does not exceed “C – Significant” and the risk has been reduced to ALARP.

Environmental performance outcomes	**Environmental performance standards**	**Measurement criteria**	**Responsibility**
No incidents of loss of hydrocarbons to the marine environment as a result of a vessel collision.	Vessels will be fitted with lights, signals, AIS transponders and navigation and communications equipment, as required by the *Navigation Act 2012.*	Records confirm that required navigation equipment is fitted to vessels to ensure compliance with the *Navigation Act 2012.*	INPEX Environmental Adviser
	Australian Hydrographic Office (AHO) will be informed of the proposed activity location prior to the activity commencing.	Records of document transmittal to AHO.	INPEX Environmental Adviser
	In accordance with the stakeholder engagement plan, other marine users will be notified of vessel presence through ongoing stakeholder consultation on an as required basis during the activity.	Stakeholder engagement records.	INPEX Environmental Adviser
	The Australian Hydrographic Service (AHO) will be notified no less than four working weeks before operations commence for the promulgation of related notices to mariners (via datacentre@hydro.gov.au).	Records of document transmittal to AHO.	INPEX Environmental Adviser
	Notification will be provided to AMSA's Joint Rescue Coordination Centre (JRCC) for promulgation of radio-navigation warnings 24-48 hours before operations commence, including following information (via rccaus@amsa.gov.au, ph: 1800 641 792 or +61 2 6230 6811): • Vessel details, including name, call sign and Maritime Mobile Service Identity (MMSI) • Satellite communications details, including INMARSAT-C and satellite telephone • Area of operation • Requested clearance from other vessels • Notification of operations start and end.	Records of document transmittal to AMSA JRCC.	INPEX Environmental Adviser

Risks of impacts to commercial, traditional and recreational fisheries, emergent benthic primary producer habitats (intertidal corals, mangroves, macroalgae and seagrasses), turtle BIAs, marine avifauna BIAs, transient, EPBC-listed species and planktonic communities from Group II or IV hydrocarbon spills are reduced and maintained at acceptable levels through implementation of the environmental performance standards and the application of the environmental management implementation strategy.	Inspections confirm that vessels >400 GT have SOPEPs compliant with Marine Orders – Part 91, the POTS Act, and Annex I of MARPOL 73/78 (oil) on board.	SOPEPs on board vessels	INPEX Environmental Adviser
	INPEX Australia Incident Management Plan (0000-AH-PLN-60005) and INPEX Australia Crisis Management Plan (0000-AH- PLN-60004) and will be implemented in the event of a vessel collision. INPEX personnel will be trained in the above plans, as defined in Section 9.10 of this EP.	Records demonstrate Incident and Crisis Management Plans and were implemented following a vessel collision. Records demonstrate personnel are trained in the INPEX Australia Incident Management Plan (0000-AH-PLN-60005), INPEX Australia Crisis Management Plan (0000-AH- PLN-60004).	INPEX Security and Emergency Management Lead
	Emergency response preparedness will be maintained through implementing Sections 8.5 and 9.10 of this EP.	Records confirm response preparedness, as detailed in Sections 8.5 and 9.10 of this EP, is maintained.	INPEX Environmental Adviser
	In the event of a vessel collision, resulting in a spill reaching WA state waters, INPEX will provide all available support to WA DoT in their performance as control agency, including provision of INPEX resources to support the WA DoT IMTs, under the relevant 'cross jurisdictional arrangements' described in the OPEP and in accordance with Figure 9-5.	In the event of a vessel collision, resulting in a spill reaching WA state waters, records confirm INPEX provided support, as requested by WA government.	IMT leader
	In the event of a vessel collision, INPEX will provide all available support to AMSA in its performance as combat (control) agency responsibilities in accordance with the AMSA/INPEX MoU.	In the event of a vessel collision, records confirm INPEX provided support, as requested by AMSA, in accordance with the MoU.	IMT leader

8.3 Loss of containment from SPS

A dropped object has the potential to rupture or damage the SPS. The risk of damage to the subsea well infrastructure following well completion, potentially resulting in a blowout, is outside of the scope of this EP. An evaluation of credible scenarios identified the following worst-case scenario to be a loss of containment due to damage/rupture of a flowline/riser/rich MEG transfer line causing a 30-minute flow (350 m^3) of Group I (gas condensate) released subsea.

Therefore, the focus of this section is the potential impacts and risks associated with a 350 m^3 release of gas condensate to represent the worst-case scenario. Where 350 m^3 of condensate and rich MEG (CRM) would be released subsea. MEG is considered as PLONOR (OSPAR 2012) and, when combined with gas condensate, does not result in any additional toxicity. Therefore, for assessment of the worst-case scenario, modelling of condensate alone is considered appropriate.

8.3.1 Location

Spill modelling (APASA 2014c) was undertaken for a Group I release using a release point on the seabed at a location close to the FPSO in WA-50-L.

8.3.2 Volume and duration

The modelled integrity failure scenario was based on a spill volume of 350 m^3 to represent the loss of inventory of the longest CRM transfer line, including flowing losses before the activation of the emergency shutdown system.

The modelling was based on a release rate calculated on the volumetric flow of condensate through the CRM transfer line and the time taken to detect the loss and isolate the CRM transfer line. On this basis, the release was estimated to occur over a period of 30 minutes.

8.3.3 Hydrocarbon properties

Hydrocarbon properties associated with the Group I gas condensate used for the modelling are described in Table 8-7.

Table 8-7: Hydrocarbon (Group I) properties

Hydrocarbon type	**Density at 15 ˚C (g/cm^3)**	**Viscosity – centipoise (cP) – at 40 ˚C**	**Characteristic**	**Volatile (%)**	**Semi-volatile (%)**	**Low volatility (%)**	**Residual (%)**
			Boiling point (˚C)	<180	180–265	265–380	>380
Gas condensate	0.7639	1.2	% of total	62.0	23.0	12.0	3.0

8.3.4 Modelling results

Analysis provided in APASA (2014c) indicates that a cloud of condensate droplets with a plume diameter approximately 70 m wide (i.e. its breadth in the water column) may be trapped between 100 m and 110 m above the release point (i.e. at 140 m to 150 m below the surface), because the momentum of the plume will be completely dissipated (rising velocity <0.10 m/s). The model also predicted that the relatively large-sized droplets will rise to the surface within minutes to hours and thus most of the condensate volume released will evaporate, with only minor proportions remaining entrained or dissolved in the water column. A summary of the modelling results is presented in Table 8-8.

Table 8-8: Loss of containment from SPS (Group I) condensate 350 m^3 modelling results summary (APASA 2014c)

Floating and shoreline accumulations				
Maximum extent (km) - **floating oil** (>1 g/m^2)	Maximum extent (km) - **floating oil** (>10 g/m^2)	Minimum **time** (hours) for floating oil shoreline contact at >10 g/m^2	Worst case **concentration** (g/m^2) of accumulated oil on shoreline (where concentration has exceeded >10 g/m^2)	Worst case **volume** (m^3) of accumulated oil on shoreline
No exposure >1 g/m^2	-	All locations recorded no contact with surface films >10 g/m^2	Browse Island – 6.9 g/m^2	Browse Island –0.08 m^3

Entrained and dissolved hydrocarbons			
Worst case **entrained oil** concentrations at submerged receptors (ppb)	Maximum extent (km) – **entrained oil** ≥ 100 ppb (EMBA)	Minimum time (hours) to receptor waters ≥ 100 ppb **entrained oil**	Worst case **dissolved oil** concentrations at any receptor (ppb)
5 ppb Ashmore Reef 12 ppb Barracouta Shoal 13 ppb Browse Island 9 ppb Cartier Island 6 ppb Echuca Shoal 6 ppb Fantome Shoals 12 ppb Heywood Shoals 5 ppb Hibernia Reef 5 ppb Seringapatam Reef 3 ppb Sahul Banks 19 ppb Scott Reef South 7 ppb Vulcan Shoal	190 km	All submerged receptors recorded no contact with entrained oil >100 ppb.	126 ppb Browse Island 3 ppb Cartier Island 4 ppb Echuca Shoal 2 ppb Heywood Shoal 153 ppb Scott Reef South 4 ppb Seringapatam Reef

8.3.5 Impact and risk evaluation

Table 8-9: Impact and evaluation – Loss of containment from SPS resulting in a Group I (condensate) spill

Identify hazards and threats	
A leak or spill of gas condensate has the potential to result in changes to water quality through entrained and dissolved hydrocarbon exposure. The threshold for impacts associated with such hydrocarbon exposures are described in Table 8-2.	
Potential consequence –surface hydrocarbons	**Severity**
No values and sensitivities were predicted to be exposed to surface hydrocarbons from a subsea condensate release due to loss of containment from the SPS.	Insignificant (F)
Potential consequence - entrained/dissolved hydrocarbons	**Severity**
Predictive oil spill modelling (APASA 2014c) reported that entrained oil concentrations exceeding the 100 ppb impact threshold could travel up to 190 km from the release location in WA-50-L. All submerged receptors recorded no contact with entrained oil >100 ppb (impact threshold). The worst-case exposure was recorded at Scott reef South with entrained oils at 19 ppb predicted. Dissolved oil modelling results (APASA 2014c) indicated the maximum dissolved oil concentrations were predicted at Scott Reef South (153 ppb) and Browse Island (126 ppb). All other locations contacted by dissolved oil were below 4 ppb, which is below the impact threshold of 50 ppb and also below the 99% species protection threshold of 50 ppb for PAH (ANZG 2018). Therefore, the values and sensitivities with the potential to be exposed above the dissolved hydrocarbon impact threshold (>50 ppb) from a subsea condensate release include; • commercial, traditional and recreational fisheries including aquaculture • KEFS (fish communities) • planktonic communities • benthic primary producer habitats / benthic habitats (coral reef/macro algae/seagrass) • transient, EPBC-listed species (BIAs - marine mammals, whale-sharks, turtles and avifauna). The values and sensitivities associated with commercial, traditional and recreational fisheries including aquaculture (seafood quality and employment) could be impacted due to dissolved oil. The impact to fish communities from exposure to dissolved hydrocarbons is primarily associated with toxicity, which is typically associated with the dissolved hydrocarbon component. Chronic impacts to juvenile fish, larvae, and planktonic organisms may occur if exposed to dissolved hydrocarbon plumes potentially resulting in lethal or sub-lethal effects or impairment of cellular functions (WA DoT 2018a). Juvenile fish and larvae may experience increased toxicity upon such exposure to plumes, because of the sensitivity of these life stages, with the worst impacts predicted to occur in smaller species (WA DoT 2018a).	Minor (E)

Pelagic fish and sharks are highly mobile in nature, and therefore they are not expected to remain within dissolved hydrocarbon plumes for extended periods, limiting the potential for acute impacts or risks associated with the exposure. There is a whale shark foraging BIA (approximately 15 km south-east of WA-50-L). Potential effects to whale sharks include damage to the liver and lining of the stomach and intestines, as well as toxic effects on embryos (Lee 2011). As whale sharks are filter-feeders they are expected to be highly vulnerable to entrained hydrocarbons (Campagna et al. 2011). Site attached fish, such as reef fish within the vicinity of the spill may be exposed to dissolved hydrocarbons above the 50 ppb threshold. Therefore, the values and sensitivities associated with fisheries (commercial, traditional, recreational, aquaculture), fish communities including the whale shark BIA and KEFs, are not expected to be exposed to any significant impacts. As such, the consequence of dissolved hydrocarbons is considered expected to be on a local scale, with short-term impacts (Insignificant F). Impacts on plankton are expected to be highly localised, with short-term impacts. However, if a dissolved plume reached a coral-spawning location, such as Browse Island or Scott Reef, during a spawning event, localised short-to-medium term impacts could occur. Therefore, the consequence is considered to be Minor (E). Benthic communities, including benthic primary producers, such as coral reefs, macro algae and seagrass could be exposed to dissolved hydrocarbons above impact thresholds. Shallowwater communities are generally at greater risk of exposure than deepwater communities (NRC 1985; WA DoT 2018a, RPS 2019). Exposure of dissolved hydrocarbons to corals has the potential to result in lethal or sublethal toxic effects, resulting in acute impacts or death at moderate to high exposure thresholds (Loya & Rinkevich 1980; Shigenaka 2001; WA DoT 2018a), including increased mucus production, decreased growth rates, changes in feeding behaviours and expulsion of zooxanthellae (Peters et al. 1981; Knap et al. 1985). Adult coral colonies, injured by oil, may also be more susceptible to colonisation and overgrowth by algae or to epidemic diseases (Jackson et al. 1989). Lethal and sublethal effects of dissolved oils have been reported for coral gametes at much lesser concentrations than predicted for adult colonies (Heyward et al. 1994; Harrison 1999; Epstein et al. 2000). Goodbody-Gringley et al. (2013) found that exposure of coral larvae to oil and dispersants negatively impacted coral settlement and survival, thereby affecting reef resilience. Dissolved hydrocarbons have the potential to affect seagrasses and macroalgae through toxicity impacts. The hydrophobic nature of hydrocarbon molecules allows them to concentrate in membranes of aquatic plants. Hence the thylakoid membrane (an integral component of the photosynthetic apparatus) is susceptible to oil accumulation, potentially resulting in reduced photosynthetic activity (Runcie & Riddle 2006). However, a layer of mucilage present on most species of seagrass prevents the penetration of toxic aromatic fractions (Burns et al. 1993). Although seagrass and macroalgae may be subject to lethal or sublethal toxic effects, including mortality, reduced growth rates, and impacts to seagrass flowering, several studies have indicated rapid recovery rates may occur even in cases of heavy oil contamination (Connell et al, 1981; Burns et al. 1993; Dean et al. 1998; Runcie & Riddle 2006). For algae, this could be attributed to new growth being produced from near the base of the plant while the distal parts (which would be exposed to the oil contamination) are lost. For seagrasses this may be because 50–80% of their biomass is in their rhizomes, which are buried in sediments, thus less likely to be adversely impacted by hydrocarbons (Zieman et al. 1984). It has been reported by Taylor & Rasheed (2011) that seagrass meadows were not significantly affected by an oil spill when compared to a non-impacted reference seagrass meadow. Based on the above impact assessment and expected recovery, the consequence to benthic habitats is considered to be Minor (E).	

Marine mammals, marine reptiles and marine avifauna could also be impacted through dissolved hydrocarbon exposure, primarily through ingestion during foraging activities (WA DoT 2018a). There are no known BIAs or aggregation areas within WA-50-L. However, the EMBA overlaps a large number of BIAs for a number of different marine fauna species (Section 4.8.4). A Ramsar site (Ashmore Reef) and a wetland of conservational significance (Mermaid Reef) are also present within the EMBA (Section 4.6), these sites provide important habitat for marine avifauna. Any dissolved plume is expected to be spatially and temporally limited in extent. As such, impacts to EPBC-listed species are expected to be on a local scale, with short-term impacts on a small portion of the population of a protected species, with the consequence considered to be Minor (E).	
Potential consequence - shoreline hydrocarbons	
Predicted exposure to shoreline hydrocarbons at all locations was reported to be < 100 g/m^2. The maximum concentration recorded from the worst-case simulation was at Browse Island where a concentration of 6.9 g/m^2 was predicted and a maximum volume of 0.08 m^3 on shorelines.	Insignificant (F)
Identify existing design safeguards/controls	
None identified	
Propose additional safeguards/control measures (ALARP evaluation)	

Hierarchy of control	Control measure	Used?	Justification
Elimination	None identified.	N/A	N/A
Substitution	None identified.	N/A	N/A
Engineering	Subsea isolation valves (SSIVs) and emergency shutdown valves (ESDVs) are installed and tested.	Yes	SSIVs and ESDVs are installed and operational to enable the isolation of the subsea infrastructure in the event of a release.
Procedures and administration	SIMOPS Interface Plan implemented to reduce the risk of dropped objects.	Yes	The SIMOPS Interface Plan will be used to ensure that the risk of dropping hazardous materials during transfers or dropping/losing control of infrastructure during installation activities are reduced and controls put in place where necessary including permit to work, key risk control mitigations, application of INPEX lifting standard etc.
	In event of a loss of containment event from the of SPS, implement the OPEP in accordance with the Ichthys Project Offshore Facility (Operations) EP (X075-AH-PLN-10015).	Yes	The Ichthys Project Offshore Facility (Operations) EP (X075-AH-PLN-10015) includes the risk assessment, strategic SIMA, oil spill response options assessment and associated OPEP to cover subsea production system loss of containment events. Therefore, these controls are not described in this EP.

Identify the likelihood		
Likelihood	Using publicly available risk data from the International Association of Oil and Gas Producers (IOGP), the risk of rupture of the flowlines is 1.48 × 10^{-4}/km per year. These statistics are based on incident history, largely for North Sea and European operations, and so their use is considered conservative given the remote location of the Project in an open-ocean, offshore area and the reduced risks associated with potential third-party interference. The condition of the subsea infrastructure will be assessed through the IMR program to pre-empt any possible defects and ensure the integrity is maintained. With the controls in place regarding SIMOPs and managing potential dropped objects to minimise the potential exposure to the particular values and sensitivities, the likelihood of this consequence occurring is considered Unlikely (4).	
Residual risk	Based on the worst-case consequence rating of Minor (E), with a likelihood of Unlikely (4), the residual risk is ranked as Moderate (8).	
Residual risk summary		
Consequence	Likelihood	Residual risk
Minor (E)	Unlikely (4)	Moderate (8)
Assess residual risk acceptability		

Legislative requirements

All reasonable means to minimise loss of containment events occurring from integrity failures have been taken during the design, route selection andinstallation of the subsea infrastructure. The Project has been developed in accordance with the relevant Australian standards and codes of practice to ensure integrity and minimise the potential for integrity failures in the hydrocarbon processing system.

Stakeholder consultation

Stakeholders have been engaged throughout the development of the EP. Where relevant, the controls in place have been developed in consultation with relevant stakeholders (e.g. WA DoT, AMSA). The controls in place are considered to manage risks to ALARP.

Conservation management plans / threat abatement plans

Several conservation management plans (refer Appendix B) identify oil spills as a key threatening process, through both direct/acute impacts of oil, as well as indirect impacts through habitat degradation (which is a potential consequence of an oil spill). The prevention of vessel collisions and reducing impacts to the marine environment through oil spill response preparedness and response (refer OPEP, Appendix D), demonstrates alignment with the various conservation management plans.

ALARP summary

As the level of environmental risk is assessed as Moderate, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "moderate", the consequence does not exceed "C – Significant" and the risk has been reduced to ALARP.

Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility
No loss of containment associated with rupture or damage to the SPS	SSIVs and ESDVs will be commissioned and tested before operation.	SSIV and ESDV integrity test records.	INPEX URF manager
	SIMOPS Interface Plan implemented, including risk assessments and permit to work, associated with critical lifts near the SPS.	SIMOPS records, including permits and risk assessments.	INPEX URF manager
Risks of impacts to commercial, traditional and recreational fisheries, emergent benthic primary producer habitats (intertidal corals, mangroves, macroalgae and seagrasses), turtle BIAs, marine avifauna BIAs, transient, EPBC-listed species and planktonic communities from a Group I hydrocarbon spill are reduced and maintained at acceptable levels through implementation of the environmental	INPEX Australia Incident Management Plan (0000-AH-PLN-60005) and INPEX Australia Crisis Management Plan (0000-AH- PLN-60004) and will be implemented in the event of a vessel collision. INPEX personnel will be trained in the above plans, as defined in Section 9.10 of this EP.	Records demonstrate Incident and Crisis Management Plans and were implemented following a vessel collision. Records demonstrate personnel are trained in the INPEX Australia Incident Management Plan (0000-AH-PLN-60005), INPEX Australia Crisis Management Plan (0000-AH- PLN-60004).	INPEX Security and Emergency Management Lead
	Emergency response preparedness will be maintained through implementing Sections 8.6 and 9.10 of this EP.	Records confirm response preparedness, as detailed in Sections 8.6 and 9.10 of this EP, is maintained.	INPEX Environmental Adviser
	In the event of a loss of containment from the SPS the Ichthys Project Offshore Facility (Operations) OPEP will be implemented.	Incident report and IMT records demonstrate implementation of Offshore Facility (Operations) OPEP.	IMT Leader

performance standards and the application of the environmental management implementation strategy.			

8.4 Spill Impact Mitigation Assessment

INPEX has developed a series of strategic Spill Impact Mitigation Assessments (SIMA) for each maximum credible spill scenario relevant to INPEX Australia's exploration and production activities in the Browse Basin.

The strategic SIMAs are:

- condensate/gas well blowout – long duration subsea release
- condensate spill – instantaneous surface release
- MGO/diesel spill – instantaneous surface release
- intermediate/heavy fuel oil spill – instantaneous surface release.

The SIMA process has been developed as a pre-spill planning tool for all INPEX EPs, to facilitate response option selection and support the development of the overall response strategies by identifying and comparing the potential effectiveness and impacts of oil spill response options (IPIECA 2017a). The strategic SIMA assists in the assessment of the impact mitigation potential and in making a transparent determination of response strategies that are considered most effective at minimising oil spill impacts (IPIECA 2017a). The framework includes environmental considerations as well as a range of shared values such as ecological, socio-economic and cultural aspects (IPIECA 2017a).

8.4.1 SIMA process

The SIMA process as outlined in the "Guidelines on implementing spill impact mitigation assessment (SIMA)" (IPIECA 2017a) has four stages:

1. Compile and evaluate data relevant for relevant oil spill scenarios including fate and trajectory modelling, identification of resources at risk and determination of safe and feasible response options.
2. Predict outcomes/impacts for the "No Intervention" (or "natural attenuation") option as well as the effectiveness (i.e. relative mitigation potential) of the feasible response strategy for each scenario.
3. Balance trade-offs by weighing and comparing the range of benefits and drawbacks associated with each response strategy, compared to 'No Intervention', for the spill scenario.
4. Select the best response strategies to form the response plan for the scenario, based on which best combination of response strategies will minimise the overall spill impacts and promote rapid recovery.

INPEX has generated strategic SIMAs, which includes a Group II (marine diesel) surface release and a Group IV (IFO/HFO) surface release from a vessel collision in the Browse Basin/NW WA region [X060-AH-LIS-60032].

Predictive oil spill modelling (e.g. outputs from various INPEX Browse Basin oil spill modelling reports) have been used to support the strategic SIMAs through defining generic oil weathering characteristics for each broad type of spill scenario.

The resource compartments presented in each SIMA reflect the values and sensitivities described in Section 4 of EPs (*Existing environment*). The resource compartments have been defined as broad habitat types which support protected species, rather than focusing on individual protected species. This approach is recommended by IPIECA (2017a).

For each generic spill scenario, a relative impact score has been assigned to each resource compartment, for the 'no intervention' option. A supporting justification for each relative impact score for each resource compartment is also presented in the SIMA.

For each SIMA, eight oil spill response strategies were considered, including operational monitor and evaluation, containment and recovery, protect and deflect, shoreline clean-up, chemical dispersant, pre-contact wildlife response, post-contact oiled wildlife response (OWR) and in-situ burn.

For each response strategy, the impact mitigation potential was assessed against each resource compartment and given a score on a scale of '-3' to '+3', where a negative score reflects additional impact and a positive score reflects mitigation of impact (balance trade-offs). A supporting justification for each impact modification score for each response strategy against each resource compartment is also presented in the SIMA.

Each impact mitigation score was evaluated with no timing or resource limitations or weather constraints on the response strategy effectiveness (these factors are further considered in the oil spill response arrangements and capability evaluation, provided in the relevant EP, as related to the EP specific spill scenario).

Those response strategies with an overall positive score, and therefore represent a mitigation of impact from the spill, are then selected for further assessment in the relevant EP. Those response options with an overall negative score have been discounted and are not further evaluated in the relevant EP.

It should be noted that it is unlikely that a single response strategy will be completely effective in a large spill scenario, hence it is expected that multiple response strategies may be utilised in the event of a Level 2/3 spill.

In order to select appropriate oil spill response strategies applicable to the oil spill scenario described in this EP (Section 8.2 *Vessel collision*), INPEX's strategic SIMAs for a diesel and IFO/HFO surface spill have been reviewed and assessed in Section 8.4.

The strategic SIMAs (diesel and HFO) are provided in Appendix E.

As the spill response controls associated with a loss of containment from the existing SPS are addressed in the Ichthys Offshore Facility (Operations) EP/OPEP, the Strategic SIMA and associated spill response strategies assessment for a loss of containment from the existing SPS are not presented in this EP or OPEP.

8.5 Oil spill response arrangements and capability evaluation

The response techniques that demonstrated a positive impact mitigation potential in the SIMAs (diesel and HFO surface release) have been assessed for their applicability and suitability as response options, taking into account the expected timing and resource limitations specific to WA-50-L and this EP. The response options further evaluated in Table 8-10 are as follows:

- operational monitoring and evaluation
- contain and recover
- protect and deflect
- shoreline clean-up
- chemical dispersion (surface application)
- pre-contact wildlife response (hazing and translocation)
- post-contact wildlife response.

The following response techniques have been excluded from this EP based on the outcome of the SIMAs for each scenario (Appendix E):

- in-situ burn.

Table 8-10 presents the response strategy applicability evaluation. In this evaluation, the response strategies which were selected via the strategic SIMA have been further evaluated for their applicability and suitability, by taking into account the expected resource and logistical limitations specific to the activity described in this EP. Spill scenario specific oil spill modelling data was also evaluated. Depending on the outcome of this evaluation, some response strategies have been excluded from further evaluation, as they have been assessed as not appropriate for the EP specific spill scenario.

Following the response strategy applicability evaluation, a response strategy element identification is undertaken, to define the resources required to successfully implement the selected response strategies, under a worst-case spill scenario. This evaluation is presented in Table 8-11.

Following the response strategy element identification, the response strategy arrangements and capability evaluation is undertaken. This process examines the merits of improving the capability or timeliness of response strategy elements. The response strategy arrangements and capability evaluation are presented in Table 8-12. This table presents the justification that the spill response arrangements in place are effective in reducing environmental risks to ALARP and provides the reasoning and justification of the selected controls presented in Table 8-13.

Table 8-10: Evaluation of the applicability of spill response strategies identified in the SIMA

Oil spill response technique	**Likelihood of success**	**Considered for implementation**
Operational monitoring and evaluation	The SIMA evaluations found that operational monitoring and evaluation should always be implemented in the event of a level 2/3 spill. To implement this response strategy, the following strategies are considered: • oil spill trajectory modelling • aerial and vessel surveillance • oil spill tracker buoys • satellite surveillance. A detailed assessment of the logistical resources required to implement this response strategy are described in Table 8-12.	Yes
Contain and recover	The SIMA evaluations found that contain and recover was appropriate for Group IV/HFO spills and potentially appropriate for Group II/diesel spills. Generally, oil needs to be >100 g/m^2 (O'Brien 2002) to feasibly corral oil with a boom and achieve any significant level of oil recovery with the skimmers. The initial, gravity-dominated release and spreading of diesel is generally complete within minutes to hours after a release (O'Brien 2002). In the context of the Browse Basin, with high sea surface and air temperatures in all seasons, the spreading of any diesel spill would be very rapid, and therefore make this response strategy not applicable for diesel spills. In addition, in the early stages of a diesel spill, in locations where concentrations are expected to be >100 g/m^2, vessel access to the immediate spill area is likely to be restricted due to the presence of VOCs in excess of safe exposure thresholds, and potential for a flammable atmosphere. Therefore, contain and recovery for a diesel spill is not considered an appropriate strategy for implementation. For an HFO spill, where the slick is more persistent, less volatile, and likely to be present on the sea surface at appropriate concentrations (>100 g/m^2) for an extended period of time, a contain and recovery operation may be possible. The deployment of booms and skimmers to recover Group IV oil spills is generally a suitable response strategy in a sheltered environment with non-emulsified heavy oils. Therefore, this strategy's effectiveness is limited by the prevailing sea state conditions of the NWMR.	Yes (HFO only)

	The strategy is relatively labour-intensive when the effort is considered against overall effectiveness in reducing the volume of floating oil (i.e. it only covers a small area of spill with 1 or 2 vessels deploying booms, plus numerous personnel). In addition, due to a large number of limitations, including ineffectiveness at >0.7 to 1 knot current speeds (often experienced in the Browse Basin); ineffectiveness in adverse sea states (common in the open ocean of the NWMR); skimmer ineffectiveness in open ocean and logistical issues associated with recovered waste at sea (ITOPF 2011); containment and recovery is unlikely to be an effective response strategy against Group IV oil spills in the EMBA. INPEX currently do not maintain any offshore containment and recovery equipment (booms and skimmers) offshore in the Browse Basin area. However, INPEX do have access (via AMOSC) to a Level 2 stockpile of equipment in Broome, including offshore boom and skimmers. The INPEX IMT would consider, in consultation with AMOSC and AMSA, the practicalities, likely success and risks associated with an at sea contain and recover operation. Weather conditions permitting, if a demonstrated tangible, positive outcome could be safely achieved it may be possible undertake a containment and recovery operation. A detailed assessment of the logistical resources required to implement this response strategy for an HFO spill are described in Table 8-12.	
Protect and deflect	The SIMA evaluations found that protection and deflection was appropriate for Group IV/HFO spills and potentially appropriate for Group II/diesel spills. The outcome of the spill modelling (Section 8.2.4) indicated that for a diesel spill, 62.6 m^3 of weathered diesel could accumulate on Browse Island for the worst-case replicate. For an HFO spill, a maximum volume of 246.7 m^3 weathered HFO could accumulate at the Tiwi Islands for the worst-case replicate (APASA 2014b). Several other locations were also predicted to accumulate volumes of oil onshore > 100 m^3 in different modelled simulations. Booms could potentially be used to protect and deflect spills away from sensitive habitats, and possibly contain some oil for recovery at a shoreline. Generally, oil needs to be >100 g/m^2 (O'Brien 2002) to feasibly deflect oil with a boom to achieve any significant level of oil deflection away from a sensitive location, or to achieve oil deflection into a collection area on a shoreline. Given the size of the offshore island shorelines (e.g. Browse Island intertidal zone is 3 km in diameter), substantial numbers of booms would need to be deployed to protect entire shorelines. Anchoring of booms would most likely result in additional damage to the subsurface environment (coral reef) surrounding most offshore islands. Booms could potentially be held in place by vessels, however due to widths of shorelines requiring protection, this would most likely require an unfeasibly large number of vessels. Booms themselves would also move around on the coral intertidal reef during periods of lower tides, potentially resulting in significant physical damage to the benthos of the reef platform.	Yes

	If a slick were potentially reaching a more sheltered location such as the Kimberley coastline, protect and deflect may be a more appropriate strategy. Therefore, if a tangible, positive outcome could be demonstrated and with the right weather conditions a protect and deflect operation may be possible. INPEX currently do not maintain any protect and deflect equipment (shoreline booming equipment) offshore in the Browse Basin area. However, INPEX do have access (via AMOSC) to Level 2 stockpiles of equipment in Broome and Darwin, including shoreline booms. The INPEX IMT would to consider, in consultation with AMOSC and the WA DoT/NT DENR, the practicalities, likely success and risks associated with a shoreline protect and deflect operation. As discussed in Table 8-4 (diesel) and Table 8-5 (HFO), surface oil concentrations of >10 g/m^2 (environmental impact threshold) were predicted out to 138 km and 490 km respectively, from the release location. Worst case concentrations of oil were predicted to arrive at shorelines in excess of the impact threshold (>100g/m^2) particularly for an HFO spill. A detailed assessment of the logistical resources required to implement this response strategy is described in Table 8-12. It should also be noted that for shorelines, the WA DoT/NT DENR, as Control Agency, would make the ultimate decision on the response strategies to be implemented, with support provided by INPEX. For Ashmore Reef and Cartier Island, INPEX maybe be the Control Agency.	
Shoreline clean-up	The SIMA evaluations found that shoreline clean-up was potentially appropriate for both Group II/diesel spills and Group IV/HFO spills. The outcome of the spill modelling (Section 8.2.4) indicated that for a diesel spill, 62.6 m^3 of weathered diesel could accumulate on Browse Island for the worst-case replicate. For an HFO spill, a maximum volume of 246.7 m^3 weathered HFO could accumulate at the Tiwi Islands for the worst-case replicate (APASA 2014b). Several other locations were also predicted to accumulate volumes of oil onshore > 100 m^3 in different modelled simulations. In the event of a spill, the IMT, in consultation with AMOSC and WA DoT/NT DENR, would consider shoreline clean-up as a response strategy based on the outcome of real-time operational monitoring and evaluation data. A detailed assessment of the logistical resources required to implement this response strategy is described in Table 8-12. It should also be noted that for shorelines, the WA DoT/NT DENR, as Control Agency, would make the ultimate decision on the response strategies to be implemented, with support provided by INPEX. For Ashmore Reef and Cartier Island, INPEX maybe be the Control Agency.	Yes

Chemical dispersion (surface application)	The SIMA evaluation for Group II/diesel spills found that chemical dispersant (surface application) was not an appropriate strategy for a surface diesel release. The SIMA evaluation for Group IV/HFO spills identified that chemical dispersant (surface application) may be appropriate response for an HFO surface release. Dispersant can be effective at reducing the surface expression of Group IV hydrocarbons, under specific circumstances. The reduction in the surface expression of Group IV spills would reduce the risk of contact with shoreline or intertidal sensitivities. Depending on sea-state, atmospheric conditions, weathering and emulsification of Group IV/HFO spills the 'window of opportunity' for effective dispersant application is generally limited – from a few hours, to a few days (ITOPF 2013). If a spill is ongoing, i.e. leaking from a vessel over several days, the window of opportunity for dispersant application may be extended. Vessel-based dispersant application could be arranged during this window of opportunity for spills within approximately 100 km of WA-50-L. Depending on the weather conditions and duration of the spill, the fixed wing aerial dispersant (FWAD) capability from Batchelor could be available within the window of opportunity for spills within 510 km (280 nm) of Mungalalu Truscott Airport or Broome Airport. However, it would take at least 24 hours to mobilise all aircraft, personnel and equipment to Mungalalu Truscott, as required by the *Fixed-Wing Aerial Dispersant Capability Joint Standard Operating Procedures (SOP) Version 1.2* (AMSA 2015c). A detailed assessment of the logistical resources required to implement this response strategy is described in Table 8-12. AMOSC maintain a contract (on behalf of the oil and gas industry) with AMSA for FWAD capability for spills in Commonwealth waters. During spill scenarios where AMSA or WA DoT is the Control Agency, AMSA or WA DoT may direct INPEX to undertake vessel based dispersant response activities.	Yes
Pre-contact wildlife response (hazing and translocation)	The SIMA evaluations found that wildlife hazing was potentially appropriate for both Group II/diesel spills and Group IV/HFO spills. The outcome of the spill modelling (Section 8.2.4) indicated that for a diesel spill, 62.6 m^3 of weathered diesel could accumulate on Browse Island for the worst-case replicate. For an HFO spill, a maximum volume of 246.7 m^3 weathered HFO could accumulate at the Tiwi Islands for the worst-case replicate (APASA 2014b). Several other locations were also predicted to accumulate volumes of oil onshore > 100 m^3 in different modelled simulations, all of which would present a risk of wildlife oiling. Wildlife hazing is most suitable when used near sensitive shoreline habitats against persistent oily slicks, such as HFO spills. It is generally not appropriate in an open water environment. In the case of a diesel spill, where surface oil slicks are thin and not considered particularly adhesive, the likelihood and severity of impacts on wildlife are less, in contrast to HFO. Additionally, hazing isn't considered an effective measure against volatile spills which rapidly evaporate.	Yes

	IPIECA (2014) advise that the difficulty of capturing wildlife safely and maintaining their health during relocation should not be underestimated, and that working with live or dead animals has health and safety issues including potential injuries (e.g. bites or scratches) or zoonotic diseases. The release of zoonotic diseases from a captured population back into a wild population could result in more significant impacts to overall population viability. Risks to wildlife are high during pre-emptive capture and the risks of oiling need to be weighed against the risk of injury, death etc, from capture and relocation. The translocation of turtles from beaches and islands would likely require the capture of large numbers of hatchlings at night, followed by translocation to a location far from the slick (to prevent surface oil impacts on released hatchlings). Attempting to capture large numbers of healthy seabirds would be very challenging and there is no practicable method to capture healthy seabirds at sea (DPaW 2014). Any seabirds captured and then released would likely fly back to the shoreline from which they originally were captured. Long term veterinary care (e.g. feeding etc.) would be required for any successfully captured birds, until spill weathering or remediation had occurred, and it was safe to release the animals. Overall, there is a potential for harm of animals captured to occur; however, as a spill response strategy it may result in a positive impact (Appendix E). In the event of a Group II or IV spill, the IMT, in consultation with WA DoT/NT DENR would consider pre-contact wildlife response as a response strategy based on the outcome of real-time operational monitoring and evaluation data received, and whether indications were that a significant number of individuals of a protected species would be likely to benefit from the response strategy. A detailed assessment of the logistical resources required to implement this response strategy is described in Table 8-12. It should also be noted that for shorelines and wildlife response, the WA DoT/NT DENR, as Control Agency, would make the ultimate decision on the response strategies to be implemented, with support provided by INPEX. For Ashmore and Cartier, INPEX may be the Control Agency.	
Post-contact wildlife response	The SIMA evaluations found that post-contact wildlife response was potentially appropriate for both Group II/diesel spills and Group IV/HFO spills. The outcome of the spill modelling (Section 8.2.4) indicated that for a diesel spill, 62.6 m^3 of weathered diesel could accumulate on Browse Island for the worst-case replicate. For an HFO spill, a maximum volume of 246.7 m^3 weathered HFO could accumulate at the Tiwi Islands for the worst-case replicate (APASA 2014b). Several other locations were also predicted to accumulate volumes of oil onshore > 100 m^3 in different modelled simulations, all of which would present a risk of wildlife oiling.	Yes

	Capture, relocation, assessment, cleaning, rehabilitation of oiled wildlife does have the ability to increase the survival of individuals. The scale of oil impacts on wildlife is dependent on factors such as timing, location, oceanographic and weather patterns, and the movements of species that forage, feed, nest and inhabit that area (IPIECA 2014). Given the predicted weathering of any Group II or IV spill, most wildlife exposure is expected to be to weathered hydrocarbons, with lower associated levels of toxicity (Stout et al. 2016). Group II hydrocarbons are relatively non-adhesive compared to HFO, and generally not considered an oil product that would 'coat' the feathers of birds, requiring a full wildlife cleaning response on a shoreline. They are also not likely to generate a thick surface barrier on a shoreline which would coat adult nesting turtles or turtle hatchlings as they transit to the ocean. However, this may be the case for an HFO spill. Any seabirds captured, cleaned and released may fly back to the shoreline from which they originally were captured and may be repeatedly affected. Therefore, long term veterinary care (rehabilitation, feeding, etc.) would be required for any successfully captured birds, until spill weathering or remediation had occurred, and it was safe to release the seabirds. Once oiled, it is generally agreed that for most bird species, there is a very low survival rate, with many studies reporting the probability of dying near to 100%. The only reported high success rates of seabird cleaning are typically associated with cleaning pelicans and penguins which are not present within the Browse Basin. IPIECA (2014) advise working with live or dead animals has health and safety issues including potential injuries (e.g. bites or scratches) or zoonotic diseases. The release of zoonotic diseases from a captured population back into a wild population could result in more significant impacts to overall population viability. In the event of a Group II or IV spill, the IMT would consider, in consultation with WA DoT/NT DENR, post-contact wildlife response as a response strategy based on the outcome of the real-time operational monitoring and evaluation data received, and whether indications were that a significant number of individuals of a protected species would be likely to benefit from the response strategy. A detailed assessment of the logistical resources required to implement this response strategy is described in Table 8-12. It should also be noted that for shorelines and wildlife response, the WA DoT/NT DENR, as Control Agency, would make the ultimate decision on the response strategies to be implemented, with support provided by INPEX. For Ashmore and Cartier, INPEX may be the Control Agency.	

As described in Table 8-6 the worst credible spill scenarios could involve:

- floating oil above impact thresholds on the open ocean
- maximum accumulated oil ashore of 246.7 m^3
- potential for multiple shorelines to be contacted.

The individual elements required to successfully undertake the identified response strategies are presented in Table 8-11.

Table 8-11: Response strategy element identification

Response strategy	Response strategy purpose	Response strategy element
Operational monitoring and evaluation	Provide up to date information to the IMT, to enable the IMT to make timely and informed decisions	Oil spill trajectory modelling (OSTM) • OSTM will provide predictions of the trajectory and fate of the oil spill For the worst credible spill response, only a single OSTM provider is anticipated to be required.
		Aerial surveillance aircraft and trained spotters • aerial surveillance will assist with validating the OSTM predictions, through visual confirmation of the location and type of slick. • personnel trained in aerial observation For a worst credible spill response, up to two flights per day over the spill area is anticipated to be required.
		Vessel surveillance • vessel surveillance will assist with validating the OSTM predictions, through visual confirmation of the location and type of slick. For a worst credible spill response, only a single vessel conducting surveillance may be required, if at all (aerial surveillance only is most likely sufficient).
		Electronic surface tracker buoys (ESTBs) • ESTBs will assist with validating the OSTM predictions • ESTBs will assist with aerial surveillance flight planning For the worst credible spill response, deployment of multiple ESTBs is anticipated to be required, to accurately validate the OSTM and assist with aerial surveillance flight planning.
		Satellite imagery • satellite imagery will assist with validating the OSTM predictions For a worst credible spill response, only a single satellite imagery provider is anticipated to be required.
		Booms and skimmers

Response strategy	**Response strategy purpose**	**Response strategy element**
Contain and recover	Remove floating oil from the sea surface to reduce impacts to marine environment	• booms to corral oil at concentrations suitable for recovery • skimmers to remove oil from the sea surface • waste management resources for transport and disposal of recovered oil
		Contain and recover personnel • experienced personnel, such as AMOSC core-group operations team personnel, who can lead a contain and recover team • vessel deck crew, who would receive on the job training from the team lead, and carry out the activities For a worst credible spill response, up to 5 deck personnel per vessel are anticipated. Refer Table 8-12 for further details.
Protect and deflect	Prevent floating oil from reaching sensitive shorelines or corral oil for collection away from sensitive shoreline locations	Booms and skimmers • booms to deflect floating oil slicks away from sensitive shorelines and/or corral oil at concentrations suitable for recovery • skimmers to recover any contained oil • waste management resources for transport and disposal of recovered oil • personnel trained in shoreline booming operations (such as AMOSC Core-Group)
		Protect and deflect personnel • experienced personnel, such as AMOSC core-group operations team personnel, who can lead a contain and recover team • labour hire personnel, who would receive on the job training from the team lead, and carry out the shoreline clean-up activities For a worst credible spill response, up to a maximum of 20 shoreline response personnel per remote shoreline is anticipated. Refer Table 8-12 for further details.
Shoreline Clean-up		Shoreline clean-up personnel • experienced personnel, such as AMOSC core-group operations team personnel, who can lead a shoreline clean-up team

Response strategy	Response strategy purpose	Response strategy element
	Remove oil from the shoreline to reduce impacts to biota and accelerate natural recovery of the shoreline	• labour hire personnel, who would receive on the job training from the team lead, and carry out the shoreline clean-up activities For a worst credible spill response, up to a maximum of 20 shoreline response personnel per remote shoreline is anticipated. Refer Table 8-12 for further details.
		Shoreline clean-up equipment • manual tools such as rakes and shovels, used to manually recover oil and oily debris from the shoreline. • Light, tracked machinery (e.g. bob-cat) for transportation of recovered oily waste along shoreline.
Chemical dispersant (surface application)	To reduce the volume of floating oil on the sea surface by transferring it into the water column where it is subjected to biodegradation	Dispersant stockpiles • Dispersant stockpile located in WA-50-L • Dispersant stockpiles located at adjacent/nearby petroleum facilities (e.g. Prelude FLNG) • Dispersant stockpiles located on Australian mainland (AMOSC/AMSA stockpiles)
		Dispersant application trained personnel • personnel trained in vessel -based and aerial-based dispersant applications
		Aviation capability • FWAD dispersant application aircraft • FWAD air attack aircraft including air attack supervisor • FWAD search and rescue platform (vessel or aircraft) • Air bases to launch dispersant sorties • Aviation support during vessel-based dispersant application
		Wildlife response personnel • experienced personnel, such as AMOSC oiled wildlife response team personnel, who can lead a wildlife response team

Response strategy	Response strategy purpose	Response strategy element
Pre and post contact wildlife response	Prevent or minimise harm associated with the oiling of marine fauna	• wildlife handlers, trained in oiled wildlife response, such as the WA Oiled Wildlife Rehabilitators Network, and Phillip Island Nature Park personnel • labour hire personnel, who would receive on the job training from the team leads, to assist with oiled wildlife response activities For a worst credible spill response, up to a maximum of 20 wildlife response personnel per remote shoreline is anticipated. Refer Table 8-12 for further details.
		Wildlife response equipment • wildlife response kits – used for the safe capture and transport of oiled wildlife • wildlife response containers – used for triage, washing and rehabilitating wildlife (wildlife response containers can be mounted on the deck of a suitable accommodation support vessel) For a worst credible spill response at a remote shoreline, only a single wildlife response kit and wildlife response container, mounted on an accommodation support vessel (ASV)), is anticipated to be required.
		Wildlife hazing equipment • wildlife hazing equipment typically only includes vessel air-horns, vessel water cannons etc. • acoustic bird scaring devices/buoy can also be deployed onshore or from a vessel. For a worst credible spill response at a remote shoreline, up to two small vessels and/or a bird-scaring device/buoy could be deployed for wildlife hazing at a remote shoreline.
Logistical Support (common to all response strategies)	Provide logistical support to enable response strategies to be undertaken	Accommodation support vessel • to act as the Forward Operating Base, coordinating the shoreline response activity, including daily activity planning and communications back to the IMT • provide accommodation and logistical support to the field response personnel • provide a platform to support waste management and oiled wildlife response, if required. For a worst credible spill response at a remote shoreline, only a single ASV is anticipated to be required. If, in the highly unlikely event that multiple shorelines were contacted at the same time, such as Ashmore Reef and Cartier Island (60 km apart), additional vessel may be required.

Response strategy	Response strategy purpose	Response strategy element
		Small support vessels (resupply vessels, tenders and landing barges) • tenders used to transport personnel and light-weight equipment to and from shorelines • landing barges used to transport heavier equipment and backload waste from shorelines • small support vessels (20-40m) used to resupply larger vessels For a worst credible spill response at a remote shoreline, two tenders, a landing barge and logistic supply vessel is anticipated to be required (total of 4 small support vessels).
		Large support vessels (offshore support tugs, PSVs, AHTs or other large offshore support vessels) • provide platform to conduct various response strategies including contain and recover, vessel based dispersant application or act as a SAR platform for FWAD activities • provide large scale logistical support and oily waste backload capability For a worst credible spill response, involving concurrent spill response strategies such as contain and recover, vessel and aerial dispersant application, multiple (4 to 6) large offshore support vessels could be required.
		Crew change helicopter • provide for routine crew change of response personnel between the mainland and spill response activities For a worst credible spill response involving both at sea and remote shoreline response activities, only a single crew change helicopter is anticipated to be required.
		Light utility helicopter • provide an alternative mechanism to land personnel and light equipment onto a shoreline, in the event that sea conditions are prohibitive to marine vessel access • using a sling, provide an alternative mechanism to move heavier equipment and backload waste between a shoreline and a support vessel, in the event that sea conditions are prohibitive to marine vessel access

Response strategy	Response strategy purpose	Response strategy element
		For a worst credible spill response at a remote shoreline, only a single light utility helicopter is anticipated to be required. If, in the highly unlikely event that multiple shorelines were contacted at the same time, such as Ashmore Reef and Cartier Island (60 km apart), the light utility helicopter asset could be shared between the adjacent shoreline response locations.

Table 8-12: Oil spill response arrangements and capability evaluation

Oil spill response control [minimum implementation time]	Can a greater response effort be implemented?	Can the time to respond be improved?	Environmental benefit of increased response effort/reduced response time
Oil spill trajectory modelling (OSTM) - access to OSTM services [OSTM contractor available on 24/7 call-out arrangement]. [OSTM contractor activated within 2 hours of IMT formation].	OSTM will be used to forecast the trajectory and fate of oil plumes resulting from surface or subsurface releases. OSTM is an iterative process using real-time observations to refine modelling predictions. No alternatives have been identified that could improve this oil spill response control.	The OSTM contractor will be available on-call on a 24/7 basis. OSTM requires access to information/situational awareness data provided by the Emergency Response Team. The IMT should reasonably be able to activate and transmit relevant situational awareness data the OSTM contractor within 2 hours of the formation of the IMT.	The purpose of OSTM is to provide spill trajectory forecasts, to enable the IMT to develop IAPs, and commence implementing secondary spill response activities which would be implemented in the days after the initial response. Reducing the activation timeframe of OSTM would not provide any benefit in relation to 'first strike' activities. Therefore, there is no benefit in reducing the activation timeframes.
Aerial surveillance with aircraft of opportunity using untrained observers will be available and may involve using any of the following: • crew change helicopters that can be mobilised or diverted with two pilots (second pilot can act as a spotter and record observations) • fixed-wing aircraft available on a best endeavours basis, via call-off contract. [crew-change helicopters commence surveillance activities at the spill location within 5 hours of IMT activation *]	Aerial surveillance is used to provide situational awareness of the slick size, type and location to the IMT. Aerial surveillance can only be undertaken during daylight hours and is guided using the OSTM modelling results and tracker buoy locations. There is a dedicated full-time Search and Rescue helicopter, plus a minimum of four crew change helicopters available in Broome at all times. The crew change helicopters have the INPEX oil spill observation aid available, ready for use during a spill event. This resource can be mobilised to WA-50-L within 5 hours. Fixed wing aircraft on call-off contracts for rapid mobilisation are only available during the cyclone-season. During the dry-season, fixed wing aircraft are utilised by the tourism industry, and therefore these fixed wing aircraft service providers will not guarantee mobilisation within specified timeframes during the dry season, however will provide services on a best-endeavours basis. The fixed wing aircraft response could be improved by having an additional dedicated fixed wing aircraft available for 12 months of the year at $100,000 per month. The cost for this is not considered reasonable based on the availability of alternative means of aerial surveillance (helicopter surveillance available all year). The addition of an extra aircraft will not significantly reduce the time of response. The accuracy of aerial surveillance data reported to the IMT could be improved though the use of trained aerial observers experienced and able to reliably detect, recognise and record oil pollution at sea. There would be additional training costs associated with training helicopter and fixed wing pilots in aerial oil spill observers. The INPEX oil spill observation aid is considered a suitable substitute to formal training and is appropriate for use during the first 24-48 hours of the spill, when the spill is likely to be located in a small geographical area. Trained aerial observers, for use during a protracted spill response are available via AMOSC. These personnel can be mobilised to Broome within 48 hours.	As the nearest emergent receptors are tens of km from WA-50-L, immediate aerial surveillance is not critical to the IMT's first strike or ongoing IAP development requirements. The shortest time to contact was predicted at Browse Island (28 hours) (APASA 2014a). It may be possible to mobilise in a shorter period as a crew change helicopter could be cancelled and diverted to the spill location immediately if safe to do so, and not required for higher priority safety/evacuation related tasks. To guarantee a faster response time, additional dedicated fixed wing aircraft at cost $100,000 per month could be positioned at Broome, Truscott or Darwin. The cost for this is not considered reasonable, as the current arrangements enable aerial surveillance of the licence area within 5 hours (daylight only).	The quality of information provided by a faster or greater response is not expected to be improved to a level that would result in substantial environmental benefits. Other techniques, such as OSTM will be implemented in parallel with aerial and/or vessel observations. This combination of data is considered sufficient to inform the IMTs situational awareness during the early stages of a spill response.

Oil spill response control [minimum implementation time]	Can a greater response effort be implemented?	Can the time to respond be improved?	Environmental benefit of increased response effort/reduced response time
Aerial surveillance using 1 x trained aerial observer [Commence aerial observation task from Broome/Darwin within 48 hours]	Personnel formally trained through the AMOSC aerial observer course could be used, to increase the quality of aerial observer data received by the IMT during the spill response. However, the quality of data that would be received by the IMT, from personnel such as a helicopter co-pilot using the INPEX oil spill observation aid, and data from other operational and monitoring evaluation techniques, should still provide adequate information for the INPEX IMT to conduct its role, especially during the first 24 hours of a spill. It should be noted that the crew-change helicopter pilots are familiar with observing the natural colours and shades of the ocean in the Browse Basin/Timor Sea area, and therefore less likely to mis-interpret natural phenomenon such as cloud-shadow or algal bloom for oil slicks. Also, without additional oil spill observation aircraft, additional trained personnel do not provide further value.	To implement aerial surveillance sooner using trained aerial observers, the only identified method would be to have observers on a stand-by contract, located in Broome. However, this additional standby cost is not considered reasonable, given INPEX has crew-change helicopter pilots available in Broome, equipped with the INPEX oil spill observation aid, which should provide adequate initial visual observation information to the IMT for planning purposes during the initial stage of the spill response. As the nearest emergent receptors are tens of km from WA-50-L, immediate aerial surveillance is not critical to the IMT's first strike or ongoing IAP development requirements. The shortest time to contact was predicted at Browse Island (28 hours) (APASA 2014a).	The increased quality of data that could be received by the IMT during the initial stages of a spill response using pre-positioned trained aerial observers, compared to the quality of data received using pilots as observers (using the INPEX oil spill observation aid and data from other operational and monitoring evaluation techniques) will not significantly increase the IMTs situational awareness and ability to develop and implement effective IAPs. Therefore, a greater and/or faster response time is not considered ALARP.
Vessel surveillance [complete mobilisation and depart from Broome/Darwin wharf within 48 hours for large support vessel; within 24 hours for small support vessel]	A typical platform support vessel bridge is 10 m to 20 m above sea level. A small support vessel bridge may only be 3 m to 5 m above sea level. Due to this low visual elevation (compared to aerial surveillance platforms) and vessel speed (~14 knots), the observational data a vessel of any size can provide is significantly limited, compared to the observation data able to be obtained by aerial observers. Therefore, additional vessels could be mobilised, however a greater level and quality of information will be obtained by focusing resources on mobilising aerial observation platforms instead. Vessel surveillance during the initial stages of a loss of well containment is not considered safe due to the potential for a flammable atmosphere and a limited surface slick is expected in the longer term.	Vessel surveillance could be undertaken faster if a PSV was made available from other activities/campaigns being undertaken in WA-50-L; however this cannot be guaranteed as the available vessels, including those supporting offshore facilities in the licence area (such as the INPEX Ichthys CPF/FPSO, and nearby Shell Prelude FLNG) may be being used for other emergency response operations. A support vessel on route between the WA mainland and WA-50-L would potentially be available to undertake vessel surveillance in <48 hours, however again this cannot be guaranteed. The time to mobilise a separate PSV, purely dedicated to conduct vessel surveillance, from Darwin or Broome wharf, loaded with crew and provisions and sail to location cannot be improved to less than 48 hours. There are less berth spaces available on wharfs in Broome and Darwin for these larger vessels. Therefore, immediate access to wharf space cannot be guaranteed. Additional time alongside the wharf is also required for bunkering and provisioning a large vessel. Therefore, at least 24 hours is required for mobilisation activities in Broome or Darwin. The vessel also requires at least 18-24 hours to transit to the spill location. Smaller support vessels are available in Broome and Darwin. These smaller vessels, in an emergency, could be along-side a smaller wharf to load marine crew, spill and supplies within 6 hours, and then transit to the spill location within approximately 24 hours from the time they were activated (assuming vessel speed of 14 knots). Whilst small support vessels can be mobilised to the location of the spill faster than larger support vessels, small vessel bridges are much closer to the sea surface, and therefore are of limited value as an oil spill observation platform. Aerial surveillance is considerably faster than any vessel surveillance platform. Therefore, resources will be focused on aerial surveillance, rather than vessel surveillance.	The environmental impacts and risks from a spill are not directly affected by this response technique, as the objective is to provide situational awareness to the IMT and to inform on other response techniques. The information provided by a quicker or greater response is not expected to be significant enough to result in substantial environmental benefits. Aerial surveillance and OSTM will provide the greatest level of situational awareness to the IMT. It should be noted that in the event of a vessel collision, the damaged vessel would not be able to conduct vessel surveillance activities, and other vessels may be prioritised to complete tasks that are not directly related to the oil spill response, such as transfer of injured personnel to nearby facilities or to shore, supporting the damages vessels involved in the collision, or search and rescue operations.

Oil spill response control [minimum implementation time]	Can a greater response effort be implemented?	Can the time to respond be improved?	Environmental benefit of increased response effort/reduced response time
Electronic surface tracking buoy will be available for deployment immediately from Ichthys facility (FPSO/CPF) or other support vessels in WA-50-L. [immediately available to deploy to support vessel from the CPF/FPSO]	The primary purpose of the tracking buoys is to assist with situational awareness of the IMT during periods when aerial surveillance isn't available (e.g. night-time), and for the longer-term validation of the OSTM. INPEX maintain a total of ten tracker buoys, which are positioned at different locations, depending on the activities underway. The Ichthys CPF and FPSO (within the licence area) maintain one oil spill tracker buoy each, which can be mobilised to the location and deployed during the early stages of a spill occurring via support vessels. Additional tracker buoys will be available on some support vessels (such as production drilling vessels) operating in WA-50-L, with more tracker buoys available from Broome or Darwin, if required. More tracker buoys are available via AMOSC, if required.	No additional measures have been identified which could improve the timeliness of deployment of tracker buoys.	Sufficient provision has been made for deployment of multiple tracker buoys as quickly as possible, and data will be received by the IMT via web-link. No additional environmental benefits can be achieved through improving the number or location of additional tracker buoys.
Satellite imagery analysis - obtain satellite imagery providers. [imagery available in the IMT within 48 hours]	Information gained from satellite imagery would be used in combination with other controls such as aerial/vessel surveillance and OSTM, to improve the IMT's situational awareness. No greater response effort has been identified.	This service cannot be provided faster as access to satellite imagery is limited due to the continuous movement and orbit of satellites around the globe. This results in up to 48-hour delays to obtain satellite imagery from service providers.	No environmental benefits identified. Satellite imagery is a tool which assists with overall validation of spill modelling and aerial surveillance, however the IMT will still maintain a high level of situation awareness, if satellite imagery isn't immediately available.
Vessel response - spill response vessel equipped with equipment such as booms, skimmers, wildlife hazing, oiled wildlife response, shoreline clean–up. [available to mobilise and depart from Broome within 48 hours for large support vessel; within 24 hours for small support vessel]	Additional vessels can be provided if required under the existing call-off contracts described within the OPEP. These contracts include larger vessels such as PSVs, AHTs etc, and many medium to small support vessels (< 30m length). Larger vessels could be used for activities such as containment and recovery, vessel based dispersant application, SAR platform for FWAD activities, wildlife hazing using their water cannons and airhorns, and as accommodation vessels to support shoreline response activities. Small support vessels can be used for supporting shallow water response activities. The very small support vessels (<6m in length) can be used for shoreline landings and intertidal access for activities such as shallow water wildlife hazing and protect and deflect booming. Each vessel can be loaded with different spill response equipment as relevant to the response activity and location. Therefore, a suitable response capacity is deemed to have been provided in this regard. It should be noted that strong winds and elevated sea-states will limit the effectiveness of most vessel-based response activities and there is no additional capability that can overcome this limitation.	Smaller support vessels (< 30 m) are available in Broome and Darwin. These smaller vessels can support most other spill response activities, including wildlife hazing and shoreline response activities. These smaller vessels, in an emergency, could be along-side a smaller wharf to load marine crew, spill response personnel, fuel and supplies within a maximum of 24 hours and then commence transit to the spill location. The time to mobilise a separate large support vessel from Darwin or Broome wharf, loaded with crew and provisions ready to sail to location cannot be improved to less than 48 hours. There are less berth spaces available on wharfs in Broome and Darwin for these larger vessels. Therefore, immediate access to wharf space cannot be guaranteed. Additional time alongside the wharf is also required for bunkering and provisioning a large vessel. In addition, the Darwin marine supply base only has two very short windows per day to transit the access channel due to tidal restrictions, placing further restrictions on mobilisation from Darwin. Other large support vessels are also potentially available in Dampier and would require approximately 48 hours to transit to Broome and complete mobilisation there. Therefore, up to 48 hours is required for mobilisation activities in Broome or Darwin for large support vessels. The only identified method to further improve the speed of a vessel-based response would be to have additional vessels on stand-by pre-loaded with spill response equipment.	Implementing a faster vessel-based response may provide an environmental benefit, by preventing the oiling of some animals at offshore/remote shorelines. However, based on the assessment, due to excessive costs, and wide range of vessel types and equipment types that may be required, it is not considered ALARP to maintain a dedicated vessel with a suite of spill response equipment offshore at all times. If poor weather conditions are limiting vessel-based responses, these same weather conditions would also be significantly increasing surface oil entrainment of diesel spills, reducing volumes of oil ashore. High wave energy on shorelines will also assist in increasing natural weathering of any oil on shorelines.

Oil spill response control [minimum implementation time]	Can a greater response effort be implemented?	Can the time to respond be improved?	Environmental benefit of increased response effort/reduced response time
		The various spill response equipment stockpiles in Darwin and Broome require regular maintenance, testing and checking and therefore can't be permanently stored and maintained on board a vessel. In addition, there may be an operational requirement to have specific equipment from the stockpiles mobilised to different locations on different types of vessels, depending on the nature of the spill, receptors at risk and weather conditions at the time. It is not possible (due to space and weight limitations) to store and maintain all potentially required types of equipment offshore, at all times on the URF installation or support vessels in WA-50-L. The cost to maintain a large vessel on stand-by in Broome or Darwin is approximately $20,000 per vessel per day. Any vessel would still need to wait for wharf space to become available, to load the relevant response equipment and personnel, then depart for the spill location. The additional cost is not considered reasonable, given that the response time would only be reduced by perhaps 12 to 24 hours. URF support vessels (and other INPEX offshore vessels) will routinely be transiting between WA-50-L and Broome/Darwin. It should be noted that the relocation of equipment stockpiles from their storage facilities in Broome/Darwin to the wharf will not result in any additional time, as the positioning of this equipment on the wharf would occur whilst the support vessel is in transit/alongside in Broome or Darwin.	
Containment and recovery equipment [One set of offshore boom and skimmer available at AMOSC Broome stockpile. Additional equipment at Darwin stockpiles. Equipment available to mobilise at Broome/Darwin wharf onto large support vessel within 48 hours].	The first large support vessel to arrive in Broome can be loaded with the offshore rated boom and skimmer from the AMOSC Broome stockpile. Additional large support vessels, likely mobilising from Darwin or Dampier could be loaded with offshore boom/skimmers from stockpiles located at those locations. This additional equipment is available to access via the AMOS Plan. Alternatively, this equipment could be road-freighted from other NW WA stockpiles to Broome, if required. Therefore, there is no significant equipment limitation to mounting a contain and recover response.	Vessel mobilisation times and their limitations have been discussed above. Vessel mobilisation timeframes are the limiting factor in relation to mobilising contain and recovery equipment to remote locations. The various URF support vessels will be on rotation between the licence area and Broome throughout the activity. If equipment were to be stored on URF support vessels offshore, all vessels would then need to be continually transferring/rotating this equipment, if it was to remain on support vessels in WA-50-L. Contain and recovery boom/skimmers could be maintained on the FPSO. However, the space which was allocated for spill response equipment has been taken by the dispersant stockpile, as this was deemed a more reliable first strike response strategy against HFO spills in WA-50-L. It is not considered practicable to maintain dedicated vessels with booms and skimmers and trained personnel offshore in WA-50-L in order to improve the time to respond in the event of a spill.	There are costs associated with purchase, maintenance and storage of contain and recover equipment offshore. The costs far outweigh the benefits when compared to other response strategies that can be implemented faster and have a greater likelihood of success, such as vessel-based dispersant. As such, maintaining contain and recovery equipment offshore is not considered ALARP.

Oil spill response control [minimum implementation time]	Can a greater response effort be implemented?	Can the time to respond be improved?	Environmental benefit of increased response effort/reduced response time
Contain and recover personnel - Contain and recovery response experts would be provided by AMOSC Core-Group. Additional deck crew always present onboard support vessels. [A minimum of 2 AMOSC core-group personnel would be ready to mobilise onto a large support vessel in Broome/Darwin, within 48 hours]	Offshore support vessel deck crews are highly trained in deck operations. As such, only one AMOSC core-group member per vessel would be required to oversee the contain and recovery activity and provide instruction to the vessel crews. Additional AMOSC Core-Group personnel trained in contain and recovery are available upon request through AMOSC.	Vessel mobilisation times and their limitations have been discussed above. Vessel mobilisation timeframes are the limiting factor in relation to mobilising contain and recovery activities. Additional trained contain and recovery personnel could be positioned on stand-by in Broome/Darwin, or offshore. However, as personnel can be mobilised from around Australia to Broome/Darwin in a similar timeframe as vessels can be mobilised to these ports, this is not considered to be necessary.	AMOSC Core-Group personnel are available to mobilise to Broome/Darwin within the vessel mobilisation window. Therefore, this response capability is considered ALARP and no additional environmental benefit can be achieved by increasing this capability.
Vessel-based dispersant application capability [Vessel loaded with 16 m^3 of dispersant and spray equipment and trained personnel within 5 hours in WA-50-L].	In WA-50-L, a stockpile of 16 m^3 of Slickgone NS dispersant and a mobile AFEDO dispersant spray system and dispersant trained personnel are maintained on the FPSO. This equipment and personnel can be mobilised onto any available support vessel located nearby (such as an URF support vessel). INPEX operated support vessels (offtake support vessel and 2 x platform supply vessel) are also equipped with their own dispersant spray systems. These vessels maintain personnel onboard at all times, who are trained in the use of their vessel specific dispersant spray system. The 16 m^3 dispersant stockpile can be deployed to any of these vessels in WA-50-L. This infield capability has been assessed to be sufficient during the first 24 hours of a response and is considered to be sufficient, and resupply of dispersant can be activated initially through the AMOSC Broome stockpile, then additional AMOSC/AMSA stockpiles around Australia. In addition, Shell's Prelude FLNG (located nearby the Ichthys Field) is supported by tugs which are equipped with dispersant stocks, spray equipment and trained personnel. This capability can be activated formally via request through the AMOS-Plan. If a greater vessel based dispersant response is required, small or large support vessels can be mobilised from Broome/Darwin and can utilise the dispersant spray equipment and dispersant stockpiles at those locations. Therefore, if required, a greater response effort can be implemented 24/48 hours after the first strike dispersant capability is activated in WA-50-L.	In the event of a spill which is amenable to dispersant application, dispersant and a mobile spray system (if required) can be transferred (i.e. crane lifted from FPSO) to the support vessel within 3 hours. Set-up on board i.e. decant dispersant and configure spray booms would take up to 2 hours, allowing vessel based dispersant application to commence within 5 hours. h A dedicated spill response vessel loaded with dispersant and spray equipment could theoretically be maintained in WA-50-L at all times. However, the existing arrangements provide for a very rapid first strike response, and therefore the costs associated with a dedicated spill response vessel is not considered ALARP.	A suitable first strike quantify of dispersant, equipment and trained personnel has been established in the Ichthys Field, which is available to respond to a HFO spill from the activity in a rapid manner. Additional capability can be rapidly mobilised. Therefore, no significant environmental benefits can be achieved through improving the offshore dispersant capability.
Fixed wing aerial dispersant (FWAD) capability [FWAD capability mobilised to a Kimberley air-base within 24 hours of activation]	Primary FWAD aircraft (crop-dusters) are available 24 hours a day, seven days a week and will be 'wheels up' (mobilised from their primary airport) within 4 hours of activation. FWAD require a sealed runway with the necessary lighting for night time operations. Lombardina and Mungalalu Truscott Airports are the largest all-weather airports closest to the Browse Basin and are the most likely bases from which to launch a FWAD response. Personnel required to support the FWAD response (as defined in the FWAD Joint Standard Operating Procedures (AMSA 2015c) would be required to be drawn through AMSA and AMOSC and would require up to 24 hours to mobilise to the selected air-base. A suitable search and rescue platform must be available before any FWAD response can be implemented. It can be an aircraft or vessel on standby near the proposed location of dispersant application. The INPEX SAR helicopter (24/7 on call), or a large support vessel could undertake the SAR tasking.	To increase FWAD aircraft availability, additional aircraft could be positioned at Broome. However, given the dispersant spray aircraft can be rapidly mobilised from Batchelor to the likely nominated airfield (Lombardina or Mungalalu Truscott Airport), the costs of maintaining additional FWAD aircraft in Broome are not considered ALARP. There is one industry owned dispersant stockpile (accessible via AMOS-Plan) at Mungalalu Truscott Airport. Additional stockpiles are in Darwin, Broome and Exmouth. They can be mobilised to the nominated airbase by air or road. Therefore, dispersant stockpiles are not limiting the response timeframe. INPEX SAR helicopter or any available support vessel can fulfil the role of SAR platform at the response location and are not limiting the response time.	With the provision of multiple vessel-based dispersant spray options available within the first 24 hours (and typically be able to respond with 5 hours), the cost associated with increasing the overall capability/availability of FWAD arrangements is not considered ALARP.

Oil spill response control [minimum implementation time]	Can a greater response effort be implemented?	Can the time to respond be improved?	Environmental benefit of increased response effort/reduced response time
		A key control and contractual requirement of the FWAD JSOP (AMSA 2015c) is the provision of an Air Attack Supervisor, to ensure dispersant is correctly applied to the spill. Incorrect air attack supervision could potentially result in dispersant contamination of the ocean, without any effect on the spill. AMOSC have confirmed that Air Attack Supervisors are government personnel, generally sourced from the various fire-emergency services department throughout Australia. This select group of personnel maintain their skill-set through ongoing real-life fire/other emergency air attack activities (e.g. bushfire water-bombing operations). There are no industry trained Air Attack Supervisors because of the limited opportunities for personnel to be trained and to maintain this skill set and it is therefore appropriate that government trained personnel are utilised and sourced by AMSA/AMOSC during an oil spill incident in support of FWAD operations. There are no realistic opportunities for full-time industry personnel to be trained and maintain this skill set, in comparison to government personnel whose primary job is to conduct the Air Attack Supervisor role, hence the industry reliance on government support for all FWAD operations. As these Air Attack Supervisor personnel are located throughout Australia, it will generally take approximately 24 hours to mobilise an Air Attack Supervisor to the FWAD nominated airfield. Therefore, there is no additional operation to improve this response timeframe.	
Light utility helicopter – use of a light utility helicopter suitable for landing on remote shorelines for OWR and shoreline clean-up. Available under INPEX aviation call-off arrangements. [Commence mobilisation activities in Broome within 7 days]	Using a BK-117, H-135 or H-145 light utility helicopter, the helicopter's maximum capacity is two pilots transporting six passengers. The use of additional utility helicopters would enable more responders to access the affected location. However, this will require additional helicopter landing pads/locations to accommodate the helicopter overnight. To mobilise and maintain a second light utility helicopter offshore, a very large support vessel equipped with a helicopter pad would be required. The costs associated with this large support vessel and second helicopter would be in excess of $100,000 per day. Under a worst credible scenario, only a single remote shoreline operation requiring the use of a light utility helicopter is anticipated.	The minimum requirements for a helicopter to support oil spill response activities at remote shoreline locations are: • capacity to carry at least 6 personnel and their equipment, • ability to be fitted with cargo hooks for the ability to sling loads (i.e. equipment/waste) between the shoreline and nearby support vessels. • long range fuel tanks due to the distance offshore • twin engines • life raft, satellite tracking and other safety systems Under the International Civil Aviation Organization (ICAO) Annex 6 Civil Aviation Safety Regulation (CASR) 133, transport category helicopters with a seating capacity of >19 must be operated under Performance Class 1 or Category A. Therefore, crew transfer helicopters, including the search and rescue (SAR) helicopter, are not available for shoreline oil spill response support activities. In addition, whilst the Sikorsky S-92s used for INPEX crew changes meet some of the criteria e.g. personnel capacity, twin engines and long-range fuel tanks required to access remote areas.	The ability to transport additional people and equipment using additional helicopters can enable quicker ramp up of the workforce and faster rate / capacity of the response, if sea-state is limiting vessel response capabilities. A faster mobilisation of a utility helicopter may result in a quicker commencement of shoreline response activities. However, under circumstances where helicopter mobilisation times may be restrictive, vessel-based shoreline responses can be mounted within a few days. If poor weather conditions are limiting vessel-based responses, these same weather conditions would also be significantly increasing the entrainment (diesel) or weathering (HFO) of any surface oil, reducing volumes of oil ashore and increasing natural weathering of any oil on shorelines. Therefore, the additional cost of maintaining a helicopter on stand-by for faster mobilisation is not considered to be ALARP, even if the costs were shared with another near-by operator.

Oil spill response control [minimum implementation time]	Can a greater response effort be implemented?	Can the time to respond be improved?	Environmental benefit of increased response effort/reduced response time
		However, they do not have the capability to sling equipment as they cannot be configured with cargo hooks. In addition, because of the size of the helicopter the downwash generated is in excess of 125 km/h and landing on unprepared sites can cause “brownout” conditions which can restrict visibility due to the recirculation effect of the rotor downwash. Therefore, these helicopters are not deemed suitable for remote shoreline operations. Smaller helicopters can be operated under Performance Class 2 or 3 (Category B) and under ICAO Annex 6 CASR 133 and the Civil Aviation Safety Authority (CASA) regulations may be able to land at remote shoreline locations with extreme caution. Under the International Association of Oil and Gas Producers (IOGP) Aircraft Management Guidelines Document 390, INPEX risk assessments, the INPEX Refuelling Handbook and CASA Civil Aviation Advisory Publication (CAAP) 234-1 (2) Para 5.4.2 recommends all aircraft operating under charter should have sufficient fuel to fly to an alternate aerodrome which is not a remote island. For example, for a response at Cartier Island, the closest usable airport would be Truscott/Mungalalu Airbase. The remoteness of other potential shoreline response locations along the WA coastline presents similar challenges. A large support vessel with a helicopter deck could however be considered an alternative landing location to the remote island, assisting in redundancy landing locations for remote helicopter activities. Based on the distance of Cartier Island to Truscott/Mungalalu and the requirement for smaller helicopter types that can land at remote islands, the most suitable twin-engine helicopter types identified were the MBB Kawasaki BK-117 and the Airbus H-135 or H-145 (if fitted with a long-range fuel tank). Small helicopters such as BELL 206, AS350B and EC120 are capable of landing on remote islands with difficult access. However, they have single engines and were ruled out as they do not meet INPEX’s aviation standards for safety, fuel range or have the ability to transport enough people/equipment to implement an effective response. Small helicopters, such as the BK-117 and Airbus H-135 or H-145, are generally working under contract with many configured in an air ambulance role or surf rescue role. The market for surplus available aircraft around Australia is therefore limited and the response time cannot be guaranteed.	

Oil spill response control [minimum implementation time]	Can a greater response effort be implemented?	Can the time to respond be improved?	Environmental benefit of increased response effort/reduced response time
		The response implementation time could be improved to <7 days if a BK-117, H-135 or a long-range H-145 helicopter was positioned, on standby in Broome or Darwin on a permanent basis. The high cost (estimated at AUD $1.5–2.0 million per year) of maintaining this capability, including the hire of the aircraft, pilots on standby, reoccurring training and maintenance of the aircraft, is considered to be grossly disproportionate to the environmental benefit gained. This is because the spill (and resulting offshore impacts) has already occurred and pre-contact wildlife hazing or translocation at a shoreline has a low likelihood of significant impact reduction. It is not expected that a significant improvement for the environment would be achieved if post-contact wildlife response or shoreline clean-up commenced within the first 7 days or whether it occurs from day 7 onwards. Other arrangements to get people and equipment on to remote shorelines to undertake oil spill response activities, without the use of a helicopter, have been considered. Vessel access to remote shorelines such as at Browse Island or Cartier Island can be achieved (noting some weather/met-ocean potential limitations). Vessel based response timings are discussed above. It should be noted that if heavy sea conditions were restricting vessel access, this same wave action would be increasing the natural break-up and weathering of oil at sea and on shorelines.	
INPEX crew-change helicopters, to provide crew rotation for remote shoreline response activities [INPEX crew-change helicopters always available]	INPEX maintain a contract with a helicopter provider, to provide a fleet of crew-change helicopters for routine operations. This fleet of helicopters would be utilised to facilitate crew-change for oil spill response activities at remote locations. If additional crew-change helicopters are required above the standard fleet already maintained in Broome, additional aircraft can be arranged through the helicopter provider.	There is no requirement to increase the speed at which routine crew-change of spill responders at remote locations occurs.	The existing crew-change helicopter fleet will be suitable for managing crew-change of spill responders.
Oiled wildlife response personnel – The Oiled Wildlife Division Coordinator and Oiled Wildlife Advisor role, within an IMT, would be provided by the WA DBCA for WA shoreline responses. If, however the response was at an Australian commonwealth island such as Ashmore or Cartier, the AMOSC core-group OWR trained personnel could undertake this role within the IMT. In the field, the OWR team would be led by the relevant personnel from WA DBCA supported by the AMOSC OWR Team.	There is an appropriate limit to the number of personnel that should be put ashore during shoreline response in a sensitive location, to avoid additional impacts, e.g. trampling of turtle nests and disturbance to bird feeding/roosting/nesting behaviours. In general, to reduce wildlife disturbance on small, offshore remote locations, a longer duration response with minimum numbers is desired. The areas of potential shoreline impacted are remote and therefore, numbers of responders are also limited by accommodation and logistics support. For offshore islands with the ability for helicopters to safely land, it is estimated that up to 24 personnel could work onshore on a single day, based on one utility helicopter conducting the daily transits to and from shore. Similar numbers would be expected using small boats for shoreline access. However, it should be noted that personnel numbers are not constrained, as INPEX's arrangements with contracted labour hire and other industry capability (e.g. AMOSC) provides access to additional personnel if required. While multiple shorelines may be assessed (to confirm presence/ absence of shoreline oiling/oiled wildlife), only a single offshore remote island/shoreline is envisaged requiring a large oiled wildlife response, even for a worst credible spill scenario.	As oiled wildlife response will most likely be undertaken on a shoreline, the Control Agency will most likely be the WA DoT. The key oiled wildlife specialists (i.e. WA DBCA oiled wildlife advisers and associated field responders, acting on behalf of the relevant Control Agency) are likely to mobilise with an oiled wildlife response activity. Personnel from these government agencies are living/working in Darwin and Broome, and therefore their mobilisation should not limit mobilisation timeframes. Additional trained OWR trained personnel could be positioned on stand-by in Broome/Darwin. However, as personnel can be mobilised from around Australia to Broome/Darwin in a similar timeframe as which vessels can be mobilised to these ports, this is not considered to be reasonable given the high cost and low likelihood of needing to implement an oiled wildlife response.	Given the limited likelihood and predicted time to shoreline contact, expected weathering of oil, limited volumes ashore, the rapid mobilisation of a larger OWR team would be unlikely to results in a significant tangible environmental benefit. Also, there are additional risks of wildlife disturbance associated with mobilising large wildlife response teams to small, remote offshore locations.

Oil spill response control [minimum implementation time]	Can a greater response effort be implemented?	Can the time to respond be improved?	Environmental benefit of increased response effort/reduced response time
Trained OWR personnel are available through the Oiled Wildlife Rehabilitators Network (approximately 100 personnel), and Philip Island Nature Park (approximately 100 personnel). INPEX could provide additional personnel via INPEX Master Service Agreement with Environmental Service Providers, or other labour hire companies. [20 oiled wildlife personnel arrive in Broome/Darwin within 24 hours]			
Oiled wildlife response kits, including the kit in Broome can be mobilised from the AMOSC Broome stockpile to a support vessel alongside in Broome. [OWR kit mobilised onboard a support vessel in Broome within 24 hours]	INPEX could purchase additional OWR kits/containers however as response planning indicates that OWR centres are most likely to be set up 'on-water', the number of centres is limited to the number of shorelines requiring the OWR centre. Only a single 'on water' OWR centre is envisaged, even for a worst credible spill scenario. Additional OWR kits are available around Australia, accessed via the Nat Plan. In addition, the types of equipment contained in the OWR kits onshore is equipment that is typically maintained and available as part of routine supplies on support vessels, and therefore resupply or bulking of stocks of OWR kits at an 'on-water' centre should not present a limitation to the response capability.	AMOSC OWR kits are present in Broome and are available to be deployed. This response cannot be implemented faster, without maintaining an OWR kit and associated trained personnel onboard a support vessel, offshore at all times. This is not considered reasonable given the high cost and impracticality compared to the low likelihood of needing an oiled wildlife response. Also, the trained personnel, such as veterinarians, would not be able to maintain their training/skills, if based offshore at all times.	Response planning indicates that a single 'on water' OWR centre would be appropriate, with additional 'on water' centres and the associated people and transport logistics not required, even under worst case scenarios. Maintaining an OWR kit and associated trained personnel offshore, to increase the speed of the response is not considered practicable nor ALARP.
Vessel-based wildlife hazing equipment including vessels and vessel fog horns/water cannons. [equipment available to mobilise and depart from Broome within 48 hours for large support vessel; within 24 hours for small support vessel]	Other equipment could be purchased such as bird scarers however vessel fog horns/water cannons will achieve the same result, of locally dispersing fauna from an immediate location (however this may just result in moving the wildlife to another location of the slick). Increasing the number of vessels may result in greater effectiveness of wildlife hazing, if a geographically appropriate location for hazing was identified. INPEX has a range of vessels it can mobilise for the purpose via vessel call-off contracts. These also include access to other vessels supporting other operations in the area.	Response times are dependent on the spill location, vessel mobilisation times and vessel transit times, as described above in vessel response.	Implementing a faster or greater wildlife hazing response may assist in preventing oiling of wildlife. However, given there are many limitations to the success of wildlife hazing, detailed in Strategic SIMA, more rapid or greater provision of vessel numbers or mobilisation timeframes compared to that provided is not considered reasonable.
Protect and deflect equipment [Shoreline booming equipment available at AMOSC Broome stockpile and Darwin stockpiles - available to mobilise onto vessels; 48 hours for large support vessel; within 24 hours for small support vessel].	As discussed in Table 8-10, protect and deflect activities are highly unlikely to be an appropriate response strategy at offshore islands in the Browse Basin. Therefore, maintaining large stockpiles of protect and deflect equipment is not considered appropriate.	Vessel mobilisation times and their limitations have been discussed above. Vessel mobilisation timeframes are the limiting factor in relation to mobilising protect and deflect equipment to remote locations.	Due to the types of shorelines that may be impacted (i.e. offshore, high energy beaches / intertidal reef platforms), protect and deflect would under most circumstances, not be considered to result in a positive environmental outcome during the initial spill response. Therefore, maintaining additional stockpiles of shoreline booming equipment is not considered ALARP.

Oil spill response control [minimum implementation time]	Can a greater response effort be implemented?	Can the time to respond be improved?	Environmental benefit of increased response effort/reduced response time
Shoreline clean-up manual cleaning equipment can be mobilised from the Broome/Darwin stockpiles to a support vessel alongside in Broome/Darwin Port or to other remote mainland locations. [Shoreline clean-up equipment immediately available to mobilise to wharf from Broome/Darwin stockpiles] WA DoT shoreline response kits can be mobilised, if requested by WA DoT. [WA DoT shoreline response kits available to mobilise to Broome from Karratha, Perth or Albany, when requested by WA DoT]	Machinery such as graders could be used to potentially assist with shoreline clean-up, however this often creates a larger volume of oily contaminated sands to be removed. In addition, heavy machinery could damage sensitive turtle nesting habitat, disturb other wildlife and may not be accessible for remote offshore islands. Therefore, response equipment will almost certainly be limited to hand-held equipment, which results in less disturbance when conducting a clean-up operation. Consequently, increasing response effort is limited to increasing numbers of personnel and manual cleaning equipment (shovels etc.). Sufficient equipment is considered available within existing stockpiles. Additional manual clean-up equipment can be purchased at retail outlets, as required in Broome or Darwin.	Manual cleaning equipment can be mobilised to the wharf from the Broome/Darwin stockpiles in 6 hours. Any improvement on this is not warranted as the vessels will not be ready in a shorter duration of time. WA DoT have selected the storage locations of their shoreline response kits (Karratha, Perth and Albany), based on their own requirements.	There is no environmental benefit to utilising heavy machinery for shoreline clean-up. Manual clean-up equipment is readily available and will not limit response time.
Protect and deflect/shoreline clean-up trained personnel - WA DoT may choose to provide their own trained SCAT assessment and initial shoreline clean-up personnel. Response experts would be provided by AMOSC core-group. Additional labour would be provided by INPEX. [A minimum of 20 personnel would be ready to mobilise onto a support vessel in Broome/Darwin within 24 hours]	Increasing the number of protect and deflect/shoreline clean-up personnel can increase the rate at which oil is collected/removed from a shoreline. Personnel numbers can be increased as required to respond to the specific spill scenario and therefore numbers are not constrained. However, personnel numbers onshore will be limited by a range of external factors. There is an appropriate limit to the number of personnel that should be put ashore during shoreline response in a sensitive location, to avoid additional impacts, e.g. trampling of turtle nests and disturbance to bird feeding/roosting/nesting behaviours. In general, to reduce wildlife disturbance on small, offshore remote locations, a longer duration response with minimum numbers is desired. If vessels are used for access, sea-state and tides can prevent shore-landings. However, if sea-state and tides are forecast to be good for shore-landings, larger groups can mobilise. If a light utility helicopter is used for shoreline clean-up, sea-state and tidal access issues are eliminated and up to 24 personnel could work ashore in any single day (based on helicopter pilot duty hour limitations). Additional personnel could be transferred using small vessels (sea-state permitting). While multiple shorelines may be assessed (to confirm presence/absence of shoreline oiling), only a single remote island/shoreline is envisaged requiring a large shoreline response, even for a worst credible spill scenario.	Additional trained shoreline clean-up personnel could be positioned on stand-by in Broome/Darwin. However, as personnel can be mobilised from around Australia to Broome/Darwin in a similar timeframe as vessels can be mobilised to these ports, this is not considered to be reasonable given the high cost and low likelihood of needing to implement a shoreline clean-up response.	Due to the labour hire arrangements INPEX has in place, personnel numbers are not limited. It is therefore, vessels and helicopters, and environmental considerations that will limit this response capacity. Given the arrangements in place, to mobilise within 24 hours, the key trained personnel (AMOSC core-group members) required to lead a shoreline clean-up, the benefits of a slightly faster response by maintaining these trained personnel in Broome/Darwin are not considered reasonable given the high associated financial costs. Also, there are additional risks of wildlife disturbance associated with mobilising large shoreline clean-up teams to small, remote offshore locations.
Waste management contract enables access to sufficient waste receptacles to be provided to meet the first response vessel. [Immediately available to commence mobilisation to wharf through INPEX waste management contractors in Broome/Darwin]	No greater response effort can be obtained as the waste contract allows for immediate delivery of waste receptacles to be mobilised offshore, when requested by INPEX. Based on the estimated worst-case volume of oil accumulated on shorelines (246.7 m^3) and a bulking factor for waste created of 10:1 it is estimated that approximately 2500 m^3 of waste could be generated. Shoreline clean-up waste would likely be captured in bulka-bags and 1 m^3 Intermediate Bulk Containers (IBCs). Therefore approximately 2500 m^3 of bulka-bag/IBC waste capacity would be required, over the full duration (weeks) of any shoreline clean-up. There are no limitations to obtaining this waste storage capacity and no benefit obtained by accessing additional waste storage capacity.	n/a	No additional environmental benefits have been identified.

Oil spill response control [minimum implementation time]	Can a greater response effort be implemented?	Can the time to respond be improved?	Environmental benefit of increased response effort/reduced response time
	Recovered oil from the sea surface during contain/recover operations would also be generated. Storage of liquid oily waste would generally be in the inboard storage tanks of the support vessel, or on specially mobilised storage tanks on the decks of vessels. This would be disposed of at an onshore facility.		

* All timings are based on the assumption that the spill occurs, and response is implemented in daylight hours where visibility is critical for successful implementation.

8.6 Oil spill response strategies

As identified in the SIMA (Appendix E) not all response strategies are appropriate for every hydrocarbon spill, and as discussed in Table 8-10, not all response strategies are appropriate for the specific spill scenarios associated with the activity. Different types of hydrocarbon, spill locations and spill volumes require different response strategies, or combinations of techniques, to implement an effective response.

Based on the SIMA and subsequent evaluations (Table 8-10), INPEX has identified a set of primary and secondary response strategies to reduce the impacts and risks of hydrocarbon spills from the petroleum activity to ALARP. However, the deployment of response strategies has the potential to introduce further impacts and risks.

8.6.1 Primary response strategy

Operational monitoring and evaluation has been determined as the only appropriate primary (first strike) response measure for all hydrocarbon spills. This involves surveillance and reconnaissance, using vessels, aircraft, satellite imagery and satellite tracking buoys to monitor the size, trajectory, weathering and fate of the hydrocarbon spill.

The information obtained through the surveillance and reconnaissance program will inform spill modelling and the development of IAPs, which will include consideration of the use of secondary response strategies, as identified in the SIMA.

8.6.2 Secondary response strategy

The following secondary response strategies have been determined as potentially applicable (depending on hydrocarbon type). An impact and risk evaluation for the implementation of these response strategies is presented in Table 8-13.

Table 8-13: Impact and risk evaluation – implementation of response strategies

Identify hazards and threats
Primary response strategy – monitoring and evaluation. Routine sewage effluent, grey water and food waste discharges from vessels used in oil spill response, when located close to shorelines (such as turtle and marine avifauna breeding rookeries), could result in the exposure of EPBC-listed species to untreated/non-macerated discharges. Accidental release of waste overboard as a result of inappropriate management may result in impacts to marine fauna through entanglement or ingestion of waste material, with the potential to result in injury. Inappropriate waste management also has the potential to expose marine flora and fauna to changes in water quality and may result in reduced ecosystem productivity or diversity. The physical presence of vessels used in the response strategy has the potential for vessel-to-vessel collisions. **Secondary response strategy – pre-contact wildlife response.** Routine sewage effluent, grey water and food waste discharges from vessels used in oil spill response, when located close to shorelines (such as turtle and marine avifauna breeding rookeries), could result in the exposure of EPBC-listed species to untreated/non-macerated discharges. Accidental release of waste overboard as a result of inappropriate management may result in impacts to marine fauna through entanglement or ingestion of waste material, with the potential to result in injury. Inappropriate waste management also has the potential to expose marine flora and fauna to changes in water quality and may result in reduced ecosystem productivity or diversity. The physical presence of vessels used in the response strategy has the potential for vessel-to-vessel collisions. Poorly implemented wildlife response has the potential to cause stress or suffering to wildlife impacted by a spill. **Secondary response strategies –post-contact wildlife response.** Routine sewage effluent, grey water and food waste discharges from vessels used in oil spill response, when located close to shorelines (such as turtle and marine avifauna breeding rookeries), could result in the exposure of EPBC-listed species to untreated/non-macerated discharges. Accidental release of waste overboard as a result of inappropriate management may result in impacts to marine fauna through entanglement or ingestion of waste material, with the potential to result in injury. Inappropriate waste management also has the potential to expose marine flora and fauna to changes in water quality and may result in reduced ecosystem productivity or diversity. The physical presence of vessels used in the response strategy has the potential for vessel-to-vessel collisions. Capture, cleaning and rehabilitation of oiled wildlife has the potential to create additional stress to animals. The movement of equipment and personnel onto offshore islands has the potential to introduce terrestrial exotic pests, including rats. The movement of personnel and equipment onto offshore islands has the potential to disturb turtle nests and turtle-nesting activities. **Secondary response strategy – shoreline clean-up.** Routine sewage effluent, grey water and food waste discharges from vessels used in oil spill response, when located close to shorelines (such as turtle and marine avifauna breeding rookeries), could result in the exposure of EPBC-listed species to untreated/non-macerated discharges.

Accidental release of waste overboard as a result of inappropriate management may result in impacts to marine fauna through entanglement or ingestion of waste material, with the potential to result in injury. Inappropriate waste management also has the potential to expose marine flora and fauna to changes in water quality and may result in reduced ecosystem productivity or diversity. The physical presence of vessels used in the response strategy has the potential for vessel-to-vessel collisions. The movement of equipment and personnel onto offshore islands has the potential to introduce terrestrial exotic pests, including rats. The movement of personnel and equipment onto offshore islands has the potential to disturb turtle nests and turtle-nesting activities. Incorrect management of hydrocarbon-contaminated wastes generated during shoreline clean-up has the potential to create additional contamination of the shoreline. **Secondary response strategy – contain and recover/protect and deflect.** Routine sewage effluent, grey water and food waste discharges from vessels used in oil spill response, when located close to shorelines (such as turtle and marine avifauna breeding rookeries), could result in the exposure of EPBC-listed species to untreated/non-macerated discharges. Accidental release of waste overboard as a result of inappropriate management may result in impacts to marine fauna through entanglement or ingestion of waste material, with the potential to result in injury. Inappropriate waste management also has the potential to expose marine flora and fauna to changes in water quality and may result in reduced ecosystem productivity or diversity. The physical presence of vessels used in the response strategy has the potential for vessel-to-vessel collisions. The movement of equipment and personnel onto offshore islands has the potential to introduce terrestrial exotic pests, including rats. The movement of personnel and equipment on offshore islands has the potential to disturb turtle nests and turtle-nesting activities. The movement/anchoring of shoreline protection booms on offshore islands has the potential to physically damage intertidal reefs. **Secondary response strategy – aerial and/or vessel-based dispersant** Routine sewage effluent, grey water and food waste discharges from vessels used in oil spill response, when located close to shorelines (such as turtle and marine avifauna breeding rookeries), could result in the exposure of EPBC-listed species to untreated/non-macerated discharges. Accidental release of waste overboard as a result of inappropriate management may result in impacts to marine fauna through entanglement or ingestion of waste material, with the potential to result in injury. Inappropriate waste management also has the potential to expose marine flora and fauna to changes in water quality and may result in reduced ecosystem productivity or diversity. The physical presence of vessels used in the response strategy has the potential for vessel-to-vessel collisions. Reduced water quality and toxicity to marine flora and fauna from dispersant and dispersed hydrocarbons in the water column. Increased concentrations of entrained hydrocarbons within the water column, potentially contacting submerged sensitive receptors.	
Potential consequence: Primary response strategy – monitoring and evaluation	**Severity**

The values and sensitivities with the potential to be impacted are transient, EPBC-listed species (marine fauna including foraging BIAs). Monitoring and evaluation does not provide any material changes to the trajectory of the spill. Instead, it provides critical information on the fate, nature and weathering of the spill, as a result of exposure to natural biological and physical degradation processes. The strategy can be used to inform other response strategies and emergency response priorities. Since this strategy does not provide any material changes to the trajectory of the spill, the inherent impacts of the hydrocarbon on marine fauna in the trajectory of the spill will remain until natural degradation/weathering reduces the impacts of the spill. Due to the types of small vessels which may support an oil spill response, all vessels may not be fitted with sewage disinfection systems, sewage macerators or food macerators. Therefore, EPBC-listed species, such as marine turtles and marine avifauna may be exposed to untreated sewage, grey water and food scraps, particularly when response vessels are conducting activities near breeding rookeries, such as Browse Island, Cartier Island and Scott Reef. The duration of any exposure is likely to be limited to between a few days and a number of weeks, depending on the duration of the oil spill response activity. Due to the local currents and deep offshore waters surrounding these offshore islands, and higher currents around nearshore waters of WA coastlines, any temporary changes to water quality that may occur are expected to be short term and localised and are therefore considered to be Insignificant (F). Various conservation management plans (refer to Appendix B) identify inappropriate waste management as a key threatening process to the recovery of EPBC-listed species. Inappropriate storage and handling of solid and liquid wastes generated through routine operations during an oil spill response could result in impacts to individuals of transient, EPBC-listed species, resulting in isolated and localised impacts only. Therefore, the consequence is considered to be Insignificant (F). The physical presence of vessels during the implementation of this response strategy has the potential to increase the risk of a vessel-to-vessel collision. The consequences of a vessel collision are discussed in Table 8-6.	Insignificant (F)
Potential consequence: Secondary response strategy – pre-contact wildlife response (wildlife hazing)	**Severity**
The values and sensitivities with the potential to be impacted are transient, EPBC-listed species (marine fauna including BIAs associated with turtle and marine avifauna nesting). Due to the types of small vessels which may support an oil spill response, all vessels may not be fitted with sewage disinfection systems, sewage macerators or food macerators. Therefore, EPBC-listed species, such as marine turtles and marine avifauna, may be exposed to untreated sewage, grey water and food scraps, particularly when response vessels are conducting activities near breeding rookeries, such as Browse Island, Cartier Island and Scott Reef. The duration of any exposure is likely to be limited to between a few days and a number of weeks, depending on the duration of the oil spill response activity. Due to the local currents and deep offshore waters surrounding these offshore islands, and higher currents around nearshore waters of WA coastlines, any temporary changes to water quality that may occur are expected to be short term and localised and are therefore considered to be Insignificant (F).	Insignificant (F)

Various conservation management plans (refer to Appendix B) identify inappropriate waste management as a key threatening process to the recovery of EPBC-listed species. Inappropriate storage and handling of solid and liquid wastes generated through routine operations during an oil spill response could result in impacts to individuals of transient, EPBC-listed species, resulting in isolated and localised impacts only. Therefore, the consequence is considered to be Insignificant (F). The physical presence of vessels during implementation of this response strategy has the potential to increase the risk of a vessel-to-vessel collision. The consequences of a vessel collision are discussed in Table 8-6. A wildlife response strategy can increase the survival of wildlife potentially affected by a spill (particularly seabirds, marine mammals and reptiles in transit) by encouraging wildlife to move away from the location of the spill (IPIECA 2017b). There may be potential for increased stress to wildlife individuals subjected to hazing activities, or the potential to cause wildlife to move into the area affected by the spill from poorly implemented hazing activities (IPIECA 2017b). Therefore, any potential impacts would be only to individuals of a population, and as the activity is being undertaken to reduce impacts, the impact is considered Insignificant (F).	
Potential consequence: Secondary response strategy – pre-contact (translocation) and post-contact wildlife response	**Severity**
The values and sensitivities with the potential to be impacted are transient, EPBC-listed species (turtles and marine avifauna). Due to the types of small vessels which may support an oil spill response, all vessels may not be fitted with sewage disinfection systems, sewage macerators or food macerators. Therefore, EPBC-listed species, such as marine turtles and marine avifauna may be exposed to untreated sewage, grey water and food scraps, particularly when response vessels are conducting activities near breeding rookeries, such as Browse Island, Cartier Island and Scott Reef. The duration of any exposure is likely to be limited to between a few days and a number of weeks, depending on the duration of the oil spill response activity. Due to the local currents and deep offshore waters surrounding these offshore islands, and higher currents around nearshore waters of WA coastlines, any temporary changes to water quality that may occur are expected to be short term and localised and are therefore considered to be Insignificant (F). Various conservation management plans (refer to Appendix B) identify inappropriate waste management as a key threatening process to the recovery of EPBC-listed species. Inappropriate storage and handling of solid and liquid wastes generated through routine operations during an oil spill response could result in impacts to individuals of transient, EPBC-listed species, resulting in isolated and localised impacts only. Therefore, the consequence is considered to be Insignificant (F). The physical presence of vessels during implementation of this response strategy has the potential to increase the risk of a vessel-to-vessel collision. The consequences of a vessel collision are discussed in Table 8-6.	Moderate (D)

Pre-contact and post-contact wildlife response (capture, cleaning, relocation and rehabilitation of wildlife) can increase the survival rates of wildlife which may be, or has become, oiled at sea or onshore. There may be a potential for increased stress to some animals during capture, cleaning, relocation and/or rehabilitation (IPIECA 2017b). However, any potential impacts are considered to be of inconsequential ecological significance to protected species, as the capture, relocation cleaning, relocation and/or rehabilitation is conducted to increase survival rates of individuals (Insignificant F). The *Threat abatement plan to reduce the impacts of exotic rodents on biodiversity on Australian offshore islands of less than 100,000 hectares* (DEWHA 2009) identifies that exotic rodents (such as rats) have been a major cause of extinction and decline of island biodiversity. Introduction of rodents to any of the offshore islands in the EMBA could result in a medium-term impact on a population of protected species (Moderate D). Physical presence and movement of personnel across turtle-nesting beaches could potentially cause damage to buried turtle eggs, reducing turtle-nesting success. Artificial light is known to disorientate marine turtles, particularly hatchlings and female adults returning to the sea from nesting areas on the shore (Pendoley 2005). Incorrect management of personnel and equipment on turtle-nesting beaches could result in a minor impact on a small proportion of a turtle-nesting population (Minor E).	
Potential consequence: Secondary response strategy – shoreline clean-up	**Severity**
The values and sensitivities with the potential to be impacted are transient, EPBC-listed species (marine fauna) and marine fauna BIAs in the EMBA (turtles and marine avifauna nesting). Due to the types of small vessels which may support an oil spill response, all vessels may not be fitted with sewage disinfection systems, sewage macerators or food macerators. Therefore, EPBC-listed species, such as marine turtles and marine avifauna may be exposed to untreated sewage, grey water and food scraps, particularly when response vessels are conducting activities near breeding rookeries, such as Browse Island, Cartier Island and Scott Reef. The duration of any exposure is likely to be limited to between a few days and a number of weeks, depending on the duration of the oil spill response activity. Due to the local currents and deep offshore waters surrounding these offshore islands, and higher currents around nearshore waters of WA coastlines, any temporary changes to water quality that may occur are expected to be short term and localised and are therefore considered to be Insignificant (F). Various conservation management plans (refer to Appendix B) identify inappropriate waste management as a key threatening process to the recovery of EPBC-listed species. Inappropriate storage and handling of solid and liquid wastes generated through routine operations during an oil spill response could result in impacts to individuals of transient, EPBC-listed species, resulting in isolated and localised impacts only. Therefore, the consequence is considered to be Insignificant (F). The physical presence of vessels during implementation of this response strategy has the potential to increase the risk of a vessel-to-vessel collision. The consequences of a vessel collision are discussed in Table 8-6. The *Threat abatement plan to reduce the impacts of exotic rodents on biodiversity on Australian offshore islands of less than 100,000 hectares* (DEWHA 2009) identifies that exotic rodents (such as rats) have been a major cause of extinction and decline of island biodiversity. Introduction of rodents to any of the offshore islands in the EMBA could result in a medium-term impact on a population of protected species (Moderate D).	Moderate (D)

Physical presence and movement of personnel across turtle-nesting beaches could potentially cause damage to buried turtle eggs, reducing turtle-nesting success. Artificial light is known to disorientate marine turtles, particularly hatchlings and female adults returning to the sea from nesting areas on the shore (Pendoley 2005). Incorrect management of personnel and equipment on turtle-nesting beaches could result in a minor impact on a small proportion of a turtle-nesting population (Minor E). A shoreline clean-up response will generate a significant quantity of hydrocarbon-contaminated solid waste. Contaminated solids will include personal protective equipment (PPE), spill clean-up equipment (shovels, rakes, etc.) and the oil-contaminated sediments collected from shorelines (IPIECA 2015). Inappropriate management of oil-contaminated waste could result in localised contamination of shoreline sediments and harm to individuals of protected species (Minor E).	
Potential consequence: Secondary response strategy – contain and recover/protect and deflect	**Severity**
Due to the potentially limited availability of suitable oil spill response vessels and short timeframes for mobilisation, oil spill response vessels may not be fitted with sewage disinfection systems, sewage macerators or food macerators. Therefore, transient, EPBC-listed species, such as marine turtles and marine avifauna, may be exposed to untreated sewage, grey water and food scraps, particularly when response vessels are conducting activities near breeding rookeries, such as Ashmore Island, Browse Island, Cartier Island and Scott Reef. The duration of any exposure is likely to be limited, from a few days to weeks, depending on the duration of the oil spill response activity. Due to the local currents and deep offshore waters surrounding these offshore islands, any temporary changes to water quality that may occur are expected to be short-term and localised and are therefore considered to be Insignificant (F). Various conservation management plans (refer Appendix B) identify inappropriate waste management as a key threatening process to the recovery of EPBC-listed species. Inappropriate storage and handling of solid and liquid wastes generated through routine operations during oil spill response could result in impacts to individuals of transient, EPBC-listed species, resulting in isolated, localised, impacts only. Therefore, the consequence is considered to be Insignificant (F). The physical presence of vessels during implementation of this response strategy has the potential to increase the risk of a vessel-to-vessel collision. The consequences of a vessel collision are discussed in Table 8-6. The *Threat abatement plan to reduce the impacts of exotic rodents on biodiversity on Australian offshore islands of less than 100 000 hectares* (DEWHA 2009) identifies that exotic rodents (such as rats) have been a major cause of extinction and decline of island biodiversity. Introduction of rodents to any of the offshore islands in the PEZ could result in a medium-term impact on a population of protected species (Moderate D). Physical presence and movement of personnel across turtle-nesting beaches could potentially cause damage to buried turtle eggs, reducing turtle-nesting success. Artificial light is known to disorientate marine turtles, particularly hatchlings and female adults returning to the sea from nesting areas on the shore (Pendoley, 2005). Incorrect management of personnel and equipment on turtle-nesting beaches could result in a minor impact on a small proportion of a turtle-nesting population (Minor E). The physical presence and movement of shoreline booms/anchors in intertidal environments could potentially cause damage to coral reefs / intertidal ecosystems, resulting in localised, short to medium term damage to these habitats (Minor E).	Moderate (D)

Protect and deflect/contain and recover response activities would generate a significant quantity of hydrocarbon-contaminated solid waste. Contaminated solids would include personal protective equipment (PPE), oil coated booms, skimmers etc. and the oily contaminated liquids and sediments collected during the response activity. Inappropriate management of the oily contaminated waste could result in localised contamination of the marine environment and shoreline sediments resulting in harm to individuals of protected species (Minor E).	
Potential consequence: Secondary response strategy – aerial and/or vessel-based dispersant	**Severity**
The values and sensitivities with the potential to be impacted are: • transient, EPBC-listed species (marine fauna) • benthic communities (submerged reefs and shoals, and seagrasses) • BIAs associated with turtle and marine avifauna nesting. Due to the potentially limited availability of suitable oil spill response vessels and short timeframes for mobilisation, oil spill response vessels may not be fitted with sewage disinfection systems, sewage macerators or food macerators. Therefore, transient, EPBC-listed species, such as marine turtles and marine avifauna may be exposed to untreated sewage, grey water and food scraps, particularly when response vessels are conducting activities near breeding rookeries, such as Ashmore Island, Browse Island, Cartier Island and Scott Reef. The duration of any exposure is likely to be limited, from a few days to weeks, depending on the duration of the oil spill response activity. Due to the local currents and deep offshore waters surrounding these offshore islands, any temporary changes to water quality that may occur are expected to be short-term and localised and are therefore considered to be Insignificant (F). Various conservation management plans (refer Appendix B) identify inappropriate waste management as a key threatening process to the recovery of EPBC-listed species. Inappropriate storage and handling of solid and liquid wastes generated through routine operations during oil spill response could result in impacts to individuals of transient, EPBC-listed species, resulting in isolated, localised, impacts only. Therefore, the consequence is considered to be Insignificant (F). The physical presence of vessels during the implementation of this response strategy has the potential to increase the risk of a vessel-to-vessel collision. The consequences of a vessel collision are discussed in Table 8-6. Applying a dispersant can reduce the amount of hydrocarbon present on the surface of the water column; therefore, reducing the exposure of surface sensitive receptors (such as seabirds and turtles), shorelines and intertidal biota. In addition, reducing the surface expression of the hydrocarbon creates a safer working environment for response personnel and can have benefits to air-breathing fauna. Dispersants have an inherent level of toxicity. Additionally, chemically dispersed hydrocarbons may, in certain instances, have a higher level of toxicity to benthic communities than the hydrocarbons themselves. Dispersant use results in increased entrainment in the water column, increasing the bioavailability of the hydrocarbon potentially impacting subtidal values and sensitivities, particularly in shallow-water environments. Monitoring undertaken after the Montara spill resulted in entrained hydrocarbons concentrating in the top 25 m of the water column (AMSA 2010).	Minor (E)

The distance at which receptors could be impacted by dispersed hydrocarbons has been assessed using the 500 ppb threshold for surface released entrained/dissolved hydrocarbons, presented in Table 8-2. INPEX commissioned a series of dispersant effectiveness modelling simulations for a 1000 m^3 IFO release, at various locations along the Ichthys gas export pipeline route. The modelling used a number of 'worst-case volume of oil ashore' and 'worst-case time/concentration at a receptor' stochastic modelling runs. The dispersant modelling report (RPS APASA 2014b) remodelled the identified worst-case stochastic model runs, with various dispersant treatments (vessel, aerial, or both), and compared 'with dispersant versus without dispersant' outcomes for surface oil concentrations, shoreline contact, and 'entrained/dissolved' concentrations at various receptors. Five of the modelling scenarios resulted in 70 m^3 to 120 m^3 of oil being successfully dispersed, within <2.5 km of a sensitive receptor. Timings ranged from instantaneous contact to a few hours to contact. The increase in entrained/dissolved oil concentrations (due to dispersant application) received at this receptor ranged from 454 ppb to 1607 ppb. These received concentrations are similar too, or up to three times higher, than the 500 ppb impact threshold presented in Table 8-2. In another modelled scenario, 48 m^3 of oil was successfully dispersed, at 12 km from Browse Island. Prevailing wind and current directed this dispersed oil plume directly at Browse Island. The received dispersed oil concentration at Browse Island was 247 ppb, half the concentration of the 500 ppb threshold. In another scenario, 50 m^3 of oil was successfully dispersed, 15 km from Browse Island. The modelled wind and currents resulted in the dispersed oil plume reaching Browse Island in 20 hours. The received concentration was 8.4 ppb, two orders of magnitude below the 500 ppb threshold. These results demonstrate that increasing the distance and/or time for the dispersed oil to reach a receptor results in a significant decrease in received entrained/dissolved oil concentrations at the receptor. Based on the conclusions of RPS APASA (2014b), the INPEX dispersant application decision matrix (Section 4.5.4 and Table 4-8 of the OPEP, Appendix D), incorporates a highly conservative no dispersant application buffer of 20 km around any wholly submerged feature. Dispersant application closer than 20 km to intertidal reefs or islands can occur, in consultation with relevant state/territory agencies, provided the Operational SIMA demonstrates a net environmental benefit is anticipated. The closest submerged shoals to the Ichthys Field are Echuca and Heywood shoals, 79 km and 96 km away, respectively (Section 4.8.2). They have average depths of 26 m and 33 m, respectively, and Browse Island has submerged and intertidal habitat (concentrated in a shallow, subtidal zone <20 m depth). Dispersant sprayed on the sea surface close to these sensitive receptors may result in additional impacts to submerged/intertidal habitats. The degree of impact associated with the toxicity of the dispersant and dispersed hydrocarbon is, however, dependent on the operational use and the performance standards engaged for the application. The 20 km no dispersant application buffer around wholly submerged receptors should prevent impacts to these receptors. Impacts from dispersant application closer to submerged/intertidal receptors, such as Browse Island, are expected to be short-term and localised with the potential for minor or temporary impacts (Minor E).	

These impacts (at intertidal locations, such as Browse Island) would only occur when the Operational SIMA demonstrated a net environmental benefit for dispersant use. The decision to conduct dispersant application (including consideration of the associated consequences) within 3 nm of Browse Island would only occur under direction/instruction from WA DoT, as it is the control agency within State waters.			
Identify existing design safeguards/controls			
Vessels fitted with lights, signals, an automatic identification system (AIS) transponders and navigation equipment as required by the *Navigation Act 2012*. Due to the nature of call-off vessels that may be used during an oil spill response, not all vessels can be confirmed to be equipped with onboard sewage treatment plants compliant with MARPOL 73/78 (depending on the sewage treatment plant installation date) or an approved sewage comminuting and disinfecting system. However, all vessels will comply with the requirements of MARPOL 73/78, Annex IV for sewage discharges and Annex V for food scrap discharges during oil spill response activities.			
Propose additional safeguards/control measures (ALARP evaluation)			
Hierarchy of control	Control measure	Used?	Justification
Elimination	No response strategies implemented.	No	Not responding to a spill which could result in harm to wildlife populations and leaving the spill without understanding its fate and trajectory is not considered to be ALARP. The spill could harm wildlife populations, contact shorelines above impact thresholds, or pose an operational risk to response personnel; therefore, INPEX will deliver monitoring and evaluation and other appropriate secondary response strategies to reduce impacts to ALARP.
	Eliminate use of vessels (collision risk and associated discharges) during a spill response.	No	Vessels are critical assets for monitoring and implementing oil spill response activities.
Substitution	None identified.	N/A	N/A
Engineering	The INPEX Operations PSVs and OSV will be equipped with dispersant application spray equipment.	Yes	Ensuring dispersant spray equipment is present on the PSVs and OSV ensures there are several INPEX vessels able to implement a vessel-based dispersant response.
	A mobile dispersant spray system, which can be mobilised to support vessels, will be stored in WA-50-L during the activity.	Yes	Locating a mobile dispersant spray system in at the Ichthys facility in WA-50-L enables rapid mobilisation of a dispersant spray system to any available support vessel. This mobile dispersant spray system also provides a 100% redundancy during operations (in the event that the OSV/PSVs are unavailable).

			During the URF installation activity several other activities ongoing in WA-50-L e.g. support vessels for the FPSO and CPF; and drilling support vessels. Therefore, several vessels may be available to provide additional support for dispersant application.
	16 m^3 of dispersant and a mobile dispersant spray system will be maintained in WA-50-L, during activities when the risk (heavy fuel oils) cannot be eliminated.	Yes	AMOSC recommends dispersant application commences at 40 L/min, increasing to up to 80 L/min for a portable spray system. This equates to 2.5–5 m^3 per hour. Therefore, a medium assumption is 3 m^3 per hour. Dispersant can only be applied during daylight hours. In previous consultation between INPEX and AMOSC it has been determined that vessels conducting dispersant application could realistically expect to spray for 4–5 hours in any single period of daylight. Based on a 12-hour daylight period to spray dispersant, and assuming an actual vessel-spraying time (i.e. 5 hours) at 3 m^3/hour, a total of 15 m^3 of dispersant could reasonably be applied in a 12-hour daylight period. 15 m^3 of dispersant is a sufficient stockpile to completely treat a 376 m^3 IFO spill scenario at a 20:1 ratio. After 24 hours, if the spill is still amenable to dispersant application, additional dispersant stocks can be mobilised from stockpiles located in Broome, Exmouth and Darwin. In addition, the fixed wing aerial dispersant (FWAD) capability can be mobilised within 24 hours, to provide aerial spraying capability for a longer-term response. Other industry operators also have dispersant capabilities nearby WA-50-L which can be accessed via AMOS-Plan.
Procedures and administration	Maintain and implement an appropriate Operational Monitoring and Evaluation capability, as described, and within the timeframes specified in Table 8-12, for any Level 2/3 spill event. Validation of this capability will be tested through the arrangements specified in Section 9.10.3	Yes	Operational Monitoring and Evaluation will be implemented for any Level 2/3 oil spill response activity, to provide real-time situational awareness to the IMT. This capability involves the mobilisation/activation of • oil spill trajectory modelling • aerial surveillance • trained aerial observers • vessel surveillance • electronic surface tracking buoys • satellite imagery Justification for the level of capability and mobilisation timeframes are provided in Table 8-12.

	Maintain and implement equipment, personnel and logistics capability, as described and within the timeframes specified in Table 8-12, for any contain and recover, protect and deflect, shoreline clean-up and/or oiled wildlife response, if selected for activation under the IAP. Validation of this capability will be tested through the arrangements specified in Section 9.10.3	Yes	If specified in the Operational SIMA/IAP, shoreline clean-up and/or oiled wildlife response strategies would involve the mobilisation of: • small vessel and large larger support vessels • light utility helicopter • shoreline clean-up and oiled wildlife response equipment • trained shoreline clean-up and oiled wildlife response personnel Justification for the level of capability and mobilisation timeframes are provided in Table 8-12.
	Maintain a waste management contract, to receive and treat/dispose of oily contaminated wastes.	Yes	In the event that an oiled wildlife or shoreline clean-up response is activated, oily wastes will be generated and will therefore require appropriate onshore disposal.
	Develop an Operational SIMA in accordance with Section 3 of the OPEP to confirm effectiveness of response strategies before including the selected strategies into the IAP.	Yes	To ensure that response strategies will be effective, the INPEX IMT will use the Operational SIMA template (Appendix D – OPEP Section 3) and operational and monitoring data generated, to develop an Operational SIMA, before selecting the response strategies for inclusion in the IAP. The OPEP details all the response strategies, capabilities, and considerations that need to be undertaken to implement an effective response to a hydrocarbon spill. The IMT will consider all relevant information at the time of the spill, and using the OPEP for guidance, develop the IAPs. The IAPs demonstrate how the OPEP was effectively implemented during a spill event.
	Emergency response preparedness will be maintained by implementing Section 9.10 this EP.	Yes	To ensure that INPEX is prepared to respond to a spill, response preparedness will be tested in accordance with Section 9.10 of this EP.
	Spill response strategy effectiveness will be monitored and terminated appropriately.	Yes	During response implementation, it is appropriate to monitor the ongoing effectiveness of the response strategy, to ensure the response continues to effectively reduce or mitigate the impacts of the spill and prevent/minimise additional harm. Ongoing monitoring of the effectiveness of the response strategy also ensures an appropriate termination point is reached.

	Visual inspections to prevent introduction of terrestrial exotic pests to offshore islands.	Yes	Visual inspections of helicopters and equipment mobilising to remote shorelines as part of any shoreline response activity will significantly reduce the risk of any introductions of terrestrial exotic pests. While the DEWHA threat abatement plan (DEWHA 2009) is focused on vessel-based vectors for introductions, this control is consistent with the intent of the actions described within that plan.
	Vessel sewage and food scrap discharges, and waste management will be conducted in accordance with MARPOL 73/78 requirements.	Yes	All vessels involved in oil spill response will have the capability to ensure sewage and food scraps discharges and waste management are compliant with MARPOL 73/78 requirements.
	Shoreline response activity HSE plan prepared and implemented which incorporates consideration of impacts to turtle nesting and anchoring of shoreline protection booms.	Yes	A site-specific HSE plan for any shoreline response activity will be developed to address any risks to turtle nesting associated with personnel and equipment movement on offshore islands / mainland turtle-nesting beaches. The plan will address specific issues including: • personnel and equipment movement on turtle-nesting beaches • light-spill (if night-time activities are required). If protect and deflect (shoreline booming) is planned, mitigation strategies for limiting impacts to intertidal ecosystems will be included in the HSE Plan. These sections of the relevant HSE plan will be prepared in consultation with AMOSC wildlife experts, DAWE (Cwlth), and WA DoT/WA DBCA for responses on WA state lands.
	Obtain permits, in consultation with the relevant government agencies, before commencing wildlife hazing activities.	Yes	Consultation and obtaining the required permits from relevant government agencies before conducting any wildlife response activities will limit the likelihood of undue stress or harm to wildlife during the response activity.
	A waste management plan will be prepared and implemented for any shoreline clean-up operations, in consultation with AMOSC and WA DoT.	Yes	A waste management plan to manage all hydrocarbon-contaminated solid/liquid waste is necessary to prevent accidental additional contamination of sediments and reduce the risks to wildlife.

	Vessel and/or aerial dispersant application on Group IV hydrocarbons will only occur in accordance with the IMT dispersant application decision matrix (OPEP, Table 4-8)	Yes	Group I and II hydrocarbons are not amenable to dispersant application (Table 8-10). INPEX has developed the IMT dispersant application decision matrix (OPEP, Table 4-8 which outlines specific conditions that must be satisfied before dispersant applications can take place, in order to reduce impacts and risks to ALARP. In order to verify that applications are acceptable to key stakeholders, in accordance with the WA DoT *Dispersant Use Guidelines,* WA DoT will be notified before any dispersant application in Commonwealth waters for spills (or dispersed spills) which may enter WA state waters. This requirement is captured within the IMT dispersant application decision matrix.
	Dispersants with high efficacy for dispersal of Group IV hydrocarbons will be used.	Yes	Selection of appropriate dispersants for the potential/credible spill products will ensure the highest chance of their successful dispersal. Poor selection of dispersant products could result in less efficient dispersant operations.
	Hard copies of the INPEX *Oil Spill and Dispersant Visual Observation Guide for Vessels and Aircraft* will be available: • on the FPSO/PSV and OSV at the location that dispersant/dispersant spray equipment is located • at the INPEX aviation contractor base in Broome.	Yes	By ensuring hard copies of the INPEX *Oil Spill and Dispersant Visual Observation Guide for Vessels and Aircraft* are available with all dispersant stockpiles/equipment in WA-50-L, it is readily accessible for the vessel-based dispersant response teams. By ensuring hard copies of the INPEX *Oil Spill and Dispersant Visual Observation Guide for Vessels and Aircraft* are available at the aviation base, it is readily accessible for personnel to use in reconnaissance or air attack aircraft, should the FWAD capability be mobilised. This ensures that decisions regarding activation of the dispersant application response and reporting on dispersant effectiveness to the IMT will be effectively managed. This also facilitates accurate information flow to the IMT during the implementation of OM03 of the Operational and Scientific Monitoring Program (Refer OPEP, Appendix D).

	PSV/OSV dispersant equipment maintenance and crew training.	Yes	INPEX PSV OSV Spill and Dispersant Training Presentation and the INPEX Oil Spill Observation and Dispersant Guide have been developed using the AMOSC IMO-1 dispersant course material, and other best practice material, including AMSA, IPIECA, ITOPF and NOAA dispersant guidance documents. The use of these reference materials ensures that industry best practice knowledge is communicated to the PSV/OSV personnel who are trained in dispersant application. Annual deployment exercises/training of the vessel crew provides familiarisation and allows lessons learned to be captured and communicated through updates to SOPs/JHAs and the INPEX PSV/OSV Oil Spill and Dispersant training presentation. Preventative maintenance of PSV/OSV dispersant equipment ensures it will remain serviceable.
	FPSO dispersant equipment maintenance and crew training.	Yes	The INPEX Oil Spill Observation and Dispersant Guide and the INPEX E-learning online FPSO Oil Spill Observation and Dispersant Application module have been developed using the AMOSC IMO-1 dispersant course material, and other best practice material, including AMSA, IPIECA, ITOPF and NOAA dispersant guidance documents. The SOP and JHA have been developed using a combination of the AFEDO manufactures operating manual and AMOSC AFEDO Standard Operating Procedure, and the Slick-Gone N/S SDS. The use of these reference materials ensures that industry best practice knowledge is communicated to the FPSO personnel who are trained in dispersant application. The dispersant application controls from the OPEP are also included in the e-learning module and SOP. An annual physical deployment/test of the FPSO AFEDO dispersant equipment provides familiarisation and allows lessons learned to be captured and communicated through updates to SOPs/JHAs and the INPEX dispersant E-learning module. Preventative maintenance ensures the FPSO dispersant equipment will remain serviceable.
Sensitive receptor protection	Permits obtained, in consultation with relevant government agencies, before activities which may have an impact on wildlife begin.	Yes	Consultation and obtaining required permits from relevant government agencies before conducting any activities which may affect wildlife will limit the likelihood of undue stress or harm to animals.
Identify the likelihood			

Likelihood	Hydrocarbon spills of a Level 2 or Level 3 nature that are likely to trigger response strategies, thereby introducing the impacts and risks from implementing response strategies, are evaluated in Table 8-6. The use of secondary response strategies may increase the likelihood of impact occurring in comparison to just employing source control and monitoring and evaluation techniques alone. However, based on the controls described, the likelihood of response activities resulting in the consequences described is considered Unlikely (4).
Residual risk	Based on a worst-case consequence of Moderate (D) and likelihood of Unlikely (4) the residual risk is Moderate (7).

Residual risk summary		
Consequence	Likelihood	Residual risk
Moderate (D)	Unlikely (4)	Moderate (7)

Assess residual risk acceptability

Legislative requirements

The activities and proposed management measures are compliant with industry standards and relevant Australian legislation/guidance, e.g. the NatPlan (AMSA 2019); the Western Australian State Hazard Plan – Maritime Environmental Emergencies (WA DoT 2018b), specifically concerning implementation of oil pollution emergency plans; and MARPOL 73/78 for vessel discharges and garbage management.

Stakeholder consultation

Stakeholders have been engaged and issues/feedback have been incorporated in to the OPEP regarding potential impacts and risks associated with implementation of response strategies for Group II and Group IV hydrocarbons. Stakeholder engagement is an ongoing process.

Conservation management plans / threat abatement plans

Several conservation management plans (refer to Appendix B) identify marine debris as a key threatening process to recovery. Also, the relevant action from the *Threat abatement plan for the impacts of marine debris on vertebrate marine life* (DEWHA 2009) is to "contribute to the long-term prevention of the incidence of harmful marine debris". The prevention of garbage entering the marine environment and the appropriate management of sewage and food wastes reduces the risk of impacts to the marine environment and demonstrates alignment with the various conservation management plans and threat abatement plans.

The *Threat abatement plan to reduce the impacts of exotic rodents on biodiversity on Australian offshore islands of less than 100,000 hectares* (DEWHA 2009), describes the threat of invasion or reinvasion of rodents on bird populations. The relevant action from DEWHA (2009) is to prevent invasion or reinvasion via prevention / risk reduction for rodents gaining access to key vessels at key ports. As INPEX proposes to access islands via helicopter, controls which align with the intent of DEWHA (2009) have been developed.

The recovery plan for marine turtles in Australia (DEE 2017a) identifies that light pollution and vehicle damage (and therefore possibly excessive foot traffic) are possible threats to turtle nesting, which could result from shoreline response activities during an oil spill response. Controls which align with the intent of the Recovery Plan have been developed.

ALARP summary

<table>
<tr><td colspan="4">Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact.
Acceptability summary
Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:
• the controls demonstrate compliance with legislative requirements
• the controls meet stakeholder expectations
• management of the activity is aligned with the relevant conservation management plans / threat abatement plans and demonstrates a contribution to the long-term prevention of the incidence of harmful marine debris
• the level of residual risk is 'Low' and impacts and risks are ALARP, and no further controls can reasonably be implemented to further reduce the risk of impact.</td></tr>
<tr><th>Environmental performance outcomes</th><th>Environmental performance standards</th><th>Measurement criteria</th><th>Responsibility</th></tr>
<tr><td rowspan="2">Oil spill response logistics, personnel and equipment capability, will be maintained at acceptable levels through implementation of the environmental performance standards.</td><td>Operational monitoring and evaluation capability which can meet the mobilisation timeframes specified in Table 8-12, will be maintained including:
• oil spill trajectory modelling
• aerial surveillance
• trained aerial observers
• vessel surveillance
• electronic surface tracking buoys
• satellite imagery.
Validation of this capability will be tested through the arrangements specified in Section 9.10.3.</td><td>Records confirm operational monitoring and evaluation capability maintained including:
• oil spill trajectory modelling contract in place
• aircraft contacts / call-off agreements
• AMOSC contract
• vessel contracts / call-off agreements
• electronic surface tracking buoy locations (tracked via INPEX Oil Spill Preparedness and Response Register)
• satellite imagery provider contract.</td><td>IMT Leader/ INPEX Environmental Advisor</td></tr>
<tr><td>Oil spill response capability for shoreline and oiled wildlife response, which can meet the mobilisation timeframes specified in Table 8-12, will be maintained including:
• access to AMOSC and OSRL equipment and personnel, including shoreline clean-up and oiled wildlife response personnel and equipment
• access to small and large support vessel capability
• access to light utility helicopter</td><td>Records confirm oil spill response capability is maintained including:
• AMOSC contract
• OSRL contract
• framework agreements.</td><td>IMT Leader/ INPEX Environmental Advisor</td></tr>
</table>

	• access to additional support personnel through Environmental Service Providers general labour hire. Validation of this capability will be tested through the arrangements specified in Section 9.10.3.		
In the event of a level 2/3 spill the IMT will evaluate operational monitoring and evaluation data for the full duration of the spill event, to determine if additional response strategies are required.	The IMT will activate and evaluate real-time operational monitoring and evaluation data for any Level 2/3 spill event. The operational monitoring and evaluation data and the OPEP's Operational SIMA template will be used for the development of the Operational SIMA and IAP.	Records confirm real-time operational monitoring and evaluation data was received and evaluated by the IMT. Records confirm operational monitoring and evaluation data and the OPEP's Operational SIMA template were used for the development of the Operational SIMA and IAP.	IMT Leader
In the event of a level 2/3 spill the risks of impacts to transient, EPBC-listed species, i.e. marine turtles, marine mammals and marine avifauna (receptors) from a Level 2 or Level 3 spill (impactors) are reduced and maintained at acceptable levels through implementation of the environmental performance standards and the application of the environmental management implementation strategy.	To monitor response strategy effectiveness, daily reports from field response activities will be provided to the IMT, in accordance with Section 4 of the OPEP. Effectiveness of the oil spill response will be monitored until: • the source of the spill has been stopped • the objectives of the IAPs have been met or • there are no further practicable steps that can be taken to respond to a spill.	Daily field activity reports, in accordance with Section 4 of the OPEP. Daily reports or other data confirms oil spill response termination criteria have been met.	IMT Leader/ INPEX Environmental Advisor
	Emergency response preparedness will be maintained by implementing Section 9.10 of this EP.	Records confirm emergency response preparedness, as detailed in Section 9.10 of this EP, is maintained.	INPEX Environmental Advisor

In the event of a level 2/3 spill the risks of impacts to transient, EPBC-listed species, i.e. marine turtles, marine mammals and marine avifauna, and benthic communities which support them (receptors) from vessel discharges during oil spill response activities (impactors) are reduced and maintained at acceptable levels through implementation of the environmental performance standards.	All vessels involved in oil spill response activities will conduct sewage disposal activities in accordance with MARPOL 73/78, Annex IV. All vessels involved in oil spill response activities will conduct food scrap disposal activities in accordance with MARPOL 73/78, Annex V. No de-ballasting within marine parks during oil spill response activities.	Records of sewage discharge locations are maintained in a sewage disposal record book that complies with MARPOL 73/78, Annex IV. Records of food scrap discharges are maintained in a garbage record book that complies with MARPOL 73/78, Annex V. Records of de-ballasting.	Vessel Master
No inappropriate disposal of garbage.	All vessels involved in oil spill response activities will conduct garbage management in accordance with MARPOL 73/78, Annex V.	Records of garbage disposals are maintained in a garbage record book that complies with MARPOL 73/78, Annex V.	Vessel Master
No incidents of loss of hydrocarbons to the marine environment as a result of a vessel collision during oil spill response.	Vessels will be fitted with lights, signals, AIS transponders and navigation equipment as required by the *Navigation Act 2012*.	A premobilisation report confirms that required navigation equipment is fitted to all vessels to ensure compliance with the *Navigation Act 2012.*	INPEX Environmental Advisor
No secondary ocean or shoreline contamination due to inappropriate waste management	A contract will be maintained with a licenced waste management contractor, capability of receiving, treating and disposing of solid and liquid oily contaminated wastes.	Records confirm contract in place with a licenced waste management contractor.	INPEX Environmental Advisor

during a shoreline clean-up response activity.	In consultation with WA DoT and AMOSC, a response waste management plan, including decontamination stations and waste storage, transport and disposal arrangements, will be prepared and implemented for any shoreline clean-up response activity. The plan will consider methods to eliminate, reduce and re-use materials to reduce the overall volume of waste generated.	Records demonstrate that a waste management plan was prepared and implemented, in consultation with WA DoT and AMOSC, for any shoreline clean-up response activity.	IMT Leader
Risks of impacts to transient, EPBC-listed species, i.e. marine turtles, marine mammals and marine avifauna (receptors) from wildlife response activities (impactors) are reduced and maintained at acceptable levels through implementation of the environmental performance standards.	Permits will be obtained in consultation with DAWE (Cwlth) before any wildlife hazing, post-contact wildlife response or shoreline clean-up activities take place in Commonwealth waters or on Commonwealth lands. Permits, including launching and landing aviation assets, will be obtained in consultation with DBCA (via WA DoT) before any wildlife hazing, post-contact wildlife response or shoreline clean-up activities take place in WA waters or lands.	Records demonstrate response activities with the potential to affect wildlife were conducted in consultation with, and under permits issued by DAWE (Cwlth) and WA DBCA. Records are kept of response activities demonstrating compliance with any controls defined in the permits.	INPEX Environmental Advisor
No introduction of terrestrial exotic pests to offshore islands.	Pre-flight visual inspections of helicopters conducted. Premobilisation visual inspections of vessels and equipment before mobilisation onto an offshore island and recorded on quarantine inspection checklists.	All aircraft technical logs confirm that pre-flight visual inspections have been conducted. Quarantine inspection checklists confirm vessel and equipment premobilisation inspections have been conducted.	INPEX Environmental Advisor
Risks of impacts to transient, EPBC-listed species, i.e. marine turtles, (receptors) from a shoreline response (impactors) are reduced and maintained at acceptable levels through implementation of the	In the event of a shoreline response, an HSE plan will be prepared, in consultation with AMOSC and WA DBCA (via WA DoT) which addresses potential impacts to turtle nesting, including: • personnel and equipment movement on turtle-nesting beaches • light-spill (if night-time activities are required). • Shoreline boom placement (if protect and deflect activities are required).	Records of correspondence with AMOSC and WA DoT regarding turtle-nesting considerations. HSE plan documentation demonstrates controls regarding turtle nesting and coral reefs. Records demonstrate compliance with controls described in the HSE Plan.	INPEX Environmental Advisor

environmental performance standards.	Vessel and/or aerial dispersant applications, on Group IV spills only, will be undertaken in accordance with the IMT dispersant application decision matrix (see Table 4-8 of the OPEP).	INPEX IMT records of dispersant application decision matrix.	INPEX Environmental adviser
	Only dispersants with high efficacy for dispersal of Group IV hydrocarbons and listing on the AMSA oil spill control agent (OSCA) register will be used in the event of dispersant application.	Records show use of high efficacy and OSCA-registered dispersant during spills, drills and exercises where dispersant is used.	INPEX Environmental adviser
	INPEX Operations support vessels (2 × PSVs and 1 × OSV) will be equipped with dispersant spray equipment.	Records demonstrate annual testing of dispersant spray equipment.	INPEX Environmental adviser
	16 m^3 of dispersant and a mobile dispersant spray system will be located in WA-50-L during URF installation activities	Records demonstrate 16 m^3 of dispersant and a mobile dispersant spray system is located in WA-50-L.	INPEX Environmental adviser
	Hard copies of the INPEX *Oil Spill and Dispersant Visual Observation Guide for Vessels and Aircraft* will be available: • on the PSV and OSV, and where that dispersant / dispersant spray equipment is located in WA-50-L • at the INPEX aviation contractor base in Broome.	Records confirm the INPEX *Oil Spill and Dispersant Visual Observation Guide for Vessels and Aircraft* will be available: • on the PSV and OSV, and where that dispersant / dispersant spray equipment is located in WA-50-L • at the INPEX aviation contractor base in Broome.	INPEX Environmental adviser
	PSV/OSV vessels dispersant spray booms will be maintained in accordance with vessel preventative maintenance system. PSV/OSV vessel crews will maintain dispersant spray competency, through one dispersant equipment deployment drill per swing, per calendar year (total of two deployment drills per vessel per year). Each drill will ensure crews: • maintain familiarity with operation of vessel spray booms including review of the vessels own dispersant spray SOP and JHA	Records demonstrate: • preventative maintenance of booms conducted • dispersant deployment exercises conducted annually.	INPEX Environmental adviser

	• maintain familiarity with INPEX dispersant spray processes and use of INPEX dispersant reporting tools, through review of: ○ INPEX oil spill observation and dispersant spray guide. INPEX PSV/OSV Oil Spill and Dispersant training presentation.		
	FPSO service technicians and HSE crew will be trained in dispersant application via an on-line E-learning module. The module will be required to be completed every 2 years. This e-learning module will cover the following topics: • INPEX Oil Spill Observation and Dispersant Guide. • INPEX AFEDO dispersant spray unit Standard Operating Procedure and Job Hazard Analysis. The INPEX FPSO AFEDO system will be maintained in accordance with the FPSO's preventative maintenance system. Once per calendar year, FPSO service technicians (who are trained in dispersant application) will move the AFEDO unit onto an available support vessel and conduct a physical deployment/testing of the AFEDO spray unit.	Records demonstrate: • FPSO crews trained via online E-learning module every 2 years • preventative maintenance of AFEDO unit conducted • dispersant deployment exercises conducted annually.	INPEX Environmental adviser

9 ENVIRONMENTAL MANAGEMENT IMPLEMENTATION STRATEGY

This section provides a description of the INPEX health, safety, environment and quality management system (HSEQ-MS) as it applies to the implementation of this EP and its associated performance outcomes and standards.

9.1 Overview

The HSEQ-MS includes standards and procedures from other business areas for its completeness. It is based on the principle of a "plan, do, check, act" (PDCA) continual improvement cycle, and has been developed in accordance with the following Australian standards:

- AS/NZS 4801:2001, *Occupational health and safety management systems—Specification with guidance for use*
- AS/NZS ISO 14001:2004, *Environmental management systems—Requirements with guidance for use*.

It provides mandatory rules and processes for the systematic and consistent management of HSEQ risks, demonstration of compliance, and facilitation of continual improvement. In the context of this EP, the HSEQ-MS enables INPEX to ensure that:

- environmental risks of activities are identified and communicated
- organisational structures and resources are provided to ensure that control measures remain effective in reducing environmental risks to levels that are acceptable and ALARP
- performance outcomes and standards are being met
- continual improvement is achieved through application of lessons learned.

The 13 external elements that influence the HSEQ-MS reflect key aspects of INPEX activities requiring process safety and HSEQ controls (Figure 9-1). These elements have to be managed and implemented properly in order to achieve the desired HSEQ performance and reflect a PDCA cycle, which is applied to every aspect of the 13 elements.

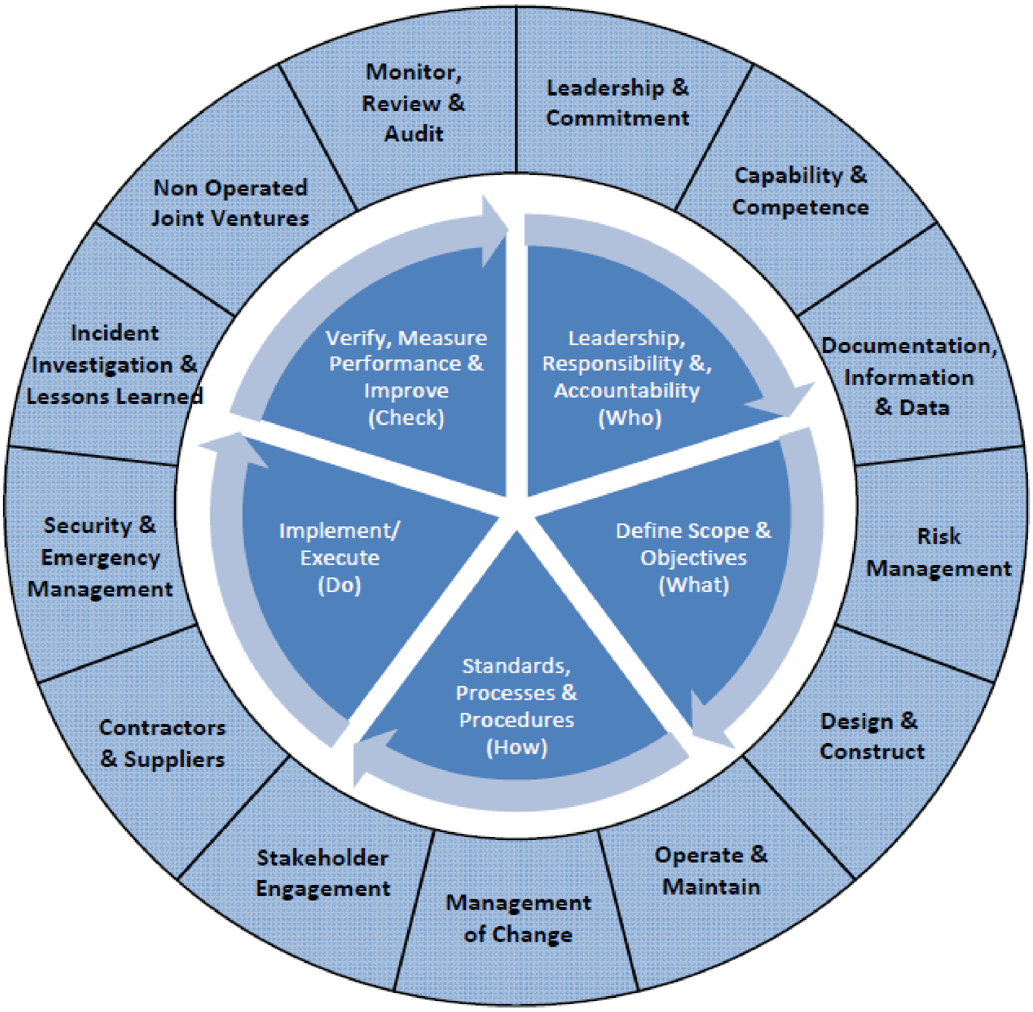


Figure 9-1: The INPEX health, safety, environment and quality management system

9.2 Leadership and commitment

INPEX environmental performance is achieved through strong visible leadership, commitment and accountability at all levels of the organisation. Leadership includes defining performance targets and providing structures and resources to meet them.

The INPEX Environmental Policy (as amended from time to time) (Figure 9-2) solidifies this commitment and states the minimum expectations for environmental performance. The policy applies to all INPEX-controlled activities in Australia including WA-50-L. All personnel, including contractors, are required to comply with the policy.

The policy as amended is available on the INPEX intranet and displayed at all INPEX workplaces, including all contractor vessels in the licence area. It will be communicated to personnel involved in the activities, including contractors, through inductions.

INPEX

Environmental Policy

Objective

INPEX is a worldwide oil and gas exploration, development and production company committed to conducting each of its activities in a manner that is environmentally responsible.

Our objective is to develop an environment culture that is recognised as amongst "best in industry" that will exceed the performance expectations of our stakeholders.

We recognise our responsibility to adhere to the principles of sustainable development and we acknowledge that we owe a duty of care to both the natural environment and the communities in which we operate.

Strategy

To accomplish this, INPEX will:

- comply with applicable laws and regulations, environmental plans and commitments and apply appropriate INPEX standards
- maintain a culture where people are empowered to intervene to prevent environmental harm
- set, measure and review environmental performance objectives and targets and ensure appropriate management of change processes are followed
- ensure our personnel have the necessary awareness, training, knowledge, resources and support, to meet environmental objectives and targets
- identify, manage and review environmental hazards and risks associated with our current and future business activities and manage these to levels that are 'as low as reasonably practicable' (ALARP)
- implement, maintain and regularly test control measures associated with major environmental events
- maintain and regularly test emergency management processes and procedures, including with industry and government emergency response partners
- engage with and communicate openly on environmental issues with internal and external stakeholders
- provide clearly defined environmental performance expectations for our contractors and suppliers, and work collaboratively with them to attain these
- endeavour to prevent pollution and seek continual improvement with respect to emissions, discharges, wastes, energy efficiency and resource consumption
- actively promote the reduction of greenhouse gas emissions across our operations in a safe, technically and commercially viable manner
- endeavour to protect biodiversity and to contribute to increased understanding of our natural environment
- drive continual improvement in environmental performance through monitoring, auditing and reviews.

Application

This policy applies to all INPEX controlled activities in Australia and related project locations. It will be displayed at all company workplaces and on the company's intranet and it will be reviewed regularly.

Hitoshi Okawa
President Director, Australia

Rev: 3
April 2019

Figure 9-2: INPEX environmental policy

9.3 Capability and competence

INPEX appoints and maintains competent personnel to manage environmental risks and provide assurance that the INPEX Environmental Policy, objectives and performance expectations will be achieved. This applies to both individual competencies and the overall capability of the organisation.

9.3.1 Organisation

Figure 9-3 illustrates the organisational structure for onshore and offshore personnel during the URF and SPS installation activities covered in this EP.

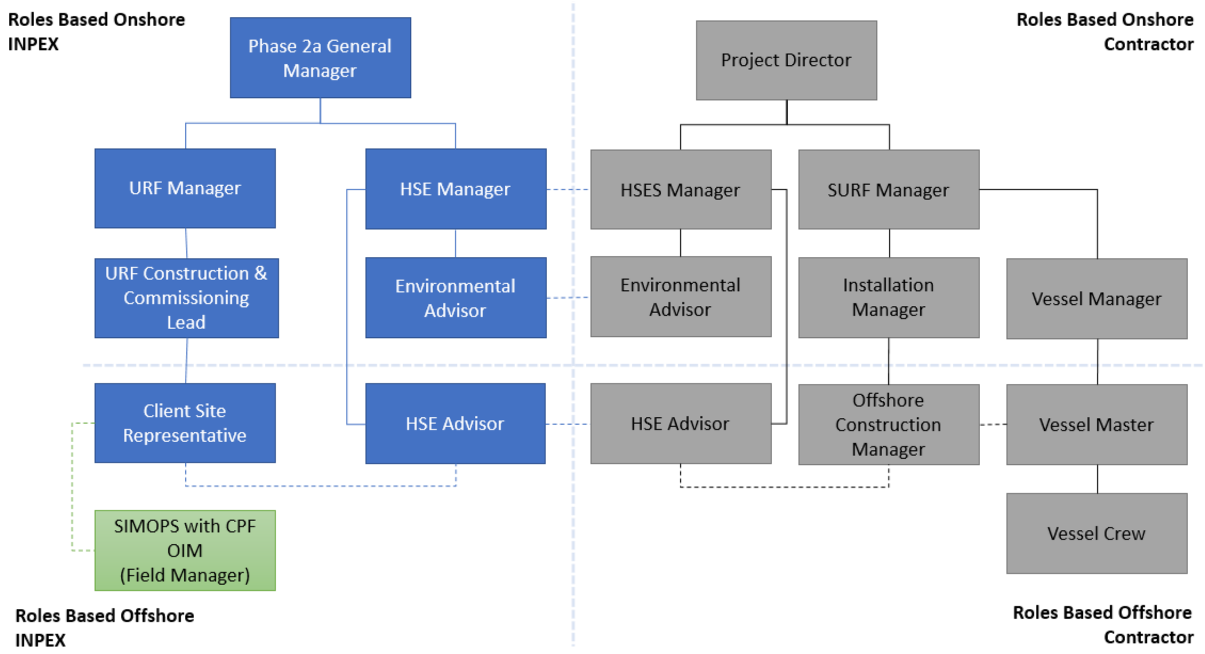


Figure 9-3: Organisational structure

Work activities will be conducted by a contractor under the direction of the INPEX Phase 2a General Manager via written work instructions and work programs.

All Contractor vessels shall be operated under their own management systems, of which their HSE management systems (HSEMS) are a key component. INPEX will, through contractual and other diligence processes, ensure that Contractors HSEMSs and HSE plans are consistent with the requirements of INPEX. INPEX will have responsibility over all Health Safety and Environmental aspects within WA-50-L during all phases of the activity.

9.3.2 Roles and responsibilities

INPEX has established and implements standards, procedures and systems to build and maintain a trained and competent workforce capable of fulfilling its assigned roles and responsibilities, as well as meeting its legislative and regulatory requirements. The selection process for the key INPEX personnel identified in Table 9-1 includes consideration of their previous work experience and recognised qualifications when compared with the INPEX minimum competency standards.

The key roles are responsible for collecting and maintaining the required evidence and monitoring data as specified in the environmental performance standards detailed in sections 7, 8 and 9 of this EP. Additional supporting roles and responsibilities related to HSEQ-MS implementation are also listed in Table 9-1.

Personnel in key roles (Table 9-1) will be informed of their respective responsibilities in relation to this EP. This information will be disseminated by INPEX (e.g. through workshops, one-on-one sessions or by email) to ensure EP/OPEP awareness and that appropriate competencies and training requirements are met.

Table 9-1: Key personnel and support roles and responsibilities

Key role	Responsibilities
Phase 2a General Manager (Onshore)	Ensures overall compliance with the INPEX HSEQ-MS including environmental performance outcomes and standards.
URF Manager (Onshore)	Ensures activities are undertaken in accordance with this EP. Ensures any changes to the activity that may affect the performance outcomes and environmental management procedures detailed in this EP are communicated to the INPEX HSEQ team. Ensures availability of resources required to ensure that commitments in this EP are met. Ensures corrective actions raised from environmental audits are tracked and closed out.
Company site representative (Offshore)	Ensures contractors perform operations in a manner consistent with the performance outcomes and environmental management procedures detailed in this EP. Ensures the implementation of the INPEX Environment Policy, through application of this EP. Ensures the vessel master, offshore construction manager and all crews adhere to the requirements of this EP. Alerts the URF Manager to any changes in activities that could have a negative impact on environmental performance. Responsible to highlight any interfacing or integration activities.
Environmental Advisor (Onshore)	Ensures that environmental audits / pre-mobilisation inspections are undertaken. Ensure that any changes to the activity that may affect EP mitigation and management measures are captured via the management of change process. Monitors the activities against relevant legislation, commitments and this EP. Oversees environmental event reporting within INPEX. Evaluates and monitors the URF Contractor.
Contractor	Demonstrate compliance with the requirements of this EP and OPEP. Ensures any changes to the activity that may affect the performance outcomes and environmental management procedures detailed in this EP are communicated to the INPEX URF Manager and the INPEX HSE team.

	Ensures contractor activities are undertaken in accordance with this EP.
Vessel masters (Offshore)	Conduct vessel operations in accordance with this EP. Implement the vessel's SOPEP/SMPEP in an emergency. Ensure that environmental incidents or breaches of performance outcomes, standards or criteria on vessels, are reported in line with INPEX's HSEQ performance reporting requirements for contractors.
Site personnel (Offshore)	Work in accordance with accepted vessel HSE systems and procedures. Comply with EP requirements as applicable to assigned role. Report any hazardous condition, near miss, unsafe act, accident or environmental incident immediately to supervisors. Attend HSE meetings and training when required.

9.3.3 Inductions

Inductions are conducted for all personnel (including INPEX representatives, contractors, subcontractors and visitors) before they start work on the vessels described in this EP. Inductions cover the health, safety and environment requirements under the INPEX and contractor HSE management systems, including information about the commitments contained in this EP.

9.4 Documentation, information and data

INPEX implements and maintains document and records management procedures and systems. These are in place to ensure that the information required to support safe and reliable operations, is current, reliable and available to those who need it.

Documents and records are stored electronically in INPEX document management systems and databases.

This EP and associated documentation are maintained within a database, with current versions also available via the controlled document repository.

Records to demonstrate implementation of the HSEQ-MS and compliance with legislative requirements and other obligations are identified and maintained for at least five years. These records will include:

- written reports – including risk assessment reports and registers, monitoring reports, audit and review reports – about environmental performance or implementation strategies
- records relating to environmental performance or the implementation strategies
- records of environmental emissions and discharges
- modification and changes authorised by INPEX and/or contractor
- incident and/or near miss investigation reports
- improvement plans (corrective actions, key performance indicators)
- records relating to training and competency in accordance with this EP.

9.5 Risk Management

The risks and impacts associated with the petroleum activity are detailed in Section 7 and Section 8. Additional risk assessments will be undertaken on an ongoing basis when triggered by any of the following circumstances:

- when there is a proposed change to the activity, as identified by an INPEX management of change (MoC) request
- when identified as necessary following the investigation of an event
- when additional information about environmental impacts or risks becomes available (e.g. through better knowledge of the receptors present within the EMBA, new scientific information/papers, results of monitoring, other industry events or studies)
- if there is a change in regulations, as necessary
- during scheduled reviews of the documentation associated with this EP.

The risk assessment will be carried out in line with the assessment process described in Section 6 and is aligned to INPEX's HSE Hazard and Risk Management Standard, to ensure hazards related to the activity are systematically identified, assessed, evaluated and controlled. An environmental risk register for the activity is reviewed and updated quarterly. The review includes assessment of any new information and other changes that have been recorded on an ongoing basis in the previous quarter. Where this review results in a change, the changes are documented and communicated.

9.6 Operate and maintain

9.6.1 Chemical assessment and approval

The purpose of the *INPEX Chemical Assessment and Approval Procedure* is to establish and communicate the process for the assessment and approval of chemicals for use on INPEX sites or facilities. The procedure has been developed to ensure compliance with relevant Australian legislation and to assess chemicals based on toxicity, bioaccumulation and biodegradation potential. By implementing the procedure, exposure to chemicals by personnel and/or the environment resulting from INPEX activities are assessed and controlled. This procedure promotes the use of chemicals that present low health and/or environmental hazard levels.

All operational chemicals discharged into the marine environment have to undergo an environmental assessment. The assessment considers the following:

- chemical’s toxicity, bioaccumulation, and biodegradation potentials
- discharge concentration
- frequency of discharge
- maximum credible volume of chemical anticipated to be discharged in 24 hours
- if the chemical is listed on the Australian Inventory of Chemical Substances (AICS)
- if the chemical contains ozone-depleting substances or synthetic greenhouse gases
- if the chemical or component of the chemical is registered on either the OSPAR priority action or possible concerns lists.

As part of the above assessment, a chemical assessment tool is used (Table 9-2) to determine the chemicals’ inherent environmental hazard potential which can be determined by considering toxicity in conjunction with bioaccumulation and biodegradation potentials. Chemicals falling within the “Green” range are considered to present a low inherent hazard potential.

Table 9-2: Chemical assessment tool

		Bioaccumulation					
		LogP$_{ow}$[1] <3 or BCF[2] ≤100 and with a molecular weight ≥700			LogP$_{ow}$[1] ≥3 or BCF[2] >100 and with a molecular weight <700		
Toxicity (ppm)		**Biodegradation (in 28 days)**					
Aquatic	Sediment	≥60%	≥20% to <60%	<20%	≥60%	≥20% to <60%	<20%
<1	<10						
1≤ to <10	10≤ to <100						
10≤ to <100	100≤ to <1000						
100≤ to <1000	1000≤ to <10000						
≥1000	≥10000						

Cells highlighted in green represent chemical characteristics associated with low environmental hazard levels.
1 Octanol–water partition coefficient.
2 Bioconcentration factor.

Category 3 chemicals in the *INPEX Chemical Assessment and Approval Procedure*, are considered to present a low environmental hazard if they meet all of the following criteria:

- they are listed on AICS
- they do not contain ozone-depleting substances or synthetic greenhouse gases for which a license is required
- they are not registered on either the OSPAR priority action or possible concerns lists
- they are in the "green" range (Table 9-2)
- the maximum credible discharge volume is less than 10 m^3 a day.

Chemicals regarded as Category 3 are considered to present inherently low potential environmental harm, and therefore are regarded as ALARP and acceptable and do not require further environmental assessment.

Category 1 chemicals, with regards to liquid effluent discharges, are chemicals which are not listed on the AICS and therefore cannot be used in Australia. As such, the use of Category 1 chemicals is not permitted by INPEX. Category 1 chemicals are not acceptable but may be ALARP. Should a Category 1 chemical be required, the chemical vendor must have the chemical listed on AICS before INPEX considers its use. Once a Category 1 chemical is listed on AICS, it is reclassified as a Category 2 or 3 depending on its characteristics and maximum daily discharge volumes.

Category 2 chemicals are those which are neither, Category 1 or Category 3 chemicals. Category 2 chemicals are required to undergo an additional environmental assessment to ensure they are ALARP and acceptable. The additional environmental assessment incorporates five criteria.

1. Potential environmental consequence of the discharge:
    - the potential environmental hazard and impact pathways based on the chemical's fate, toxicity, bioaccumulation and biodegradation potential (chemical characteristics provided by the chemical vendor)

- comparison of the proposed chemical discharge concentration against the Safety Data Sheet (SDS) toxicity value and adjusted No Effect Concentration (NEC) to obtain the severity of the potential hazard
- use of the SDS toxicity data and adjusted NEC to predict distances for the chemical to reach threshold dilutions (if not already reached at the point of discharge)

2. Potential likelihood of the negative environmental consequence occurring:
   - Whether the chemical will be spent (i.e. partially/completely used in the process) before discharge, neutralised and or have no potential to reach the marine environment (e.g. does not partition with the water during processing) and the likelihood of the identified environmental consequences being realised.
3. Risk level (using the INPEX risk matrix in Figure 6-2) based on the consequence and likelihood determined above
4. Alternative chemicals:
   - the identification of viable alternative options
   - identification of the reasons why the alternatives were not selected (such as environmental characteristics, fate, volume and concentration of discharges, overall efficacy, practicality of use/storage, compatibility with other chemicals, health and safety risks, and costs)
5. Alternative techniques:
   - identification of other non-chemical (engineering) solutions considered
   - identification of the reasons why other alternative techniques were not selected (such as environmental costs/benefits, practicality of implementation, track record – proven and/or efficient technology, health and safety risks, and costs).

9.6.2 Biofouling risk assessment for domestic movements

The biofouling risk assessment process for domestic vessel movements includes aspects of the vessels history with respect to IMS risk e.g. vessels origin from within Australian waters and previous locations of operation (including whether these Australian locations have reported IMS occurrences), periods out-of-water and inspections/cleaning undertaken, age of anti-fouling coatings, presence and condition of internal treatment systems etc.

While undertaking the INPEX biofouling risk assessment for domestic movements (Figure 9-4), in any instances where potential risks are identified e.g. no anti-fouling coating or extended stays in Port, the process requires INPEX to engage an independent IMS expert and if required a further risk assessment may be undertaken.

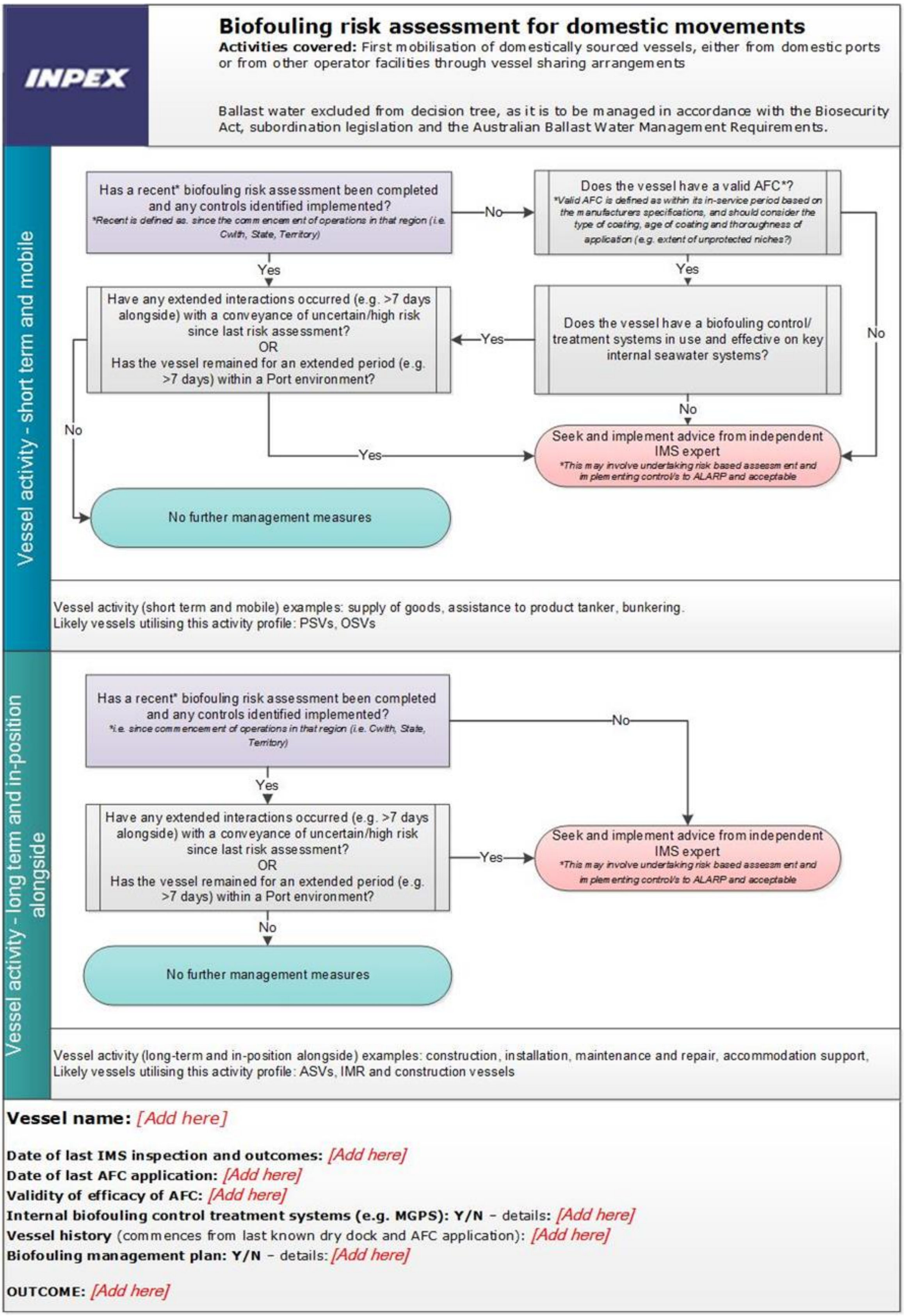


Figure 9-4: INPEX biofouling risk assessment for domestic movements

9.7 Management of change

Changes to this EP will be managed in accordance with a business-wide standard, and related procedures and guidelines. Where a change to management of an activity is proposed, it will be logged. Internal notification will be communicated via a management of change (MoC) request. The request will identify the proposed change(s) along with the underlying reasons and highlight potential areas of risk or impact. In accordance with the INPEX business rules, it is mandatory to undertake an environmental risk assessment in every case for changes that could affect the environment. The MoC request will be managed by an environmental adviser who will then determine the necessary approval/endorsement pathway, in consultation with the environmental approvals coordinator. Minor changes (such as updating a document or process) that do not invoke a revision trigger are made in document reviews from time to time.

In accordance with Regulation 17 of the OPGGS (E) Regulations 2009, a revision of this EP will be submitted to NOPSEMA where:

- a change is considered to represent a new activity
- a change is considered to represent a significant modification to, or a new stage of, an existing activity
- a change will create a significant new environmental impact or risk that is not provided for in the current EP
- a change will result in a series of new (or increased) environmental impacts or risks that, together, will result in a significant new environmental impact or risk, or a significant increase in an existing environmental impact or risk.

The MoC request process will be periodically checked against NOPSEMA guidance to ensure ongoing compliance and will be undertaken as part of the management review process described in Section 9.13.

9.8 Stakeholder engagement

9.8.1 Legislative and other requirements

INPEX maintains an approvals and compliance tracking system which identifies future approval requirements and when they must be in place, as well as compliance with existing approvals. Through this system, responsible persons are provided with alerts for required actions and time frames to avoid non-compliance and ensure there are no gaps in approvals.

In addition, INPEX personnel participate in industry and regulator forums, as well as maintain up-to-date knowledge of industry practices and proposed regulatory changes. Changes to legislative and other requirements are reviewed for potential impacts to business operations and communicated, as required, to personnel managing potentially affected activities.

Updates to matters relating to the EPBC Act, including policy statements and conservation management documentation will be achieved through subscription to automated email notifications provided by the DAWE. Where required, updates to this EP will be conducted in accordance with the MoC process described in Section 9.7.

9.8.2 Communication

The requirements of the INPEX HSEQ-MS are communicated throughout the organisation. This facilitates the cascading and implementation of business policies and standards through the business, and on to contractors who work on behalf of INPEX.

INPEX and its contractors adopt a number of methods to ensure that information relating to HSEQ risks and impacts are communicated to personnel, including:

- daily toolbox meetings
- vessel HSE meetings
- use of noticeboards, intranet, HSE alerts and newsflashes e.g. environmental aspects and events
- internal and external reporting.

9.8.3 Ongoing stakeholder consultation

In relation to an EP Implementation Strategy, Regulation 14(9) of the OPPGS (E) Regulations 2009 specifies a requirement for consultation with relevant authorities of the Commonwealth, a state or territory, and other relevant interested persons or organisations. Any objections or claims received from stakeholders while the activity is ongoing will be considered and assessed as detailed in Section 5, using the same process and criteria described for the stakeholder consultation undertaken during the development of this EP. Mechanisms that provide ongoing opportunities for consultation with stakeholders, in relation to the implementation of this EP, are summarised in Table 9-3.

Table 9-3: Ongoing stakeholder consultation

Stakeholder	Information supplied	Frequency
Australian Hydrographic Office (Cwlth)	The AHO will be notified of the activity commencement and cessation via datacentre@hydro.gov.au, for promulgation of fortnightly Notice to Mariners.	4 weeks prior to commencement and upon completion
Australian Maritime Safety Authority (AMSA; Cwlth) Joint Rescue Coordination Centre (JRCC)	INPEX to notify AMSA JRCC for promulgation of radio-navigation warnings 24-48 hours before operations commence and upon completion of the survey (Email: rccaus@amsa.gov.au; Phone: 1800 641 792 or +61 2 6230 6811). AMSA's JRCC require the vessel names, IMO vessel numbers and call signs, and Maritime Mobile Service Identity (MMSI) numbers.	24-48 hours before operations commence and upon completion
NOPSEMA (Cwlth)	NOPSEMA will be notified of the activity commencement and cessation, using the Regulation 29 Notification Form available at https://www.nopsema.gov.au/environmental management/notification-and-reporting/	At least 10 days prior to commencement and within 10 days of completion
NOPTA (Cwlth)	NOPTA will be notified of the activity commencement and cessation via reporting@nopta.gov.au	48 hours prior to commencement and upon completion
Department of Mines, Industry Regulation and Safety (WA)	DMIRS will be notified of the activity commencement and cessation.	As required

9.9 Contractors and suppliers

Selection and management processes are in place to ensure that contractors working for, or on behalf of, INPEX are able and willing to meet the minimum business expectations of INPEX, including those related to HSEQ and risk management.

The implementation of the INPEX contractor management requirements are achieved via the following processes:

- Contractors undergo an HSE assessment before receipt of an invitation to tender. As part of this process, INPEX carries out an assessment of the suitability of each contractor's management system.
- During the tender evaluation process, each contractor's management system is reviewed, assessed and ranked according to its robustness and ability to meet INPEX performance expectations as relevant to the tender work scope.
- All contractors and their subcontractors are required to meet INPEX HSEQ minimum requirements. These requirements are communicated to the contractors as part of the *Contract HSEQ Exhibits*, *Specifications* and *Terms and Conditions* documents.
- Key contractor and subcontractor personnel must be approved by INPEX under the *Contract HSEQ Exhibits*, *Specifications* and *Terms and Conditions* documents.
- INPEX maintains contract-specific management teams which are responsible for the day–to-day supervision and review of contractor compliance with INPEX requirements.
- Contract compliance audits, and quality control and assurance checks, are conducted throughout the life of the contract as appropriate to the scope of work and risks involved. Contractors are required to provide regular reports to communicate their HSEQ performance and compliance status.
- HSEQ performance of contractors is monitored through regular engagement between INPEX and contractor personnel, and through regular audits of compliance against the contractor HSE management plans.
- Periodic checks and reviews are conducted by INPEX representatives.
- Contractor documents, including environmental certification, procedures, emergency response and HSEQ management plans, need to be reviewed and accepted by INPEX before any work commences.

9.10 Security and emergency management

Regulation 14(8) of the OPGGS (E) Regulations 2009 requires the implementation strategy to contain an OPEP and the provision for the OPEP to be updated. The OPEP is designed to be an operational document. As such, some of the content requirements of the regulations are included in this EP. A summary of the regulatory requirements and a reference to where the obligations are met is provided below. The OPEP is presented in Appendix D.

In accordance with Regulation 14 (8AA) of the OPGGS (E) Regulations 2009, the OPEP must include arrangements to respond to and monitor oil pollution, including:

- the control measures necessary for a timely response to an oil pollution emergency (Table 2-1 of the OPEP, and the controls provided in Table 8-6 and Table 8-9 of this EP)
- the arrangements and response capability to implement a timely implementation of those controls, including ongoing maintenance of that capability (Sections 9.10.1, 9.10.3 and 9.10.4 of this EP)

- the arrangements and capability for monitoring the effectiveness of the controls and ensuring that performance standards for those controls are met (Table 8-6 and Table 8-9 of this EP)
- the arrangements and capability for monitoring oil pollution to inform response activities (refer to OPEP (Appendix D) and Section 4.7.2 *Scientific Monitoring*)
- the provision for the OPEP to be updated (Section 9.10.4).

9.10.1 Arrangements and capability

INPEX adopts the emergency management principles of prevention, preparedness, response, recovery (PPRR). The aim of PPRR is to ensure that risks are identified and minimised; plans to respond are developed and practised; and recovery plans are in place.

Preparedness also includes ensuring that there are competent personnel available to respond to and manage emergency events and that their competence is maintained through regular training. INPEX achieves this through its adoption of competency-based training and annual ‘crisis and emergency’ exercise plans.

Onshore

INPEX maintains a trained and ready incident management team (IMT) and crisis management team (CMT) to execute the emergency response plans (ERPs) and crisis management plans.

The IMT and CMT will utilise the INPEX Australia Incident Management Plan (0000-AH-PLN-60005), INPEX Australia Crisis Management Plan (0000-AH- PLN-60004) respectively, to respond to the event.

The IMT provides operational management support, and the CMT provides strategic direction with respect to management of reputational damage and impacts to business continuity.

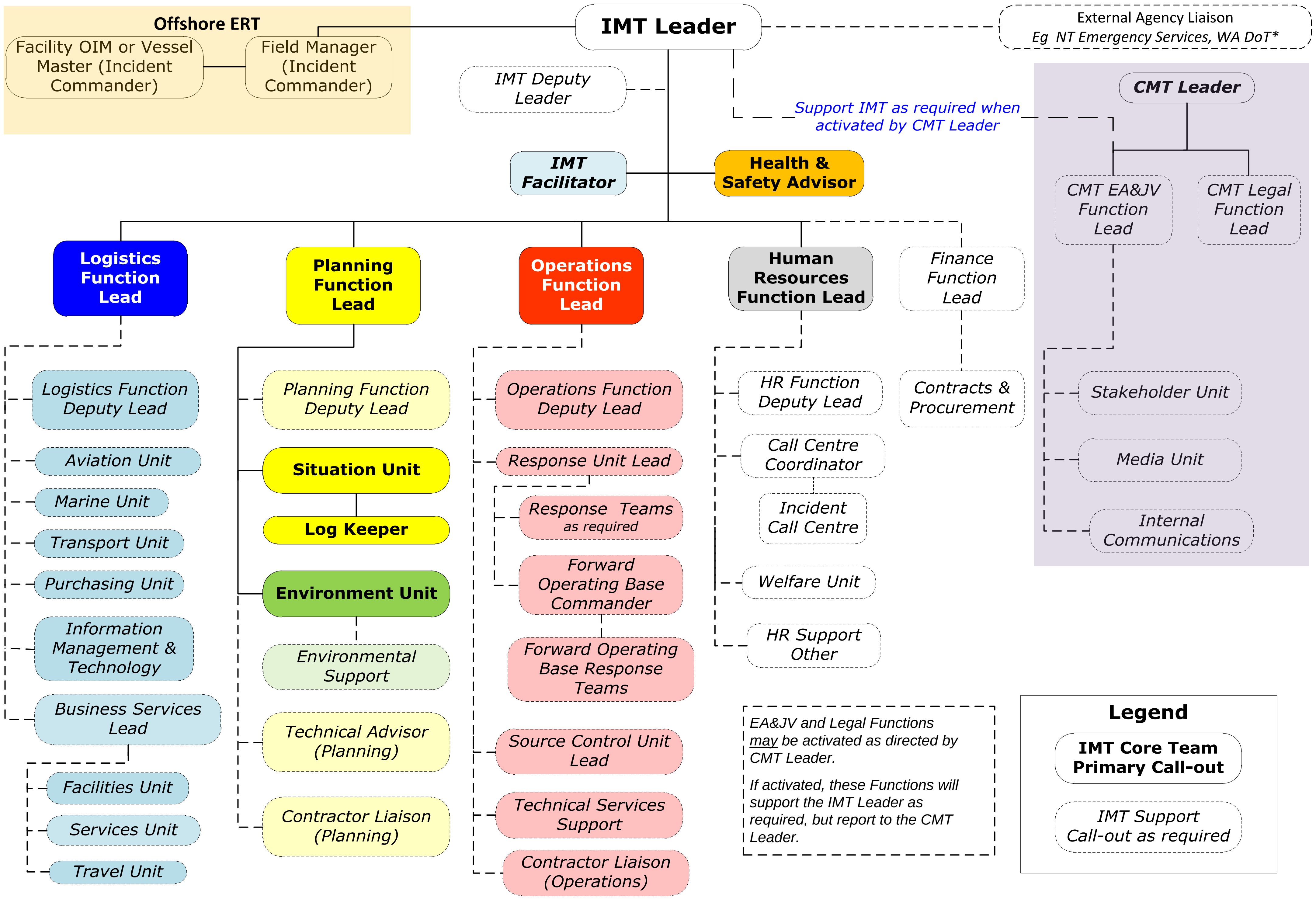
The IMT and CMT teams are large enough so that, during an emergency event, a roster can be operated to avoid fatigue and maintain staff health and well-being.

Offshore

There are ERPs for all contractor vessels that are implemented by an emergency response team (ERT). INPEX and contractors nominate and train workplace personnel to form facility and vessel-based ERTs. The ERTs will be coordinated by the relevant person in charge (vessel master) to ensure adequate emergency service cover on board at all times.

The vessel master will be the point of contact between assets within the licence area and the INPEX IMT. The INPEX IMT leader is the point of contact between the INPEX IMT and the CMT. Contractors are required to notify the INPEX offshore representative of any emergency.

The emergency response structure is presented in Figure 9-5.



* Department of Transport (WA or NT) have legal right to transfer Control Agency from Titleholder to DoT for level 2/3 oil spills impacting within State or Territory waters. WA DoT will appoint a DoT IMT Leader responsible for managing an oil spill impacting WA state waters in accordance with the State Hazard Plan Maritime Environmental Emergencies (MEE). INPEX resources will be made available to support the WA DoT 'cross jurisdictional arrangements', as specified under the MEE (WA DoT, 2018b), if requested by WA DoT. NT DIPL will appoint a DoT Incident controller (in accordance with the NT OSCP cross jurisdiction interim arrangements) to interface with the INPEX IMT where NT waters may be impacted by a spill. NT IC will become the control agency, supported by the INPEX IMT, if a spill reaches NT shorelines.

Note that the IMT structure presented is flexible and is to be collapsed or expanded at the discretion of the IMT Leader depending on the nature and scale of an emergency.

Figure 9-5: INPEX emergency response structure

Environmental performance outcomes, standards and measurement criteria relating to the maintenance of emergency response arrangements and capability are presented in Table 9-4.

Table 9-4: Environmental performance outcome, standards and measurement criteria for maintenance of emergency response arrangements and capability

Environmental performance outcome	Performance standards	Measurement criteria	Responsibility
OPEP preparedness is maintained through implementation of the environmental performance standards.	The INPEX Emergency Contacts Directory is maintained with current and relevant contact details for OPEPs on an annual basis.	Records demonstrate that electronic and hard copies of the INPEX Emergency Contacts Directory are updated at least annually.	INPEX Environmental Adviser
	The INPEX Oil Spill Forms List is reviewed annually and maintained with current and relevant forms for INPEX OPEPs.	Records demonstrate that electronic and hard copies of the relevant forms list are updated at least annually.	INPEX Environmental Adviser
	The Oil Spill Equipment Tracking Register is reviewed on an annual basis, to ensure the capabilities stated in this EP are maintained. Specifically, this includes reviewing the status of: • aviation mobilisation capability • vessel call-off contracts • contracts for additional personnel as general field responders • INPEX personnel oil spill response training • AMOSC capabilities • Oiled wildlife response kit locations • location of containment and recovery spill response equipment • spill tracker buoy batteries and servicing	Records demonstrate that the Oil Spill Equipment Tracking Register is updated at least annually.	INPEX Environmental Adviser

9.10.2 Emergency response training

This section describes the training that will be provided to the INPEX IMT, CMT and relevant offshore personnel in support of the *Ichthys URF and SPS Installation WA-50-L OPEP* (E075-AH-PLN-70001). Environmental performance outcomes, standards and measurement criteria relating to emergency response training are presented in Table 9-5.

INPEX incident and crisis management teams

Specific functions identified within the incident management team (IMT) receive nationally accredited training in line with the Australian Quality Training Framework. In addition to this, certain identified functions, along with some key support members receive specific oil spill response training. This approach ensures that INPEX always has the capability to respond to an oil spill event.

The minimum training provision for an IMT leader is PMAOMIR418 – *Coordinate incident response,* with the course material tailored to align with the INPEX Australia Incident Management Plan (0000-AH-PLN-60005). In addition, there will be at least four IMT Leaders with IMO III – oil spill command & control aligned competency to supplement the minimum IMT leader training requirement.

The minimum training provision for the IMT Core Team (positions as defined in Figure 9-4) is PMAOMIR320 - *Manage Incident Response Information*, with the course material tailored to align with the INPEX Australia Incident Management Plan (0000-AH-PLN-60005). In addition, a minimum of 15 IMT Core Team personnel will have completed an IMO II – oil spill response management aligned competency, to supplement the minimum IMT Core Team personnel training requirement.

The INPEX Crisis Management Team all receive an in-house training package, which is tailored to align with the requirements of the INPEX Australia Crisis Management Plan (0000-AH- PLN-60004).

Offshore emergency response team

Each vessel ERT will maintain its own training in oil spill response, commensurate with the risks and responses required. Vessel masters will complete mandatory minimum requirements under the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978 which includes oil spill response training.

Vessel masters will also ensure vessel ERTs complete drills as scheduled in their relevant Contractor ERP, including SOPEP drills.

In addition, vessel masters and bridge crews will be required to participate in an Ichthys *URF and SPS Installation WA-50-L OPEP* induction.

Table 9-5: Environmental performance outcome, standards and measurement criteria for emergency response training

Environmental performance outcome	Performance standards	Measurement criteria	Responsibility
INPEX IMT and vessel ERTs maintain oil spill response training as described in the performance standard.	Vessel masters will complete mandatory minimum training requirements under the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978 (STCW) which includes oil spill response training.	Records of training.	INPEX Environmental Adviser
	Vessel ERTs - conduct routine drills in accordance with the Vessel Contractor ERPs, including SOPEP drills.	Records of training.	INPEX Environmental Adviser
	INPEX Australia OPEPs induction delivered to vessel masters and vessel bridge crews.	Records of training.	INPEX Environmental Adviser
	All INPEX CMT personnel will receive INPEX in-house CMT training, which is tailored to align with the requirements of the INPEX Australia Crisis Management Plan (0000-AH-PLN-60004).	Records of training.	INPEX Environmental Adviser
	INPEX IMT Leaders (all) will have completed the INPEX tailored, nationally accredited course - PMAOMIR418 – *Coordinate incident response*.	Records of training.	INPEX Environmental Adviser
	INPEX IMT Leader (minimum of 4) will be trained in IMO-3 aligned oil spill response training.	Records of training.	INPEX Environmental Adviser
	INPEX IMT Core Team personnel (all) will have completed the INPEX tailored, nationally accredited course – PMAOMIR320 - *Manage Incident Response Information*	Records of training.	INPEX Environmental Adviser

	INPEX IMT Core Functions (minimum of 15) will be trained in IMO-2 aligned oil spill response training.	Records of training.	INPEX Environmental Adviser

9.10.3 Testing, drills and exercises

INPEX oil spill response arrangements shall be tested by the IMT:

- before the activity commences
- when the arrangements for an activity are significantly amended
- not later than 12 months following the most recent test.

Notification and call-out drills, that test communications channels and the ability to contact key individuals, shall be conducted at least annually.

Environmental performance outcomes, standards and measurement criteria relating to testing of response arrangements are presented in Table 9-6.

Table 9-6: Environmental performance outcome, standards and measurement criteria for testing response arrangements

Environmental performance outcome	Performance standards	Measurement criteria	Responsibility
OPEP preparedness is maintained through the implementation of the performance standards.	The INPEX IMT will conduct a minimum of two oil spill exercises per year, using NOPSEMA-accepted OPEPs.	Exercise records demonstrate that the INPEX IMT tested a NOPSEMA-accepted OPEP at least twice yearly.	INPEX Environmental Adviser
	The Operational SIMA Templates (from the OPEP) and the environmental sensitivities maps from Section 4 - Existing Environment, will be maintained in hard copy in the Perth IMT room	Records demonstrate the Operational SIMA Templates (from the OPEP) and the environmental sensitivities maps from Section 4 - Existing Environment, will be maintained in hard copy in the Perth IMT room	INPEX Environmental Adviser
	IMT exercises will test the IMT's ability to develop an Operational SIMA and IAP.	Exercise records will contain copies of completed Operational SIMAs and IAPs.	INPEX Environmental Adviser

	Desktop validation exercises will be conducted to test notifications processes, contracted service provider activations, and logistics assumptions, annually.	Desktop validation exercise records demonstrate that notifications processes, contracted service provider activations, and logistics assumptions were tested annually.	INPEX Environmental Adviser
	A communication drill between vessels and the INPEX IMT within 7 days of first arrival in the licence area.	Drill records demonstrate that a communication drill has occurred within 7 days of the first arrival of each vessel in the licence area.	Vessel master / INPEX Environmental Adviser

9.10.4 Updating the OPEP

The OPEP will be reviewed following events requiring its activation, in order to identify any lessons learned. OPEPs will be updated accordingly, and the INPEX Emergency Contacts Directory is reviewed as part of this process.

Environmental performance outcomes, standards and measurement criteria relating to updating the OPEP are presented in Table 9-7.

Table 9-7: Environmental performance outcome, standards and measurement criteria for updating the OPEP

Environmental performance outcome	Performance standards	Measurement criteria	Responsibility
The OPEP is reviewed and updated, as needed, with relevant lessons learned.	The OPEP will be reviewed and updated following any INPEX IMT exercise or incident in which the OPEP was used, or with any significant lessons learned from other INPEX OPEPs, as relevant to this OPEP (Appendix D).	Records demonstrate a review and update (if necessary) of the OPEP.	INPEX Environmental Adviser

9.11 Incident investigation and lessons learned

9.11.1 HSEQ performance measurement and reporting

HSEQ performance data is monitored in accordance with the INPEX HSEQ Performance Measurement and Reporting Standard. This enables the status of conformance with HSEQ obligations and goals to be determined, and also ensures HSEQ risks are being effectively managed to support continuous improvement. HSEQ is regularly reviewed by senior management.

9.11.2 Environmental incident reporting – internal

INPEX refers to environmental incidents and hazards as "environmental events", which all personnel, including contractors, are required to report as soon as is reasonably practicable. Reporting must be in accordance with the INPEX *Event Reporting and Investigation Standard* and associated procedure.

All events will be documented and reviewed for their actual and potential consequence severity levels and investigated as appropriate. Corrective or preventative actions will be identified and documented, and their completion verified in an action register. These actions may include changes to the risk registers, standards, or procedures, or the need for training, different tools or equipment. Any actions will be recorded and tracked.

9.11.3 Environmental incident reporting – external

For the purposes of regulatory reporting to NOPSEMA, an incident is classified as either "Reportable" or "Recordable" based on the definitions contained in Regulation 4 of the OPGGS (E) Regulations 2009.

A "Reportable" incident is defined as "an incident relating to the activity that has caused, or has the potential to cause, moderate to significant environmental damage." Environmental damage (or the potential to cause damage) includes social, economic and cultural features of the environment. For the purposes of this EP, such an incident is considered to have an environmental consequence level of Moderate (D) to Catastrophic (A) as defined in the INPEX Risk Matrix (Figure 6-1).

Based on the consequence assessments described in sections 7 and 8 of this EP, incidents identified as having the potential to be "Reportable" (i.e. Moderate (D) or above on the INPEX Risk Matrix) include:

- the introduction of IMS
- a vessel collision resulting in a spill
- loss of containment from the SPS.

A "Recordable" incident is defined as "a breach of an environmental performance outcome or environmental performance standard … that is not a reportable incident." In terms of the activities within the scope of this EP, it is a breach of the performance standards and outcomes listed in Section 7, Section 8 or Section 9 of this EP.

For the purposes of regulatory reporting to DAWE, any significant impact to matters of national environmental significance (MNES), as classified using the INPEX Risk Matrix, will be reported to DAWE. The Director of National Parks will be notified of any oil/gas pollution incidences within or likely to impact a marine park as soon as possible (refer to OPEP Section 2.4.3,Table 2-3).

Reportable incidents

Initial verbal notification

In the event of a reportable incident, INPEX will give NOPSEMA an initial verbal notification of the occurrence as soon as is practicable; and in any case, not later than two hours after the first occurrence of the reportable incident; or if it is not detected at the time of the first occurrence, within two hours of the time that INPEX becomes aware of the incident.

The initial verbal notification will contain:

- all material facts and circumstances concerning the reportable incident that are known or can, by reasonable search or enquiry, be found out

- any action taken to avoid or mitigate any adverse environmental impacts of the reportable incident
- the corrective action that has been taken, or is proposed to be taken, to stop, control or remedy the reportable incident.

Written notification

As soon as possible after an initial verbal notification of a reportable incident, INPEX will provide a written record of the notification to:

- NOPSEMA
- the National Offshore Petroleum Titles Authority (Cwlth)
- the Department of Mines, Industry Regulation and Safety (WA) or the Department of Primary Industry and Resources (NT), depending on the jurisdiction.

In the event of a significant impact to MNES, INPEX will provide an initial notification to DAWE within 24 hours of becoming aware of the event.

In the event of a reportable incident, INPEX will provide a written report to NOPSEMA as soon as is practicable; and in any case, not later than three days after the first occurrence of the incident. If, within the three-day period, NOPSEMA specifies an alternative reporting period, INPEX will report accordingly. The report will contain:

- all material facts and circumstances concerning the reportable incident that are known or can, by reasonable search or enquiry, be found out
- any action taken to avoid or mitigate any adverse environmental impacts of the reportable incident
- the corrective action that has been taken, or is proposed to be taken, to stop, control or remedy the reportable incident
- the action that has been taken, or is proposed to be taken, to prevent a similar incident occurring in the future.

Within seven days of giving a written report of a reportable incident to NOPSEMA, INPEX will provide a copy of the report to:

- the National Offshore Petroleum Titles Authority (Cwlth)
- the Department of Mines, Industry Regulation and Safety (WA) or Department of Primary Industry and Resources (NT), depending on the jurisdiction.

Following submission of the above, NOPSEMA may, by notice in writing, request INPEX to submit an additional report(s) of the incident. Where this is the case, NOPSEMA will identify the information to be contained in the report(s) or the matters to be addressed and will specify the submission date for the report(s). INPEX will prepare and submit the report(s) in accordance with the notice given.

In the event of a significant impact to MNES, INPEX will provide a written notification to DAWE (Cwlth) within three days of becoming aware of the event, and provide additional information as available, if requested.

This includes reporting any vessel strike incidents to the National Ship Strike Database at <https://data.marinemammals.gov.au/report/shipstrike>.

Suspected or confirmed presence of any marine pest or disease will be reported to DPIRD within 24 hours by email (biosecurity@fish.wa.gov.au) or telephone. This includes any organism listed in the WA prevention list for introduced marine pests and any other non-indigenous organism that demonstrates invasive characteristics.

Recordable incidents

Reporting

In the event of a recordable incident, INPEX will report the occurrence to NOPSEMA as soon as is practicable after the end of the calendar month in which it occurs; and in any case, not later than 15 days after the end of the calendar month. The report will contain:

- a record of all the recordable incidents that occurred during the calendar month
- all material facts and circumstances concerning the recordable incidents that are known or can, by reasonable search or enquiry, be found out
- any action taken to avoid or mitigate any adverse environmental impacts of the recordable incidents
- the corrective action that has been taken, or is proposed to be taken, to stop, control or remedy the recordable incident
- the action that has been taken, or is proposed to be taken, to prevent a similar incident occurring in the future.

9.11.4 Annual performance reporting – external

In accordance with Regulation 14(2) of the OPGGS (E) Regulations 2009, INPEX will undertake a review of its compliance with the environmental performance outcomes and standards set out in this EP and will provide a written report of its findings for the reporting period January 1 to December 31, to NOPSEMA on an annual basis, as agreed with NOPSEMA. The annual submission date for the environmental performance report will be April 1 of each year.

9.12 Monitor, review and audit

9.12.1 Management system audit

An audit and inspection program will be developed and implemented in accordance with the INPEX business standard for auditing. The program will include:

- self-assessment HSEQ audits against the HSEQ-MS
- regular inspections of workplace equipment and activities
- reviews to evaluate compliance with legislative and other requirements.

Unscheduled audits may be initiated by INPEX in the event of an incident, non-compliance or for other valid reasons.

Audit teams will be appropriately qualified, experienced and competent in auditing techniques. They will include relevant technical expertise, as required, and the audit team structure will be commensurate with the scope of the audit. HSEQ audit and inspection findings will be summarised in a report. Non-conformances, actions and improvement plans resulting from audits will be managed in an action tracking system.

9.12.2 Vessel inspections

Inspections will be undertaken to ensure that the environmental performance outcomes and standards documented in this EP are achieved.

Vessel inspections may be conducted prior to arrival and post arrival in WA-50-L to ensure that the EPO and EPSs in this EP are met.

During the activity, operational compliance against relevant EPO/EPSs will be assessed and maintained through the implementation of weekly checks, relevant to key activities occurring that week.

Non-conformances and relevant findings during the inspections will be converted into actions that will be tracked within an action tracking database until closed.

9.13 Management review

Through a process of adaptive management, lessons from management outcomes will be used for continual improvement. Formal reviews of the effectiveness and appropriateness of the INPEX HSEQ-MS are performed by senior management on a periodic basis. The things learned from this process and iterative decision-making will then be used as feedback to improve future management.

Together with the annual environmental performance report described in Section 9.11.4, EP management reviews will enable the review of environmental performance, as well the efficacy of the implementation strategy used during URF installation.

Management reviews of this EP shall assess whether:

- the environmental impacts and risks of the activity continue to be identified and reduced to a level that is ALARP
- control measures detailed in this EP are effective in reducing the environmental impacts and risks of the activity to ALARP and an acceptable level
- implementation of the management of change (MoC) process has remained consistent with the commitment to ensuring impacts and risks are reduced to ALARP and are acceptable
- any changes in legislation, or matters relating to the EPBC Act, including policy statements and conservation management documentation, have occurred which affect or need to be taken into consideration in relation to this EP
- any changes in NOPSEMA guidance which may affect or need to be taken into consideration in relation to this EP
- the Operational and Scientific Monitoring Program (within the OPEP) remains fit for purpose
- lessons learned have been communicated and, where applicable, applied across all titleholder activities, as relevant.

Where the documented findings of the EP management reviews have implications for this EP, the EP will be updated in accordance with the EP MoC process.

10 REFERENCES

ADB–see Asian Development Bank -driving may be used to install piles for the ZRBs' to

AFMA–see Australian Fisheries Management Authority

AIMS-see Australian Institute of Marine Science

Allen, G.R. and Erdmann, M.V. 2013. *Coral Reef Fishes of Timor-Leste*. Pp. 33-82 in *A Rapid Marine Biological Assessment of Timor-Leste*. Conservation International, Virginia, United States. Available at http://www.bioone.org/doi/full/10.1896/054.066.0103.

AMEC Ltd. 2011. *CPF and FPSO Environmental Conditions Data Sheets* (Doc. No. A075-AH-DAT-5000 Rev G). Report prepared by AMEC Ltd on behalf of INPEX Browse Ltd, Perth, Western Australia.

ANZG – see Australian and New Zealand Guidelines for Fresh and Marine Water Quality

APASA – see Asia-Pacific Applied Science Associates

Asia-Pacific Applied Science Associates (APASA). 2014a. *INPEX Ichthys Gap Analysis EP – OSC14.* J0312, Rev 0. Report prepared by RPS Asia-Pacific Applied Science Associates, Perth, for INPEX Browse, Ltd., Perth, Western Australia.

Asia-Pacific Applied Science Associates (APASA). 2014b. *INPEX Ichthys Gap Analysis EP – OSC31.* J0312, Rev 0. Report prepared by RPS Asia-Pacific Applied Science Associates, Perth, for INPEX Browse, Ltd., Perth, Western Australia.

Asia-Pacific Applied Science Associates (APASA). 2014c. *INPEX Ichthys Gap Analysis EP – OSC03.* J0312, Rev 0. Report prepared by RPS Asia-Pacific Applied Science Associates, Perth, for INPEX Browse, Ltd., Perth, Western Australia.

Asia-Pacific Applied Science Associates (APASA). 2015. *INPEX Ichthys FPSO Liquid Effluent Dispersion Modelling.* J0344, Rev 0. Report prepared by RPS Asia-Pacific Applied Science Associates for INPEX Browse, Ltd., Perth, Western Australia.

Asian Development Bank. 2014. *State of the Coral Triangle: Indonesia*. Mandaluyong City, Philippines.

Australian Fisheries Management Authority. 2020a. Western Tuna and Billfish Fishery. Australian Fisheries Management Authority, Canberra, ACT. Accessed online 02/02/2020 at https://www.afma.gov.au/fisheries/western-tuna-and-billfish-fishery

Australian Fisheries Management Authority. 2020b. Western Skipjack Tuna Fishery. Australian Fisheries Management Authority, Canberra, ACT. Accessed online 02/02/2020 at https://www.afma.gov.au/fisheries/skipjack-tuna-fishery

Australian Fisheries Management Authority. 2020c. North West Slope Trawl Fishery. Australian Fisheries Management Authority, Canberra, ACT. Accessed online 02/02/2020 at https://www.afma.gov.au/fisheries/north-west-slope-trawl-fishery

Australian Fisheries Management Authority. 2020d. Southern Bluefin Tuna Fishery. Australian Fisheries Management Authority, Canberra, ACT. Accessed online 02/02/2020 at https://www.afma.gov.au/fisheries/southern-bluefin-tuna-fishery

Australian Fisheries Management Authority. 2020e. Northern Prawn Fishery Fishery. Australian Fisheries Management Authority, Canberra, ACT. Accessed online 02/02/2020 at https://www.afma.gov.au/fisheries/northern-prawn-fishery

Australian Fisheries Management Authority. 2020f. Joint Authority Fisheries. Australian Fisheries Management Authority, Canberra, ACT. Accessed online 02/02/2020 at https://www.afma.gov.au/fisheries/joint-authority-fisheries

Australian Fisheries Management Authority. 2019e. Scampi. Australian Fisheries Management Authority, Canberra, ACT. Accessed online 23/08/2019 at https://www.afma.gov.au/fisheries-management/species/scampi

Australian Institute of Marine Science. 2012. *Montara: 2011 Offshore Banks Assessment Survey.* Final Report prepared by the Australian Institute of Marine Science, Townsville, Queensland for PTTEP Australasia (Ashmore Cartier) Pty. Ltd, Perth, Western Australia.

Australian and New Zealand Guidelines for Fresh and Marine Water Quality. 2018. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Accessed online 01/02/2020 at www.waterquality.gov.au/anz-guidelines

Australian Maritime Safety Authority (AMSA). 2010. *Montara Well Release Monitoring Study S7.2 Oil Fate and Effects Assessment Modelling of Chemical Dispersant Operation*. Prepared for: PTTEP Australasia. Perth WA.

Australian Maritime Safety Authority. 2015a. Technical Guideline for the Preparation of Marine Pollution Contingency Plans for Marine and Coastal Facilities. Australian Maritime Safety Authority, Canberra, ACT.

Australian Maritime Safety Authority. 2015b. *National Plan response, assessment and termination of cleaning for oil contaminated foreshores*. NP-GUI-025. Australian Maritime Safety Authority, Canberra, ACT.

Australian Maritime Safety Authority. 2015c. *Fixed Wing Aerial Dispersant Capability Joint Standard Operating Procedures (SOP) Version 1.2*. Prepared by the Australian Maritime Safety Authority, the Australian Marine Oil Spill Centre and Aerotech First Response.

Australian Maritime Safety Authority. 2019. *National plan for maritime environmental emergencies*. Australian Maritime Safety Authority, Canberra, ACT.

Australian Transport and Safety Bureau. 2013. *Australian Shipping Occurrence Statistics 2005 to 2012. Marine Research Report MR-2013-002*. Australian Transport and Safety Bureau, Canberra, ACT. Accessed online on 23/08/2019 at: https://www.atsb.gov.au/media/4119146/mr-2013-002_final.pdf

Azis P., Al-Tisan, I., Daili, M., Green T., Dalvi, A. and Javeed, M. 2003. Chlorophyll and plankton of the Gulf coastal waters of Saudi Arabia bordering a desalination plant. Desalination 154:291–302.

Baker, C., Potter, A., Tran, M. & Heap, A.D. 2008. *Geomorphology and sedimentology of the northwest marine region of Australia*, record 2008/07, Geoscience Australia, Canberra, ACT.

Bamford M., Watkins D., Bancroft W., Tischler G. and Wahl, J. 2008. *Migratory Shorebirds of the East Asian–Australasian Flyway; Population Estimates and Internationally Important Sites.* Wetlands International. Oceania. Canberra, ACT.

Bannister, J.L., Kemper, C.M. and Warneke, R.M. 1996. *The Action Plan for Australian Cetaceans*. Canberra: The Director of National Parks and Wildlife, Biodiversity Group, Environment Australia, Canberra, ACT.

Beasley I., Robertson, K.M. and Arnold, P. 2005. Description of a new dolphin: The Australian snubfin dolphin *Orcaella heinsohni* sp.n. (Cetacea, Delphinidae). *Marine* Mammal Science 21(3):365–400.

BirdLife International. 2012. Light pollution has a negative impact on many seabirds including several globally threatened species. Birdlife International, Cambridge, United Kingdom. Accessed online 23/08/2019 at http://datazone.birdlife.org/light-pollution-has-a-negative-impact-on-many-seabirds-including-several-globally-threatened-species

BirdLife International. 2020. *Important Bird Areas factsheet: Lacepede Islands*. Birdlife International, Cambridge, United Kingdom. Accessed online 01/02/2020 at http://datazone.birdlife.org/site/factsheet/lacepede-islands-iba-australia

BOM–see Bureau of Meteorology.

Brewer, D.T., Lyne, V., Skewes, T.D. & Rothlisberg, P. 2007. *Trophic systems of the north west marine region.* Report prepared by CSIRO Marine and Atmospheric Research, Cleveland, Queensland for the Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.

Brunnschweiler, J.M., Baensch, H., Pierce, S. J., and Sims, D.W. 2009. Deep-diving behaviour of a whale shark Rhincodon typus during long-distance movement in the western Indian Ocean. *Journal of Fish Biology*, 74:706-714.

Brunnschweiler, J.M., and Sims, D.W. 2011. Diel oscillations in whale shark vertical movements associated with meso-and bathypelagic diving. *American Fisheries Society Symposium* 76:457–469.

Buehler, D., R. Oestman, J.A. Reyff, K. Pommerenck, and B. Mitchell. 2015. Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish. Report Number CTHWANP-RT-15-306.01.01. California Department of Transportation (CALTRANS), Division of Environmental Analysis. 532 p. http://www.dot.ca.gov/hq/env/bio/files/bio_tech_guidance_hydroacoustic_effects_110215.pdf.

Bureau of Meteorology. 2020. Climate Data Online. Bureau of Meteorology, Melbourne, Victoria. Accessed online on 01/02/2020 from http://www.bom.gov.au/climate/data/

Burns, K.A., Garrity, S.D. and Levings, S.C. 1993. How many years before mangrove ecosystems recover from catastrophic oil spills? *Marine Pollution Bulletin.* 26(5):239–248.

Campagna, C., Short, F.T., Polidoro, B.A., McManus, R., Collette, B.B., Pilcher, N.J., Mitcheson, Y.S., Stuart, S.N. and Carpenter, K.E. 2011. Gulf of Mexico oil blowout increases risks to globally threatened species. *BioScience* 61:393–397.

CAPAD–see Collaborative Australian Protected Areas Database

Carlton, J.T. 1996. Pattern, process, and prediction in marine invasion ecology. Biological Conservation 78: 97-106.

Carlton, J.T. 2001. Introduced Species in U.S. Coastal Waters - Environmental Impacts and Management Priorities. Prepared for the Pew Oceans Commission, United States.

CCWA–see Conservation Commission of Western Australia

Clarke, R.H. 2010. *The Status of Seabirds and Shorebirds at Ashmore Reef and Cartier and Browse Islands: Monitoring Program for the Montara Well release – Pre-impact assessment and First Post-Impact Field Survey*. Report prepared for PTTEP Australasia and the Department of the Environment, Water, Heritage and the Arts (now the Department of the Environment), Australia.

Clarke, R. 2015. *Seabirds and shorebirds at Adele Island*. Applied Research Program 6: Milestone Report #2. Shell Australia, Perth and INPEX Operations Australia Pty Ltd, Perth by the Australian Institute of Marine Science, Perth, Western Australia.

Collaborative Australian Protected Areas Database. 2018. CAPAD: protected area data. Department of the Environment and Energy, Canberra, ACT. Accessed online 01/02/2020 at http://www.environment.gov.au/land/nrs/science/capad

Commonwealth of Australia. 2002. Ashmore Reef National Nature Reserve and Cartier Island Marine Reserve Management Plans. Environment Australia, Canberra, ACT.

Connell, D.W., Miller, G.J. and Farrington, J.W. 1981. Petroleum hydrocarbons in aquatic ecosystems—behavior and effects of sublethal concentrations: Part 2. *Critical Reviews in Environmental Science and Technology* 11(2):105–162.

Conservation Commission of Western Australia (CCWA). 2010. *Status Performance Assessment: Biodiversity Conservation on Western Australian Islands, Phase 2 – Kimberley Islands.* Final Report. Conservation Commission of Western Australia, Perth Western Australia.

Cook, K., Gilmour, J., Piggott, C., Oades, D., McCarthy, P., Howard, A., Bessell-Browne, P., Arklie, S. and Foster, T. 2017. *Key ecological processes in Kimberley benthic communities: coral recruitment.* Final report of Project 1.1.2b Kimberley Marine Research Program. Western Australian Marine Science Institution, Perth, Western Australia.

Coral Triangle Atlas. 2014. Savu Sea National Marine Conservation Area information requirements for inclusion in CTMPAs Categories 3 or 4. Accessed online on 01/02/2020 at http://ctatlas.reefbase.org/pdf/monitoring/CTMPAS%20SavuSea%20July%202014.pdf

Dafforn, K. A., Glasby, T. M., and Johnston, E. L., 2009a. Links between estuarine condition and spatial distributions of marine invaders. *Diversity and Distributions* 15(5): 807–821.

Dafforn, K. A., Johnston, E. L., Glasby, T. M., 2009b. Shallow moving structures promote marine invader dominance. *Biofouling* 25:3, 277-287.

David Evans and Associates, Inc. 2011. Columbia River Crossing Test Pile Project Hydroacoustic Monitoring. Washington State Department of Transportation. Agreement Number Y-9246, Task AH, Amendment No. 7, Seattle. http://www.nmfs.noaa.gov/pr/pdfs/permits/columbiariver_monitoring_report2012.pdf.

DAWR – see Department of Agriculture and Water Resources

Dean, T.A., Stekoll, M.S., Jewett, S.C., Smith, R.O. and Hose, J.E. 1998. Eelgrass (*Zostera marina* L.) in Prince William Sound, Alaska: effects of the Exxon Valdez oil spill. *Marine Pollution Bulletin*, 36:201–210.

DEC and MPRA—*see* Department of Environment and Conservation and Marine Parks and Reserves Authority

DEE- see Department of the Environment and Energy

Department of Agriculture and Water Resources (DAWR). 2017. *Australian Ballast Water Management Requirements, Version 7*. Department of Agriculture and Water Resources, Canberra, ACT.

Department of the Environment. 2015. Conservation Management Plan for the Blue Whale—A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999 2015-2025, Commonwealth of Australia, Canberra, ACT.

Department of Environment and Conservation and Marine Parks and Reserves Authority. 2005. *Management Plan for the Ningaloo Marine Park and Muiron Islands Marine Management Area 2005–2015*. Department of Environment and Conservation and Marine Parks and Reserves Authority, Perth, Western Australia.

Department of the Environment and Energy (DEE) 2017a. *Recovery Plan for Marine Turtles in Australia*. Commonwealth of Australia, Canberra, ACT.

Department of the Environment and Energy (DEE) 2017b. *EPBC Act Policy Statement 3.21. Industry guidelines for avoiding, assessing and mitigating impacts on EPBC listed migratory shorebird species*. Commonwealth of Australia, Canberra, ACT.

Department of the Environment and Energy. 2018. Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia's coast and oceans. Commonwealth of Australia 2018, Canberra, ACT.

Department of the Environment and Energy. 2020. *Light pollution guidelines – National light pollution guidelines for wildlife: Including marine turtles, seabirds and migratory shorebirds*. Commonwealth of Australia, Canberra, ACT.

Department of the Environment and Energy. 2020a. *Continental slope demersal fish communities*. Accessed online 01/02/2020 at https://www.environment.gov.au/sprat-public/action/kef/view/79;jsessionid=01AD87551D0DE1B0248C8722BE137004

Department of the Environment and Energy. 2020b. *SPRAT Profile – Dugong dugon —* Dugong*.* Accessed online 01/02/2020 at http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=28

Department of the Environment. 2020c. *SPRAT Profile – Tursiops aduncus — Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin.* Accessed online 01/02/2020 at http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=68418

Department of the Environment. 2020d. *SPRAT Profile – Orcaella heinsohni — Australian Snubfin Dolphin* Accessed online 01/02/2020 at http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=81322

Department of the Environment. 2020e. *SPRAT Profile – Sousa sahulensis — Australian Humpback Dolphin* Accessed online 01/02/2020 at http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=50

Department of the Environment. 2020f. *Carcharodon carcharias* — White Shark, Great White Shark Accessed online 01/02/2020 at http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=64470

Department of the Environment. 2020g. *The West Kimberley, Australian Heritage Database*. Accessed online 02/02/2020 at http://www.environment.gov.au/cgi-bin/ahdb/search.pl?mode=place_detail;place_id=106063.

Department of the Environment and Energy. 2020h. *Indigenous Protected Areas.* Accessed online 02/02/2020 at https://www.environment.gov.au/land/indigenous-protected-areas

Department of the Environment, Water, Heritage and the Arts. 2008. North Marine Bioregional Plan bioregional profile: a description of the ecosystems, conservation values and uses of the North Marine Region. Commonwealth of Australia, Canberra, ACT.

Department of the Environment, Water, Heritage and the Arts. 2009. Threat abatement plan to reduce the impacts of exotic rodents on biodiversity on Australian offshore islands of less than 100,000 hectares. Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.

Department of Environment, Water, Heritage and the Arts. 2010. Survey guidelines for Australia's threatened birds Guidelines for detecting birds listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999. Department of Environment, Water, Heritage and the Arts, Canberra, ACT.

Department of Environment and Water Resources. 2006. *Sea turtle conservation and education on the Tiwi Islands*. Final National Heritage Trust Report. Department of the Environment and Water Resources, Canberra, ACT.

Department of Parks and Wildlife. 2013. *Lalang-garram / Camden Sounds Marine Park management plan 73 2013-2023*. Department of Parks and Wildlife, Perth Western Australia.

Department of Parks and Wildlife. 2014. Western Australian Oiled Wildlife Response Plan (WA OWRP). Department of Parks and Wildlife, Perth, Western Australia.

Department of Parks and Wildlife. 2016a. *North Kimberley Marine Parks joint management plan 2016*. Management Plan 89. Department of Parks and Wildlife, Perth, Western Australia.

Department of Parks and Wildlife. 2016b. *Lalang-garram/Horizontal Falls and North Lalang-garram marine parks joint management plan 2016*. Management Plan 88. Department of Parks and Wildlife, Perth, Western Australia.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC). 2008. Recommendation Report. *Development of the Ichthys Gas Field*. EPBC 2008/4208. Report prepared by DSEWPaC, Canberra, ACT.

Department of Sustainability, Environment, Water, Population and Communities. 2012a. *Marine bioregional plan for the North-west Marine Region*. 2012. Department of Sustainability, Environment, Water, Population and Communities, Canberra, ACT.

Department of Sustainability, Environment, Water, Population and Communities. 2012b. *Marine bioregional plan for the North Marine Region*. Department of Sustainability, Environment, Water, Population and Communities, Canberra, ACT.

Det Norske Veritas. 2015. Environmental Class, New Buildings, Special Equipment and Systems -Additional Class. Rules for Classification of Ships, Part 6 Chapter 12. July 2015.

DEWR – see Department of Environment and Water Resources

DeVantier, L., Turak, E., Allen, G. 2008. Lesser Sunda Ecoregional Planning Coral Reef Stratification: Reef- and Seascapes of the Lesser Sunda Ecoregion. Report to the Nature Conservancy. Bali, Indonesia. 72 pp.

DEWHA – see Department of Environment, Water, Heritage and the Arts

Director of National Parks. 2018a*. North-west Marine Parks Network Management Plan* 2018. Director of National Parks, Canberra, ACT.

Director of National Parks. 2018b. *North Marine Parks Network Management Plan* 2018. Director of National Parks, Canberra, ACT.

DNV – see Det Norske Veritas

DoE – see Department of the Environment

Dolman, S. and Williams-Grey, V. 2006. *Vessel collisions and cetaceans: What happens when they don't miss the boat. A WDCS Science Report*. The Whale and Dolphin Conservation Society (WDCS), Chippenham, Wiltshire, United Kingdom.

Done, T.J., Williams, D. McB., Speare, P.J., Davidson, J., DeVantier, L.M., Newman, S.J. & Hutchins, J.B. 1994. *Surveys of coral and fish communities at Scott Reef and Rowley Shoals*. Australian Institute of Marine Science, Townsville, Queensland.

Donovan, A., Brewer, D., van der Velde, T. and Skewes, T. 2008. *Scientific descriptions of four selected key ecological features in the North-west Bioregion: final report.* Report to the Australian Government Department of Environment, Water, Heritage and the Arts, Canberra, ACT and CSIRO Marine and Atmospheric Research, Cleveland, Queensland.

Double, M.C, Andrews-Goff, V., Jenner, K.C.S., Jenner, M-N., Laverick, S.M., Branch, T.A. and Gales, N.J. 2014. Migratory Movements of Pygmy Blue Whales (*Balaenoptera musculus brevicauda*) Between Australia and Indonesia as Revealed by Satellite Telemetry. PLoS One. 2014 Apr 9:9(4):e93578. doi: 10.1371/journal.pone.0093578. eCollection 2014.

Dow Piniak W.E. 2012. Acoustic Ecology of Sea Turtles: Implications for Conservation. PhD thesis, Marine Science and Conservation Duke University. pp 136. Accessed online on 07/06/2019 at: https://dukespace.lib.duke.edu/dspace/bitstream/handle/10161/6159/Piniak_duke_0066D_11691.pdf?sequence=1

DSEWPaC – see Department of Sustainability, Environment, Water, Population and Communities

Duke, N., Burns, K., Swannell, J., Dalhaus, O. and Rupp, R. 2000. Dispersant use and a bioremediation strategy as alternative means of reducing impacts of large oil spills on mangroves: the Gladstone field trials. *Marine Pollution Bulletin*. 41, (7–12):403–412.

Duke, N. Wood, A. Hunnam, K. Mackenzie, J. Haller, A. Christiansen, N. Zahmel, K. and Green, T. 2010. *Shoreline Ecological Assessment Aerial and Ground Surveys 7-19 November 2009*. As part of the Scientific Monitoring Study of the Montara Monitoring Plan. A report commissioned by PTTEP Australasia (Ashmore Cartier) PL, Perth, Western Australia for the Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.

Duncan, A.J. and Parsons, M.J.G. 2011. How Wrong Can You Be? Can a Simple Spreading Formula Be Used to Predict Worst-Case Underwater Sound Levels? Paper Number 87, Proceedings of ACOUSTICS 2011, 2-4 November 2011, Gold Coast, Australia.

Eckert, S. A. and Stewart, B. S. 2001. Telemetry and satellite tracking of whale sharks, Rhincodon typus, in the Sea of Cortez, Mexico, and the north Pacific Ocean. *Environmental Biology of Fishes* 60(1-3): 299-308.

Environment Australia 2002. Australian IUCN Reserve Management Principles for Commonwealth Marine Protected Areas. ISBN 0642548536.

Epstein, N., Bak, R.P.M. and Rinkevich, B. 2000. Toxicity of 3rd generation dispersants and dispersed Egyptian crude oil on Red Sea coral larvae. *Marine Pollution Bulletin*, 40: 497–503.

Evans, K., Bax, N.J. & Smith, D.C. 2016. Marine environment: State and trends of indicators of marine ecosystem health: Physical, biogeochemical and biological processes. In: *Australia state of the environment* 2016 Department of the Environment and Energy, Canberra, ACT.

Fandry, C.B. and Steedman, R.K. 1994. Modelling the dynamics of the transient, barotropic response of continental shelf waters to tropical cyclones. Continental Shelf Research, 14:1723–1750.

Foster, S.J. and Vincent, A.C.J. 2004, Life history and ecology of seahorses: implications for conservation and management, *Journal of Fish Biology* 65 (1–61).

French-McCay, D.P. 2002. Development and application of an oil toxicity and exposure model, OilToxEx. Environmental Toxicology and Chemistry 21(10):2080–2094.

French McCay, D.P. 2003. Development and Application of Damage Assessment Modelling: Example Assessment for the North Cape Oil Spill. *Marine Pollution Bulletin* 47(9–12):341-359.

French-McCay, D.P. 2009. *State of the art and research needs for oil spill impact assessment modelling*. pp. 601-653, in Proceedings of the 32nd AMOP Technical Seminar on Environmental Contamination and Response, Emergencies Science Division, Environment Canada, Ottawa, Canada.

Fucik, K.W., Bight, T.J. and Goodman, K.S. 1984. Measurements of damage, recovery, and rehabilitation of coral reefs exposed to oil. pp. 115–134 in Cairns Jr., J. and Buikema Jr., A.L. (eds.), *Restoration of Habitats Impacted by Oil Spills*, Butterworth Publishers, Boston, United States.

Fugro Survey Pty Ltd. 2005. *Ichthys Field Development: Western Extension, Browse Basin. Volume 1a – Survey results*. Fugro Survey Job No. P0358. Report prepared by Fugro Survey Pty Ltd, Perth, for INPEX Browse, Ltd., Perth, Western Australia.

Gaughan, D.J. and Santoro, K. (eds). 2018. *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2016/17: The State of the Fisheries*. Department of Primary Industries and Regional Development, Western Australia.

Geraci, J.R. and St. Aubin, D.J. (eds) 1988. *Synthesis of Effects of Oil on Marine Mammals*. Report prepared by the Battelle Memorial Institute for U.S. Department of the Interior, Minerals Management Service, Atlantic OCS Region, OCS Study, MMS 88-0049, Ventura, CA.

Gilmour, J., Smith, L. and Brinkman, R. 2009. Biannual spawning, rapid larval development and evidence of self-seeding for scleractinian corals at an isolated system of reefs*. Marine Biology* 156:1297–1309.

Gilmour, J.P., Travers, M.J., Underwood, J.N., McKinney, D.W., Gates, E.N., Fitzgerald, K.L., Case, M., Ninio, R., Meekan, M.G., O'Leary, R., Radford, B., Ceccarelli, D. and Hoey, A.S. 2010. Long-term Monitoring of Coral and Fish Communities at Scott Reef, AIMS Document No SRRP-RP-RT-045, SRRP Project 1: 2010 Annual Report for Woodside as operator of the Browse LNG Development, Australian Institute of Marine Science, Townsville, pp. 254.

Gilmour, J.P., Travers, M.J., Underwood, J.N., Markey, K.L., Ninio, R., Ceccarelli, D., Hoey, A.S., Case, M. and O'Leary, R. 2011. *Long term Monitoring of Shallow Water Coral and Fish Communities at Scott Reef*. AIMS Document No SRRP-RP-RT-048, SRRP Project 1: 2011. Report prepared for Woodside as operator of the Browse LNG Development, Perth, Western Australia by Australian Institute of Marine Science, Townsville, Queensland.

Gilmour, J., Smith, L., Cook, K. and Pincock, S. 2013. *Discovering Scott Reef: 20 years of exploration and research.* Woodside and the Australian Institute of Marine Science, Perth, Western Australia.

Glasby, T. M., Connell, S. D., Holloway, M. G., Hewitt, C. L., 2007. Nonindigenous biota on artificial structures: could habitat creation facilitate biological invasions. *Marine Biology* 151: 887–895.

Goodbody-Gringley, G., Wetzel, D.L., Gillon, D., Pulster, E. and Miller, A.l. 2013. Toxicity of Deepwater Horizon Source Oil and the Chemical Dispersant, Corexit® 9500, to Coral Larvae. *PLOS ONE* 8(1): e45574.

Gray, C.A., Otway, N.M., Laurenson, F.A., Miskiewicz, A.G. and Pethebridge, R.L. 1992. Distribution and abundance of marine fish larvae in relation to effluent plumes from sewage outfalls and depth of water. *Marine Biology* 113: 549–559.

Gubbay, S. and Earll, R. 2000. *Review of literature on the effects of oil spills on cetaceans. Scottish National Heritage Review No. 3*. Report to Talisman Energy (United Kingdom) Limited and Scottish Natural Heritage, United Kingdom.

Guinea, M. 2006. Sea turtles, sea snakes and dugongs of Scott Reef, Seringapatam Reef and Browse Island with notes on West Lacepede Island. Unpublished report for the Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.

Hale, J. and Butcher, R. 2009. *Ecological Character Description of the Eighty Mile Beach Ramsar Site.* Report to the Department of Environment and Conservation, Perth, Western Australia. Accessed online 22/08/2019 at https://www.dpaw.wa.gov.au/images/documents/conservation-management/wetlands/ramsar/eighty-mile-beach-ecd_final-with-disclaimer.pdf

Hale, J. and Butcher, R. 2013. *Ashmore Reef Commonwealth Marine Reserve Ramsar Site -Ecological Character Description*. A report to the Department of Environment, Canberra, ACT.

Hallegraeff, G.M. 1995. Harmful algal blooms: A global overview. In Hallegraeff, G.M., D.M. Anderson & A.D. Cembella (eds.), pp. 1-22 Manual on Harmful Marine Microalgae, IOC Manuals and Guides No. 33, UNESCO Paris, France.

Hamernik, R. P., Ahroon, W. A., Hsueh, K. D., Lei, S. F. and Davis, R. I. 1993. Audiometric and histological differences between the effects of continuous and impulsive noise exposures. Journal of the Acoustical Society of America, 93(4):2088–2095.

Hamernik, R. P., Qiu, W. and Davis, B. 2003. The effects of the amplitude distribution of equal energy exposures on noise-induced hearing loss: The kurtosis metric. Journal of the Acoustical Society of America, 114:386–395.

Harrison, P.L. 1999. Oil pollutants inhibit fertilisation and larval settlement in the scleractinian reef coral Acropora tenuis from the Great Barrier Reef, Australia in Sources, Fates and Consequences of Pollutants in the Great Barrier Reef and Torres Strait: Conference Abstracts. Great Barrier Reef Marine Park Authority, Townsville, Queensland.

Harte, C. and Curtotti, R. 2018. North West Slope Trawl Fishery. In: Department of Agriculture and Resources ABARES Fishery Status Reports 2018. Commonwealth of Australia, Canberra, ACT.

Hearn, C.J. and Holloway, P.E. 1990. A three-dimensional barotropic model of the response of the Australian North West Shelf to tropical cyclones. Journal of Physical Oceanography 20(1):60–80.

Hewitt, C., Campbell, M., Coutts, A., Dahlstrom, A., Shields, D., Valentine, J., 2011. Species Biofouling Risk Assessment, Department of Agriculture, Fisheries and Forestry. Canberra, ACT.

Heyward, A.J., Farrell, P.D. and Seamark, R.F. 1994. The effect of petroleum based pollutants on coral gametes and fertilisation success. p 119 in the *Sixth Pacific Congress on Marine Science and Technology*, Townsville, Australia.

Heyward, A., Moore, C., Radford, B. and Colquhoun, J. 2010a. *Monitoring program for the Montara well release Timor Sea: final report on the nature of Barracouta and Vulcan shoals*. Report prepared by the Australian Institute of Marine Science for PTTEP Australasia, Perth, Western Australia.

Heyward, A., Radford, B., Burns, K., Colquhoun, J. and Morre, C. 2010b. Montara surveys: Final *report on benthic surveys at Ashmore, Cartier and Seringapatam reefs*. Report prepared by the Australian Institute of Marine Science for PTTEP Australasia, Perth, Western Australia.

Heyward, A., Jones, R., Meeuwig, J., Burns, K., Radford, B., Colquhoun, J., Cappo, M., Case, M., O'Leary, R.A., Fisher, R., Meekan, M. and Stowar, M. 2011. *Monitoring Study S5 Banks and Shoals, Montara. 2011. Offshore Banks Assessment Survey*. Report for PTTEP Australasia (Ashmore Cartier) Pty Ltd. Australian Institute of Marine Science, Townsville, Queensland.

Heyward, A., Speed, C., Meekan, M., Cappo, M., Case, M., Colquhoun, J., Fisher, R., Meeuwig, J. and Radford, B. 2013. Montara: Vulcan, Barracouta East and Goeree shoals survey 2013. Report prepared by the Australian Institute of Marine Science for PTTEP Australasia, Perth, Western Australia.

Heyward, A., Wakeford, M., Cappo, M., Olsen, Y., Radford, B., Colquhoun, J., Case, M., and Stowar, M. 2018. *Submerged Shoals 2017*. Applied Research Project 7: Subtidal Benthos: towards benthic baselines in the Browse Basin. Report prepared for Shell/INPEX by the Australian Institute of Marine Science, Perth, Western Australia.

Hick, P. 1995. Spectral measurement of illumination sources at Thevenard Island: a preliminary study of the probable effects of gas flares and oil production facility lights on green *turtles; a subsequent revisit to measure a range of gas-flow rates.* Restricted report prepared for West Australian Petroleum Pty Limited, Perth, by the CSIRO Remote Sensing of Environment Group, Perth, Western Australia. Minesite Rehabilitation Research Program Report No. 516c, CSIRO, Canberra, ACT.

Hoff, R., and Michel, J. 2014. Oil spills in mangroves: planning and response considerations. US Department of Commerce. National Oceanic and Atmospheric Administration (NOAA), Seattle, Washington, United States.

Hook, S.S. and Osborn, H. L. 2012. Comparison of toxicity and transcriptomic profiles in a diatom exposed to oil, dispersants, dispersed oil. *Aquatic Toxicology* 124–125: 139–151.

Hsu, H.H., Joung, S.J., Liao, Y.Y., and Liu, K.M. 2007. Satellite tracking of juvenile whale sharks*, Rhincodon typus, in the Northwestern Pacific. Fisheries Research* 84(1), 25-31.

Huffard, C.L., M.V. Erdmann, T.R.P. Gunawan (Eds) 2012. *Geographic Priorities for Marine Biodiversity Conservation in Indonesia*. Ministry of Marine Affairs and Fisheries and Marine Protected Areas Governance Program. Jakarta- Indonesia. 105 pp.

Huhta, H. K., Rytkonen, J. and Sassi, J. 2009. Estimated nutrient load from waste waters originating from ships in the Baltic Sea area – Updated 2009. VTT-R-07396-08. Report to the Technical Research Centre of Finland (VTT). Helsinki, Finland.

Hutomo M and Moosa M K. 2005. Indonesian marine and Coastal biodiversity: Present Status. *Indian Journal of Marine Sciences* 34(1): 88-97.

IFSEC Global. 2014. *Environmental impact of foam*. Accessed online 12/02/2020 at http://www.ifsecglobal.com/environmental-impact-of-foam/

INPEX. 2010. *Ichthys Gas Field Development Project: draft environmental impact statement*. Report prepared by INPEX Browse, Ltd., Perth Western Australia, for the Commonwealth Government, Canberra ACT, and the Northern Territory Government, Darwin, Northern Territory.

International Petroleum Industry Environmental Conservation Association. 2014. Wildlife response preparedness. IPIECA-IOGP Good Practice Guide Series, Oil Spill Response Joint Industry Project (OSR-JIP). IOGP Report 516. London, United Kingdom.

International Petroleum Industry Environmental Conservation Association. 2015. *A guide to oiled shoreline clean-up techniques*. IOGP report 521. International Petroleum Industry Environmental Conservation Association, London, United Kingdom.

International Petroleum Industry Environmental Conservation Association. 2017a. *Guidelines on implementing spill impact mitigation assessment (SIMA*). IOGP Report 593. International Petroleum Industry Environmental Conservation Association, London, United Kingdom.

International Petroleum Industry Environmental Conservation Association. 2017b. *Key principles for the protection, care and rehabilitation of oiled wildlife*. IOGP Report 583. International Petroleum Industry Environmental Conservation Association, London, United Kingdom.

International Tanker Owners Pollution Federation. 2011. *Effects of Oil Pollution on Fisheries and Mariculture*. Technical Information Paper 11. International Tanker Owners Pollution Federation, London, United Kingdom. Accessed online on 05/02/2020 at: http://www.itopf.com/fileadmin /data/Documents/ TIPS%20TAPS/TIP11EffectsofOilPollutiononFisheriesandMariculture.pdf

International Tanker Owners Pollution Federation Limited. 2013. Technical Information Paper (TIP) 04: *Use of Dispersants to Treat Oil Spills*. London. UK.

International Whaling Commission 2011. *Country Report on Ship Strikes*. Accessed online 18/06/2019 at https://iwc.int/private/downloads/ogt-ONlgW44CXYJphC5vIQ/64-CC%203.pdf

IPIECA - See International Petroleum Industry Environmental Conservation Association

ITOPF – See International Tanker Owners Pollution Federation

IWC – see International Whaling Commission

Jackson, J.B.C., Cubit, J.D., Keller, B.D., Batista, V., Burns, K., Caffey, H.M., Caldwell, R.L., Garrity, S.D., Getter, C.D., Gonzalez, C., Guzman, H.M., Kaufmann, K.W., Knap, A.H., Levings, S.C., Marshall, M.J., Steger, R., Thompson, R.C. and Weil, E. 1989. Ecological effects of a major oil spill on Panamanian coastal marine communities. *Science* 243:37–44.

Jenner, K.C.S., Jenner, M.N., and McCabe K.A. 2001. *Geographical and temporal movements of humpback whales in Western Australian waters*. APPEA Journal 38(1): 692-707.

Jenner, C., Jenner, M. and Pirzl, R. 2008. A study of cetacean distribution and oceanography in the Scott Reef/Browse Basin development areas during the austral winter of 2008, Centre for Whale Research (WA) Inc., Perth, Western Australia.

Jenner, KCS & Jenner, MN. 2009a. Humpback whale distribution and abundance in the near shore SW Kimberley during winter 2008 using aerial surveys. Report produced for Woodside Energy Limited, Perth, Western Australia.

Jenner, KCS & Jenner, MN. 2009b. *Near-shore Vessel Surveys in the SW Kimberley Region During the Humpback Whale Southern Migration, 2008*. Report produced for Woodside Energy Limited, Perth, Western Australia.

Jenssen, B.M. 1994. Review article: Effects of oil pollution, chemically treated oil, and cleaning on the thermal balance of birds. *Environmental Pollution*, 86:207–215.

Jimenez-Arranz, G., Glanfield, R., Banda, N., and Wyatt, R. 2017. Review on existing data on underwater sounds produced by the oil and gas industry. Prepared by Sieche Ltd and submitted to E&P Sound and Marine Life (JIP). August 2017. Devon, UK.

Khalanski, M. 2002. Organic products generated by the chlorination of cooling water at marine power stations. Journe´es d'Etudes du Cebedeau, *Tribune de l'Eau* No. 619-620-621, France.

Knap, A.H., Sleeter, T.D., Dodge, R.E., Wyers, S.C., Frith, H.R. and Smith, S.R. 1985. *The effects of chemically and physically dispersed oil on the brain coral Diploria strigosa (Dana)—a summary review*. pp. 547–551 in American Petroleum Institute, Proceedings 1985 Oil Spill Conference. API Publication Number 4385. Washington D.C.

Kunhold, W.W. 1978. *Effects of the water soluble fraction of a Venezuelan heavy fuel oil (No. 6) on cod eggs and larva*e in Wilson, M.P., McQuin, J.P. and Sherman, K. (eds), In the Wake of the Argo Merchant. Centre for Ocean Management Studies, University of Rhode Island, Rhode Island, United States.

Laist, D.W., Knowlton, A.R., Mead, J.G., Collet, A.S. and Podesta, M. 2001. Collisions between ships and whales. *Marine Mammal Science* 17:35–75.

Lee, K. 2011. *Toxicity Effects of Chemically Dispersed Crude Oil on Fish*. International Oil Spill Conference Proceedings 2011(1):163.

Leung, H.W. 2000. Ecotoxicology of glutaraldehyde: review of environmental fate and effects studies. *Ecotoxicology and Environmental Safety* 49(1):26–39.

Limpus, C. J., Miller, J. D., Parmenter, C. J. and Limpus, D. J. 2003. The green turtle, Chelonia mydas, population of Raine Island and the Great Barrier Reef: 1843–2001. *Memoirs of the Queensland Museum*. 49:349–440.

Lohmann, K. J. and Fittinghoff-Lohmann, C. M. 1992. Orientation to oceanic waves by Green Turtle Hatchings. *Journal of Experimental Biology*, 171:1–13.

Lourie, S. A., Vincent, A. C. J. & Hall, H. J. 1999. *Seahorses: an identification guide to the world's species and their conservation*, Project Seahorse, London, United Kingdom.

Loya, Y. and Rinkevich, B. 1980. Effects of oil pollution on coral reef communities. *Marine Ecology Progress*, Series 3:167–180.

Marine Conservation Institute. 2020. Atlas of Marine Protection. KKPN Laut Sawu Marine National Park. Marine Conservation Institute. Accessed online 01/02/2020 at http://www.mpatlas.org/mpa/sites/67705397/.

Marine Pest Sectoral Committee. 2018. National biofouling management guidelines for the petroleum production and exploration industry. December 2018. Department of Agriculture and Water Resources, Canberra, ACT.

Marquenie, J., Donners, M., Poot, H., Steckel, W., de Wit, B. and Nam, A. 2008. *Adapting the Spectral Composition of Artificial Lighting to Safeguard the Environment*, Petroleum and Chemical Industry Conference Europe – Electrical and Instrumentation Applications, 5th PCIC Europe.

Marsh, H., T.J. O'Shea and J.R. Reynolds. 2011. *The ecology and conservation of sirenia; dugongs and manatees*. Cambridge University Press, London, United Kingdom.

Matcott, J., Baylis, S., and Clarke, R.H. 2019. The Influence of Petroleum oil films on the feather structure of tropical and temperate seabird species. Marine Pollution Bulletin 138: 135-144.

McCauley, R.D. 1998. Radiated underwater noise measured from the drill ship Ocean General, drill ship tenders Pacific Ariki and Pacific Frontier, fishing vessel Reef Venture and natural sources in the Timor Sea, Northern Australia. Unpublished report prepared by the Centre for Marine Science and Technology, Curtin University, Perth, Western Australia for Shell Australia.

McCauley, R.D., Fewtrell, J., Duncan, A.J., Jenner, C., Jenner, M-N., Penrose, J.D., Prince, R.I.T., Adhitya, A., Murdoch, J. and McCabe, K. 2000, *Marine Seismic Surveys – A Study of Environmental Implications*, APPEA Journal 40:692-707.

McCauley, R.D. 2009. *Ambient, biological and anthropogenic sea noise sources from Browse and Maret Islands, Kimberley, 2006–2008*. Prepared in association with the Centre for Whale Research and the Centre for Marine Science and Technology, for INPEX Browse, Ltd. Perth, Western Australia.

McCauley, R.D. and Jenner, C. 2010. Migratory patterns and estimated population size of pygmy blue whales (*Balaenoptera musculus brevicauda*) traversing the Western Australian coast based on passive acoustics, Paper SC/62/SH26 presented to the International Whaling Committee Scientific Committee, 2010 (unpublished).

McDonald, S. F., Hamilton, S. J., Buhl, K. J. and Heisinger, J. F. 1996. Acute toxicity of fire control chemicals to Daphnia magna (Straus) and Selenastrum capricornutum (Printz). *Ecotoxicology and Environmental Safety* 33:62–72.

MCI–see Marine Conservation Institute

McIlwaine, D. 2002. Challenging traditional biodegradation tests: the biodegradation of glutaraldehyde. Paper presented at the 9th Annual International Petroleum Environmental Conference, Albuquerque, New Mexico, USA, 22–25 October 2002.

McIntyre, A.D. and Johnston, J. 1975*. Effects of Nutrient Enrichment from Sewage in the Sea* in Gameson A.L.H. (ed.) Discharge of sewage from sea outfalls. Pergamon Press, Oxford, United Kingdom.

McKinnon, D., Meekan, M., Stevens, J. and Koslow, T. 2002. WA-271-P Biological/Physical Oceanographic and Whale shark movement study: R.V. Cape Ferguson Cruise 2982, 2-24 April 2002. Australian Institute of Marine Science Final Report produced for Woodside Energy Limited Perth, Western Australia.

McLoughlin, R.J., Davis, T.L.O. and Ward, T.J. 1988. Sedimentary provinces, and associated bedforms and benthos on the Scott Reef–Rowley Shoals platform off north-west Australia. *Australian Journal of Marine and Freshwater Research* 39(2):133–144.

McPherson, C. and Wood, M. 2017. Otway Basin Geophysical Operations Acoustic Modelling - Acoustic Modelling for Assessing Marine Fauna Sound Exposures. Prepared for Lattice Energy on 2 November 2017. Document 01473

Meekan, M.G. and Radford, B. 2010. *Migration patterns of Whale Sharks: A summary of 15 satellite tag tracks from 2005 to 2008.* Report produced for Woodside Energy Ltd, Australian Institute of Marine Science, Perth, Western Australia.

Milton, S., Lutz, P. and Shigenaka G. 2003. Oil Toxicity and Impacts on Sea Turtles. In Shigenaka, G. (ed.), *Oil and Sea Turtles: Biology, Planning, and Response*. National Oceanic and Atmospheric Administration, Seattle, Washington, United States.

Milton, D.A., Fry, G.C, and Quinton, D. 2009. Reducing impacts of trawling on protected sea snakes: by-catch reduction devices improve escapement and survival. *Marine and Freshwater Research* 60: 824-832.

Moody, C.A. and Field, J.A. 2000. Perfluorinated Surfactants and the Environmental Implications of Their Use in Fire-Fighting Foams. *Environmental Science and Technology* 34 (18):3864–3870.

Mrosovsky, N., Ryan G.D. and James M.C. 2009. Leatherback turtles: The menace of plastic. Marine Pollution Bulletin 58(2):287–289.

Mustoe, S. and Edmunds, M. 2008. Coastal and Marine Natural Values of the Kimberley. WWF Australia, Sydney, NSW, cited in Department of State Development. 2010. *Browse Liquefied Natural Gas Precinct – Strategic Assessment Report (draft for public comment)*, *Part 3 Environmental Assessment – Marine Impacts*. Department of State Development, Perth, Western Australia.

National Indigenous Australians Agency. 2020. *Indigenous Protected Area (IPAs*). Accessed online 02/02/2020 at https://www.niaa.gov.au/indigenous-affairs/environment/indigenous-protected-areas-ipas

National Marine Fisheries Service. 2013. Marine Mammals: Interim Sound Threshold Guidance (webpage). National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce.

National Marine Fisheries Service. 2014. *Marine Mammals: Interim Sound Threshold Guidance* (webpage). National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce. http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/threshold_guidance.html.

National Marine Fisheries Service. 2018. 2018 Revision to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Department of Commerce, NOAA. NOAA Technical Memorandum NMFS-OPR-59.

National Oceanic and Atmospheric Administration. 2010. Oil Spills in Mangroves, Planning and Response. National Oceanic and Atmospheric Administration. US Department of Commerce, Office of Response and Restoration.

National Offshore Petroleum Safety Environment Authority (NOPSEMA) 2014. *Issues Paper IP1411 (Consultation Requirements under the OPGGS Environment Regulations 2009 - Rev 2).*

National Offshore Petroleum Safety Environment Management Authority. 2019a. *Oil spill modelling.* NOPSEMA Bulletin #1, A652993, Rev 0, April 2019. National Offshore Petroleum Safety Environment Management Authority, Perth, Western Australia.

National Offshore Petroleum Safety Environment Management Authority. 2019b. *Clarifying statutory requirements and good practice consultation.* NOPSEMA Bulletin #2, A696998, Rev 0, November 2019. National Offshore Petroleum Safety Environment Management Authority, Perth, Western Australia.

National Research Council. 1985. *Oil in the Sea: Inputs, Fates, and Effects*. The National Academies Press. Washington, DC.

National Research Council. 2005. *Oil Spill Dispersants: Efficacy and Effects*. The National Academies Press. Washington, DC.

National Science Foundation, U.S. Geological Survey, and National Oceanic and Atmospheric Administration (U.S.). 2011. *Final Programmatic Environmental Impact Statement/Overseas.* Environmental Impact Statement for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey. National Science Foundation, Arlington, VA. https://www.nsf.gov/geo/oce/envcomp/usgs-nsf-marine-seismic-research/nsf-usgs-final-eis-oeis_3june2011.pdf.

Negri, A.P. and Heyward, A.J. 2000 Inhibition of fertilization and larval metamorphosis of the coral *Acropora millepora* (Ehrenberg, 1834) by petroleum products. *Marine Pollution Bulletin* 41(7–12):420–427.

NIAA – see National Indigenous Australians Agency

NMFS – see National Marine Fisheries Service

NOAA – see National Oceanic and Atmospheric Administration

NOPSEMA – see National Offshore Petroleum Safety Environment Management Authority

Northern Territory Department of Primary Industries and Resources Commercial Fishing. 2020a. *Bait net fishery licences*. Accessed online 02/02/2020 at https://nt.gov.au/marine/commercial-fishing/fishery-licenses/mollusc-industry-and-licences

Northern Territory Department of Primary Industries and Resources Commercial Fishing. 2020b. *Coastal net fishery and licences*. Accessed online 02/02/2020 at https://nt.gov.au/marine/commercial-fishing/coastal-net-fishery_and-licences

Northern Territory Department of Primary Industries and Resources Commercial Fishing. 2020c. *Coastal line fishery and licences*. Accessed online 02/02/2020 at https://nt.gov.au/marine/commercial-fishing/coastal-line-fishery-and-licences

Northern Territory Department of Primary Industries and Resources Commercial Fishing. 2020d. *Mollusc fishery and licences*. Accessed online 02/02/2020 at https://nt.gov.au/marine/commercial-fishing/fishery-licenses/mollusc-industry-and-licences

Northern Territory Department of Primary Industries and Resources Commercial Fishing. 2020e. *Offshore net and line fishery*. Accessed online 02/02/2020 at https://nt.gov.au/marine/commercial-fishing/offshore-net-and-line-fishery

Northern Territory Department of Primary Industries and Resources Commercial Fishing. 2020f. *Pearl oyster fishery*. Accessed online 02/02/2020 at https://nt.gov.au/marine/commercial-fishing/pearl-oyster-industry

Northern Territory Department of Primary Industries and Resources Commercial Fishing. 2020g. *Spanish mackerel fishery and licences*. Accessed online 02/02/2020 at https://nt.gov.au/marine/commercial-fishing/spanish-mackerel-fishery-and-licences

Northern Territory Government. 2010. Water Quality Objectives for the Darwin Harbour Region – Background Document. Aquatic Health Unit, Department of Natural Resources, Environment, The Arts and Sport. Darwin, Northern Territory.

Northern Territory Government. 2016. Status of Key Northern Territory Fish Stocks Report 2015. Northern Territory Government. Department of Primary Industry and Resources. Fishery Report No. 118. Darwin, Northern Territory.

Northern Territory Seafood Council. 2020a. Timor Reef Fishery. Accessed online 02/02/2020 at https://www.ntsc.com.au/content/about-our-fisheries/timor-reef

Northern Territory Seafood Council. 2020b. Demersal Fishery. Accessed online 02/02/2020 at https://www.ntsc.com.au/content/about-our-fisheries/demersal

Northern Territory Seafood Council. 2020c. Trepang Fishery. Accessed online 02/02/2020 at https://www.ntsc.com.au/content/about-our-fisheries/trepang

Northern Territory Seafood Council. 2020d. Wildcatch and aquaculture. Accessed online 02/02/2020 at https://www.ntsc.com.au/content/about-our-fisheries/wildcatch-and-aquaculture

Northern Territory Seafood Council. 2020e. Aquarium Fishery. Accessed online 02/02/2020 at https://www.ntsc.com.au/content/about-our-fisheries/aquarium

Northern Territory Seafood Council. 2020f. Mud Crab Fishery. Accessed online 12/02/2020 at https://www.ntsc.com.au/content/about-our-fisheries/mud-crab

NRC–see National Research Council

NSF–see National Science Foundation

NT DPIR-see Northern Territory Department of Primary Industries and Resources

NTG–see Northern Territory Government

NTSC-see Northern Territory Seafood Council

O'Brien, M. 2002. *At-sea recovery of heavy oils - A reasonable response strategy?* 3rd Forum on High Density Oil Spill response. The International Tanker Owners Pollution Federation Limited (ITOPF). London, United Kingdom.

Olsen, Y.S., Kendrick, G.A., Bessay, C., McLaughlin, J., Darnell, R. and Keesing J. 2018. *Baselines of benthic communities, herbivory and reef metabolism at Browse Island*. Shell/INPEX ARP7-2 Final Report. Australian Institute of Marine Science, Perth, Western Australia.

OSPAR Commission. 2012. OSPAR List of Substances Used and Discharged Offshore Which Are Considered to Pose Little or No Risk to the Environment (PLONOR) 2012. OSPAR Agreement 2012-06.

Parks Australia. 2020a. Arafura Marine Park. Accessed online 01/02/2020 at https://parksaustralia.gov.au/marine/parks/north/arafura/

Parks Australia. 2020b. Argo-Rowley Terrace Marine Park. Accessed online 01/02/2020 at https://parksaustralia.gov.au/marine/parks/north-west/argo-rowley-terrace/

Parks Australia. 2020c. Ashmore Reef Marine Park. Accessed online 01/02/2020 at https://parksaustralia.gov.au/marine/parks/north-west/ashmore-reef/

Parks Australia. 2020d. Cartier Island Marine Park. Accessed online 01/02/2020 at https://parksaustralia.gov.au/marine/parks/north-west/cartier-island/

Parks Australia. 2020e. Kimberley Marine Park. Accessed online 01/02/2020 at https://parksaustralia.gov.au/marine/parks/north-west/kimberley/

Parks Australia. 2020f. Mermaid Reef Marine Park. Accessed online 01/02/2020 at https://parksaustralia.gov.au/marine/parks/north-west/mermaid-reef/

Parks Australia. 2020g. Oceanic Shoals Marine Park. Accessed online 01/02/2020 at https://parksaustralia.gov.au/marine/parks/north/oceanic-shoals/

Pendoley, K.L. 2005. *Sea turtles and the environmental management of industrial activities in north-west Western Australia*. PhD thesis. Murdoch University, Perth, Western Australia.

Perdanahardja, G. and Lionata, H. 2017. *Nine Years in Lesser Sunda*. Indonesia: The Nature Conservancy, Indonesia Coasts and Oceans Program. Accessed online on 01/02/2020 at http://marineplanning.org/wp-content/uploads/2018/02/Nine_years_Lesser_Sunda.pdf

Peters, E.C., Meyers, P.A., Yevich, P.P. and Blake, N.J. 1981. Bioaccumulation and histopathological effects of oil on a stony coral. *Marine Pollution Bulletin* 12(10):333–339.

Phillips, M., Henriksson, P.J.G., Tran, N., Chan, C.Y., Mohan, C.V., Rodriguez, U-P., Suri, S., Hall, S. and Koeshendrajana, S. 2015. *Exploring Indonesian aquaculture futures*. Penang, Malaysia: WorldFish.Program Report: 2015-39.

Pimental, D.L., Leach, R., Zuniga, Morrison, D. 2000. Environmental and economic costs of nonindigenous species in the United States. *Bioscience* 50:53-65.

Poot, H., Ens, B.J., de Vries, H., Donners, M.A.H., Wernand, M.R. and Marquenie, J.M. 2008. Green light for nocturnally migrating birds. *Ecology and Society* 13(2):47. Accessed online 02/02/2020 at http://www.ecologyandsociety.org/vol13/iss2/art47/

Popper, A.N., Hawkins, A.D., Fay, R.R., Mann, D.A., Bartol, S., Carlson, T.J., Coombs, S., Ellison, W.T., Gentry, R.L., Halvorsen, M.B., Løkkeborg, S., Rogers, P.H., Southall, B.L., Zeddies, D.G. and Tavolga, W.N. 2014. *Sound Exposure Guidelines for Fishes and Sea Turtles.* Technical report prepared by the ANSI-Accredited Standards Committee S3/SC1 and registered with the American National Standards Institute (ANSI). ASA S3/SC1.4 TR-2014. Springer and ASA Press, Cham, Switzerland.

Protected Planet. 2020. KKPN Laut Sawu, Indonesia. Accessed online 01/02/2020 at https://www.protectedplanet.net/kkpn-laut-sawu-marine-national-park

Qiu, B., Mao, B. and Kashino, Y. 1999. Intraseasonal variability in the Indo-Pacific Throughflow and the regions surrounding the Indonesian Seas. *Journal of Physical Oceanography*, 29:1599–1618.

Reiersen, L.-O. and Fugelli, K. The Effect of the Water-Soluble Fraction of North Sea Crude Oil on the Transport Mechanism of Taurine in Erythrocytes from Flounder, *Platichthys Flesus.* In "Fate and Effects of Oil in Marine Ecosystems": Proceedings of the Conference on Oil Pollution Organized under the auspices of the International Association on Water Pollution Research and Control (IAWPRC) by the Netherlands Organization for Applied Scientific Research TNO Amsterdam., The Netherlands, 23–27 February 1987.

Rodríguez, A., Holmes, N.D., Ryan, P.G., Wilson, K.-J., Faulquier, L., Murillo, Y., Raine, A.F., Penniman, J., Neves, V., Rodríguez, B., Negro, J.J., Chiaradia, A., Dann, P., Anderson, T., Metzger, B., Shirai, M., Deppe, L., Wheeler, J., Hodum, P., Gouveia, C., Carmo, V., Carreira, G.P., Delgado-Alburqueque, L., Guerra-Correa, C., Couzi, F-X., Travers, M. and Le Corre, M. 2017. A global review of seabird mortality caused by land-based artificial lights. *Conservation Biology* 31:986-1001.

Ross, A., Stalvies, C., Talukder, A., Trefry, C., Mainson, M., Cooper, L., Yuen, M., Palmer, J. 2017. *Interpretive geochemical data report on samples obtained during ARP2 Trip 6184, May 2015*. Applied Research Program project 2 task 3 report - Applied Research Program project 2 task 4 report. CSIRO confidential report EP173371.

Rowat, D. and Gore, M. 2007. Regional scale horizontal and local scale vertical movements of whale sharks in the Indian Ocean off Seychelles. *Fisheries Research*, 84(1), 32-40.

RPS. 2007. *Environmental baseline survey results*. Report prepared by RPS Environmental Pty Limited for INPEX Browse, Ltd., Perth, Western Australia.

RPS. 2008. *INPEX environmental impact assessment studies – Technical appendix: Marine ecology*. Report prepared by RPS Environmental Pty Limited., Perth, for INPEX Browse Limited, Perth, Western Australia.

RPS APASA. 2014a. *Ichthys Offshore Operations Gap Analysis: Dispersion of exhaust emissions from the Ichthys CPF and FPSO – modelling assessment*. J0312 Rev 0 01/10/2014. Report prepared by RPS APASA Pty Ltd for INPEX Operations Australia, Perth, Western Australia.

RPS APASA. 2014b. INPEX – Ichthys GEP Vessel Spills – Dispersant Application Modelling Study. Job Ref# J0293. Report prepared by RPS APASA for INPEX Operations Australia, Perth, Western Australia.

RPS. 2019. *INPEX Ichthys Phase 2 Development WA-50-L Oil Spill Risk Assessment*. MAW0796J rev 3. Report prepared by RPS for INPEX Operations Australia, Perth, Western Australia.

RPS Environment and Planning Pty Ltd 2010. *Marine Megafauna 2009 Humpback Whale Survey Report.* Report produced for Woodside Energy Limited, Perth, Western Australia.

RPS Environment and Planning Pty Ltd 2011. *Marine Megafauna Study 2010.* Report produced for Woodside Energy Limited, Perth, Western Australia.

RPS MetOcean Pty Ltd. 2011. *Final Metocean Design Criteria for Ichthys Development Browse Basin.* R1285v6. Report prepared by RPS MetOcean Pty Ltd for INPEX Browse, Ltd., Perth, Western Australia.

Ryan, P.G., Connell, A.D., and Gardner, B.D. 1988. Plastic ingestion and PCBs in seabirds: is there a relationship? *Marine Pollution Bulletin* 19:174–176.

Scales, H. 2010. 'Advances in the ecology, biogeography and conservation of seahorses (genus *Hippocampus*)', *Progress in Physical Geography* 34 (443).

Schaefer, T. 2013. *Aquatic Impacts of Firefighting Foams*. Whitepaper. Form Number F-2012007, Solberg, Illinois, United States.

Shigenaka, G. 2001. *Toxicity of Oil to Reef Building Corals: A Spill Response Perspective*. National Oceanic and Atmospheric Administration (NOAA) Technical Memorandum, National Ocean Service, Office of Research and Restoration 8, Seattle, USA.

Simmonds, M., Dolman, S. and Weilgart, L. 2004. Oceans of Noise. A WDCS Science Report. The Whale and Dolphin Conservation Society (WDCS). Wiltshire, United Kingdom.

Sleeman, J. C., Meekan, M.G., Fitzpatrick, B.J., Steinberg, C.R., Ancel, R., and Bradshaw, C.J.A. 2010. Oceanographic and atmospheric phenomena influence the abundance of whale sharks at Ningaloo Reef, Western Australia. *Journal of Experimental Marine Biology and Ecology*, 383:77–81.

Southall, B.L., Bowles, A.E., Ellison, W.T., Finneran, J.J., Gentry, R.L., Greene Jr., C.R., Kastak, D., Ketten, D.R., Miller, J.H., Nachtigall, P.E., Richardson, W.J., Thomas, J.A. and Tyack, P.L. 2007. Marine mammal noise exposure criteria: Initial scientific recommendations. *Aquatic Mammals* 33(4):1–121.

Stout, S. A., Payne, J. R., Emsbo-Mattingly, S. D., and Baker, G. 2016. Weathering of field-collected floating and stranded Macondo oils during and shortly after the Deepwater Horizon oil spill. *Marine Pollution Bulletin* 105(1):7-22.

Suhring, R., Philips, C. Gioia, R. and Rowles, R. 2017. *Perfluorinated compounds in offshore fire-fighting foams – a source for marine contamination?* Organohalogen Compounds Vol 79, 667-669. Dioxin Symposium - August 2017, Vancouver, Canada.

Taylor, J.G. 1996. Seasonal occurrence, distribution and movements of the whale shark, Rhincodon typus, at Ningaloo Reef, Western Australia. *Marine and Freshwater Research* 47 (637-642).

Taylor, C. J. L. 2006. The effects of biological fouling control at coastal and estuarine power stations. *Marine Pollution Bulletin* 53(1–4):30–48.

Taylor, H., and Rasheed, M. 2011. Impacts of a fuel oil spill on seagrass meadows in a subtropical port, Gladstone, Australia – The value of long-term marine habitat monitoring in high risk areas. *Marine Pollution Bulletin* 63:431-437.

Thums, M., Jenner, C., Waples, K., Salgado-Kent, C. and Meekan, M. 2018. *Humpback whale use of the Kimberley: understanding and monitoring spatial distribution*. Report Project 2.1.1 prepared for the Kimberley Marine Research Program. Western Australian Marine Science Institution, Perth, Western Australia.

Tsvetnenko, Y. 1998. Derivation of Australian tropical marine water quality criteria for protection of aquatic life from adverse effects of petroleum hydrocarbons. *Environmental Toxicology and Water Quality* 13(4):273–284.

UNEP - see United Nations Environment Programme

Underwood, J.N., Smith, L.D., van Oppen, M.J.H. and Gilmour, J.P. 2009. Ecologically relevant dispersal of corals on isolated reefs: implications for managing resilience. *Ecological Applications* 19: 18-29.

Underwood, J., Richards, Z., Berry, O. and Gilmour, J. 2017. *Population connectivity and genetic diversity in brooding and broadcast spawning corals in the Kimberley*. Report of Project 1.1.3 - Project 1.1.3.1 Kimberley Marine Research Program. Western Australian Marine Science Institution, Perth, Western Australia.

United Nations Environment Programme. 1985. *GESAMP: Thermal discharges in the marine environment*. United Nations Environment Programme Regional Seas Reports and Studies No. 45.

URS Corporation. 2007. Port of Anchorage Marine Terminal Development Project Underwater Noise Survey Test Pile Driving Program, Anchorage, Alaska. Report prepared for Integrated Concepts & Research Corporation, Anchorage, Alaska.

Vanderlaan, A.S.M. and Taggart, C.T. 2007. Vessel collisions with whales: the probability of lethal injury based on vessel speed. *Marine Mammal Science* 23(1):144–156.

Waayers, D., Mau, R., Mueller, A., Smith, J., and Pet-Soede, L. 2015. *A review of the spatial distribution of marine turtle nesting and foraging areas in western Australia*. In Proceedings of the Second Australian and Second Western Australian Marine Turtle Symposia, Perth 25-27 August 2014. 2015. Science Division, Department of Parks and Wildlife, Perth, Western Australia.

Waples, K., Field, S., Kendrick, A., Johnston, A., Twomey, L. 2019. Strategic Integrated Marine Science for the Kimberley Region: Kimberley Marine Research Program Synthesis Report 2012-2018. Prepared for the Western Australian Marine Science Institution, Perth Western Australia.

Ward, T. 1996. Sea snake by-catch of fish trawlers on the northern Australian continental shelf. *Marine and Freshwater Research* 47: 625-630.

Warner, G.A. 2014. Bayesian geoacoustic inversion of airgun modal dispersion using a single hydrophone in the Chukchi Sea. 2nd International Conference and Exhibition on Underwater Acoustics. June 2014, Rhodes, Greece.

Webb, G.J.W., Whitehead, P.J. and Manolis, S.C. 1987. *Crocodile management in the Northern Territory of Australia. Pp. 107-124 in Wildlife Management: Crocodiles and Alligators*, ed. by G.J.W. Webb, S.C. Manolis and P.J. Whitehead. Surrey Beatty and Sons: Sydney, New South Wales.

Weis, P., Weis, J.S. and Greenberg, A. 1989. Treated municipal wastewaters: effects on development and growth of fishes. *Marine Environmental Research* 28: 527–532.

Wells, F.E. Hanley, J.R. Walker, D.I. 1995. *Marine Biological Survey of the Southern Kimberley, Western Australia.* Western Australian Museum, Perth, Western Australia.

Western Australian Department of Transport. 2018a. *DOT307215 Provision of Western Australian Marine Oil Pollution Risk Assessment – Protection Priorities*. Protection Priority Assessment for Zone 1: Kimberley – Draft Report May 2018, Perth, Western Australia.

Western Australian Department of Transport. 2018b. *State Hazard Plan, Maritime Environmental Emergencies.* State Emergency Management Committee, Government of Western Australia, Perth, Western Australia.

Western Australian Fishing Industry Council. 2020a. Mackerel Managed Fishery. Accessed online 02/02/2020 at http://www.wafic.org.au/fishery/mackerel-fishery/

Western Australian Fishing Industry Council. 2020b. Pearl Oyster Fishery. Accessed online 02/02/2020 at http://www.wafic.org.au/fishery/pearl-oyster-fishery/

Western Australian Fishing Industry Council. 2020c. North Coast Prawn Fishery. Accessed online 02/02/2020 at http://www.wafic.org.au/fishery/north-coast-prawn-fishery/

Western Australian Fishing Industry Council. 2020d. Trochus Fishery. Accessed online 02/02/2020 at http://www.wafic.org.au/fishery/trochus-fishery/

Western Australian Fishing Industry Council. 2020e. North Coast Crab Fishery. Accessed online 02/02/2020 at http://www.wafic.org.au/fishery/north-coast-crab-fishery/

Western Australian Fishing Industry Council. 2020f. North Coast Prawn Fishery. Accessed online 02/02/2020 at http://www.wafic.org.au/fishery/north-coast-prawn-fishery/

Western Australian Fishing Industry Council. 2020g. Roe's Abalone Fishery. Accessed online 02/02/2020 at http://www.wafic.org.au/fishery/roes-abalone-fishery/

Western Australian Fishing Industry Council. 2020h. North Coast Nearshore and Estuarine Fishery. Accessed online 02/02/2020 at https://www.wafic.org.au/fishery/north-coast-nearshore-and-estuarine-fishery/

Whiting, S. and Guinea, M. 2005. *Dugongs of Ashmore Reef and the Sahul Banks: a review of current knowledge and a distribution of sightings*. In Russell B., Larson H., Glasby C.J., Willan R.C., and Martin, J. (eds) Understanding the Cultural and Natural Heritage Values and Management Challenges of the Ashmore Region, Proceedings of a Symposium organised by the Australian Marine Sciences Association and the Museum and Art Gallery of the Northern Territory, Darwin, 4–6 April 2001. Museum and Art Galleries of the Northern Territory & Australian Marine Sciences Association, Darwin, Northern Territory.

Whiting, A.U., Thomson, A., Chaloupka, M., and Limpus, C.J. 2008. Seasonality, abundance and breeding biology of one of the largest populations of nesting flatback turtles, Natator depressus: Cape Domett, Western Australia. *Australian Journal of Zoology* 56: 297-303.

Wiese, F. K., Montevecchi, W. A., Davoren, G. K., Huettmann, F., Diamind, A. W., and Linke, J. 2001. Seabirds at risk around offshore oil platforms in the north-west Atlantic. *Marine Pollution Bulletin* Vol 42(12):1285–1290.

Wilson, S.G., Polovina, J.J., Stewart, B. S., and Meekan, M. G. 2006. Movements of Whale Sharks (Rhincodon typus) tagged at Ningaloo Reef, Western Australia. *Marine Biology* 148:1157–1166.

Wilson, J., Darmawan, A., Subijanto, J., Green, A. and Sheppard, S. 2011. *Scientific Design of a Resilient Network of Marine Protected Areas. Lesser Sunda Ecoregion, Coral Triangle*. The Nature Conservancy. Asia Pacific Marine Program Report No. 2/11. March 2011.

Witherington, B.E. 1992. Behavioral responses of nesting sea turtles to artificial lighting. Herpetologica 48:31–39.

Witherington, B. E. and Martin, R. E. 2000. Understanding, Assessing and Resolving Light-Pollution Problems on Sea Turtle Nesting Beaches. Florida Fish and Wildlife Conservation Commission FMRI Technical Report TR-2, Second Edition, Revised. Florida Marine Research Institute, Tequesta, Florida.

Wolanski, E. 1994. Physical Oceanographic Processes of the Great Barrier Reef. CRC Press, Florida, United States.

Woodside – see Woodside Energy Ltd.

Woodside Energy Ltd. 2009. Scott Reef status report 2008. Woodside Energy Ltd., Perth, Western Australia.

Woodside Energy Ltd. 2014. Browse FLNG Development, Draft Environmental Impact Statement. EPBC 2013/7079. November 2014. Woodside Energy Ltd., Perth, Western Australia.

Zieman, J.C., Orth, R., Phillips, R.C., Thayer, G. and Thorhaug, A. 1984. The effects of oil on seagrass ecosystems. pp. 37–64 in Cairn, J. and Buikema, A.L. (eds), Restoration of Habitats Impacted by Oil Spills. Butterworth, Boston, USA.

Zykov. M. 2013. Underwater Sound Modelling of Low Energy Geophysical Equipment Operations. JASCO Document 00600, Version 2.0. Technical report prepared by JASCO Applied Sciences for CSA Ocean Sciences Inc., Florida, USA.

Appendix A
EPBC Act Approval (2008/4208)
Ministerial Conditions

On 27 May 2015, INPEX received revised conditions for Approval Decision EPBC 2008/4208 from DAWE, to reflect the outcomes of the Commonwealth Government's regulatory streamlining process. Condition 19 was added as a new condition and it requires INPEX to ensure elements of conditions which are no longer required to be implemented are included in Environment Plans submitted to NOPSEMA for assessment. This Appendix demonstrates how Condition 19 has been met.

Relevant EPBC 2008/4208 Ministerial Conditions	**Location in Environment Plan submission**
19. A plan, strategy or program (however described) required by conditions 1, 2, 5, 7, 8, 9 or 15 is automatically deemed to have been submitted to, and approved by, the Minister if the measures (as specified in the relevant condition) are included in an environment plan (or environment plans) relating to the taking of the action that:	This EP includes the elements of relevant conditions, as cross-referenced below.
a) was submitted to NOPSEMA after 27 February 2014; and	
b) either: i. is in force under the OPGGS Environment Regulations; or ii. has ended in accordance with Regulation 25A of the OPGGS Environment Regulations.	
19B. Where an environment plan which includes measures specified in the conditions referred to in conditions 19 and 19A above, is in force under the OPGGS Environment Regulations that relates to the taking of the action, the person taking the action must comply with those measures as specified in that environment plan.	This EP
1. Oil Spill Contingency Plan The person taking the action must develop and submit to the Minister for approval, an Oil Spill Contingency Plan that demonstrates the response preparedness of the person taking the action for any hydrocarbon spills, including the capacity to respond to a spill and mitigate the environmental impacts on the Commonwealth marine area and listed species habitat within offshore areas and Darwin Harbour. The Plan must include, but is not limited to:	This EP
a) Oil spill trajectory modelling for potential spills from the action. This should include consideration of a well blow out or uncontrolled release. The modelling should be specific to the characteristics of the hydrocarbons contained in the Ichthys gas field, the likely volumes released in a worst-case scenario spill, and the potential time over which the oil may be released in a worst-case scenario spill, including a scenario of a minimum eleven (11) week uncontained spill;	Section 8.1, Section 8.2 and Section 8.3 Table 8-3, Table 8-4, Table 8-5, Table 8-6, Table 8-7, Table 8-8 and Table 8-9.

Relevant EPBC 2008/4208 Ministerial Conditions	**Location in Environment Plan submission**
b) A description of resources available for use in containing and minimising impacts in the event of a spill and arrangements for accessing them;	Section 8.2.5, Section 8.3.5, Section 8.5 and Section 8.6 and Section 9.10 and Appendix D (OPEP) of this EP
c) A demonstrated capacity to respond to a spill at the site, including application of dispersants, if required and appropriate, and measures that can feasibly be applied within the first 12 hours of a spill occurring;	Section 8.2.5, Section 8.3.5, Section 8.5 and Section 8.6 and Section 9.10 and Appendix D (OPEP) and Appendix E (SIMA) of this EP
d) Identification of sensitive areas that may be impacted by a potential spill, in particular, Browse Island, specific response measures for those areas and prioritisation of those areas during a response;	Section 4 in particular Section 4.4.2 and Section 8.3.5 and Section 8.3.5 of this EP and Appendix D (OPEP)
e) Details of the insurance arrangements that have been made in respect of paying the costs associated with operational and scientific monitoring, as outlined in the Operational and Scientific Monitoring Program required under condition 2 and repairing any environmental damage arising from potential oil spills, as determined necessary from the results of the Operational and Scientific Monitoring Program;	Section 1.6 of this EP
f) Training of staff in spill response measures and identifying roles and responsibilities of personnel during a spill response; and	Sections 9.3, 9.10.2 and 9.10.3 of this EP
g) Procedures for reporting oil spill incidents to the Department.	Section 9.11.3 and Appendix D (OPEP) of this EP
The person taking the action must not commence drilling activities until the Oil Spill Contingency Plan is approved. The approved Oil Spill Contingency Plan must be implemented.	INPEX will not commence activities until this EP is Accepted by NOPSEMA and a commencement notification has been made. The Accepted EP will be implemented as required under the OPGGS Act and OPGGS(E) Regulations.
2. Operational and Scientific Monitoring Program	This EP

Relevant EPBC 2008/4208 Ministerial Conditions	Location in Environment Plan submission
The person taking the action must develop and submit to the Minister for approval, an Operational and Scientific Monitoring Program that will be implemented in the event of an oil spill to determine the potential extent and ecosystem consequences of such a spill, including, but not limited to:	
a) Triggers for the initiation and termination of the Operational and Scientific Monitoring Program, including, but not limited to, spill volume, composition, extent, duration and detection of impacts;	Section 4.7 of Appendix D (OPEP)
b) A description of the studies that will be undertaken to determine the operational response, potential extent of impacts, ecosystem consequences and potential environmental reparations required as a result of the oil spill.	Section 4.7 and Appendix A of the OPEP
c) Details of the insurance arrangements that have been made in respect of paying the costs associated with operational and scientific monitoring, as outlined in the Operational and Scientific Monitoring Program, and repairing any environmental damage arising from potential oil spills, as determined necessary from the results of the Operational and Scientific Monitoring Program;	Section 1.6 of this EP
d) Inclusion of sufficient baseline information on the biota and the environment that may be impacted by a potential hydrocarbon spill, to enable an assessment of the impacts of such a spill;	Section 4, Section 8 particularly Table 8-6 and Table 8-9 and Appendix D (OPEP) of this EP
e) A strategy to implement the Operational and Scientific Monitoring Program, including timelines for delivery of results and mechanisms for the timely peer review of studies;	Section 4.7 of Appendix D (OPEP)
f) In the event of an oil spill the person taking the action must pay all costs associated with all operational and scientific monitoring undertaken in response to the spill, as outlined in the approved Operational and Scientific Monitoring Program and any environmental remediation determined necessary by the results of the approved Operational and Scientific Monitoring Program; and	Section 1.6 of this EP
g) Provision for periodic review of the program.	Section 9.13 of this EP

Relevant EPBC 2008/4208 Ministerial Conditions	**Location in Environment Plan submission**
The Operational and Scientific Monitoring Program must be submitted at least three months prior to the commencement of drilling activities. The person taking the action must not commence drilling activities until the Operational and Scientific Monitoring Program is approved. The approved Operational and Scientific Monitoring Program must be implemented.	INPEX will not commence activities until this EP is Accepted by NOPSEMA and a commencement notification has been made. The Accepted EP will be implemented as required under the OPGGS Act and OPGGS (E) Regulations.
7. Offshore Waste Management Plan The person taking the action must submit for the Minister's approval an Offshore Waste Management Plan or plans to mitigate the environmental effects of any wastes generated from the proposal within the Commonwealth marine area. The Offshore Waste Management Plan(s) must address the following:	
a) identify all sources of waste;	Table 3-1 and Table 3-2 and Section 7.2 of this EP
b) describe any impacts associated with disposal of these wastes;	Table 7-8 of this EP
c) clearly articulate the objectives of the plan and set measurable targets to demonstrate achievement of these;	Table 7-8 of this EP
d) outline measures to avoid impacts;	Table 7-8 of this EP
e) where impacts are unavoidable describe why they are unavoidable and measures to minimise impacts;	Section 7.2 of this EP
f) identify all regulatory requirements relating to the disposal of waste and how these will be met;	Table 2-1 and Table 7-8 of this EP
g) include a monitoring regime to determine achievement of objectives and success of measures used;	Table 7-8 and Section 9.12 of this EP
h) outline reporting and auditing arrangements; and	Section 9.11 and Section 9.12 of this EP
i) describe how the plan will apply the principles of adaptive management.	Section 9.13 of this EP

Relevant EPBC 2008/4208 Ministerial Conditions	Location in Environment Plan submission
The plan(s) must be submitted prior to the commencement of the relevant activity to which they apply. The relevant activity may not commence until the plan is approved. The approved plan(s) must be implemented.	INPEX will not commence activities until this EP is Accepted by NOPSEMA and a commencement notification has been made. The Accepted EP will be implemented as required under the OPGGS Act and OPGGS (E) Regulations.
8. Liquid Discharge Management Plan The person taking the action must submit for the Minister's approval a Liquid Discharge Management Plan or plans to mitigate the environmental effects of any liquid discharge from the proposal, including sewerage and surface water runoff. The Liquid Discharge Management Plan(s) must be for the protection of the Commonwealth marine area and habitat for listed species in Darwin Harbour and must:	This EP
a) identify all sources of liquid discharge;	Table 3-1 and Table 3-2 and Section 7.1.3 of this EP
b) describe any impacts associated with the discharge of liquids, including the cumulative impacts associated with the discharge of sewerage;	Section 7.1.3 of this EP
c) clearly articulate the objectives of the plan and set measurable targets to demonstrate achievement of these;	Section 7.1.3 of this EP
d) outline measures to avoid impacts;	
e) where impacts are unavoidable describe why they are unavoidable and measures to minimise impacts;	
f) demonstrate how any discharges into Darwin Harbour are consistent with the guidelines for discharges, and the water quality objectives for Darwin Harbour, developed under the National Water Quality Management Strategy;	N/A
g) identify all regulatory requirements relating to the discharge of liquids and how these will be met;	Table 2-1 and Section 7.1.3 of this EP

Relevant EPBC 2008/4208 Ministerial Conditions	**Location in Environment Plan submission**
h) include a monitoring regime to determine achievement of objectives and success of measures used;	Section 7.1.3 and Sections 9.12 of this EP
i) outline reporting and auditing arrangements; and	Section 9.11 and Section 9.12 of this EP
j) describe how the plan will apply the principles of adaptive management.	Section 9.13 of this EP
The plan(s) must be submitted prior to the commencement of the relevant activity to which they apply. The relevant activity may not commence until the plan is approved. Separate Liquid Discharge Management plans can be submitted for the management of liquid discharges in the Commonwealth Marine Area and Darwin Harbour. The approved plan(s) must be implemented.	The Accepted EP will be implemented as required under the OPGGS Act and OPGGS(E) Regulations.
Condition 9. Noise Management Plan The person taking the action must submit for the Minister's approval a Noise Management Plan (or multiple plans) to avoid and mitigate the noise impacts on marine fauna associated with construction activities in Darwin Harbour or the Commonwealth marine area. The Noise Management Plan/s must be for the protection of listed species in Darwin Harbour or the Commonwealth marine area (whichever area the construction activities are to be undertaken) and must:	This EP
a) identify all sources of noise that may adversely impact fauna in Darwin Harbour or the Commonwealth marine area;	Table 7-10 and Section 7.3 of this EP
b) describe any impacts associated with noise generated by pile driving and blasting;	Table 7-10 and Section 7.3 of this EP
c) provide a schedule of expected pile driving and blasting activities;	Section 3.5.2, Table 7-10 and Section 7.3 of this EP
d) clearly articulate the objectives of the plan and set measurable targets to demonstrate achievement of these;	Table 7-10 and Section 7.3 of this EP
e) outline measures to avoid impacts;	Table 7-10 and Section 7.3 of this EP

Relevant EPBC 2008/4208 Ministerial Conditions	**Location in Environment Plan submission**
f) where impacts are unavoidable describe why they are unavoidable and measures to minimise impacts;	Table 7-10 and Section 7.3 of this EP
g) include a monitoring regime to determine achievement of objectives and success of measures used;	Table 7-10, Section 7.3 and Section 9.12 of this EP
h) provide for the involvement of an expert panel in the development of the plan and monitoring program required to detect and manage impacts;	Table 7-10, Section 7.3 and Section 9.12 of this EP
i) outline reporting and auditing arrangements; and	Section 9.11 and Section 9.12 of this EP
j) describe how the plan will apply the principles of adaptive management.	Section 9.13 of this EP
In addition, the person taking the action is not permitted to undertake any blasting unless it can be demonstrated that all prudent and feasible alternatives have been ruled out and the Minister has given specific permission to allow blasting. If permission is granted the person taking the action must not undertake blasting activities for more than 28 days in total, without written approval from the Minister, and must not undertake blasting before sunrise or after sunset on any of these days. The plan/s must be submitted at least three months prior to the commencement of any pile driving or blasting activities to which the plan applies. Pile driving or blasting activities may not commence until the plan is approved. The approved plan must be implemented.	

Appendix B
EPBC ACT Protected Matters Report and Species Risk Evaluation

Australian Government

Department of the Environment and Energy

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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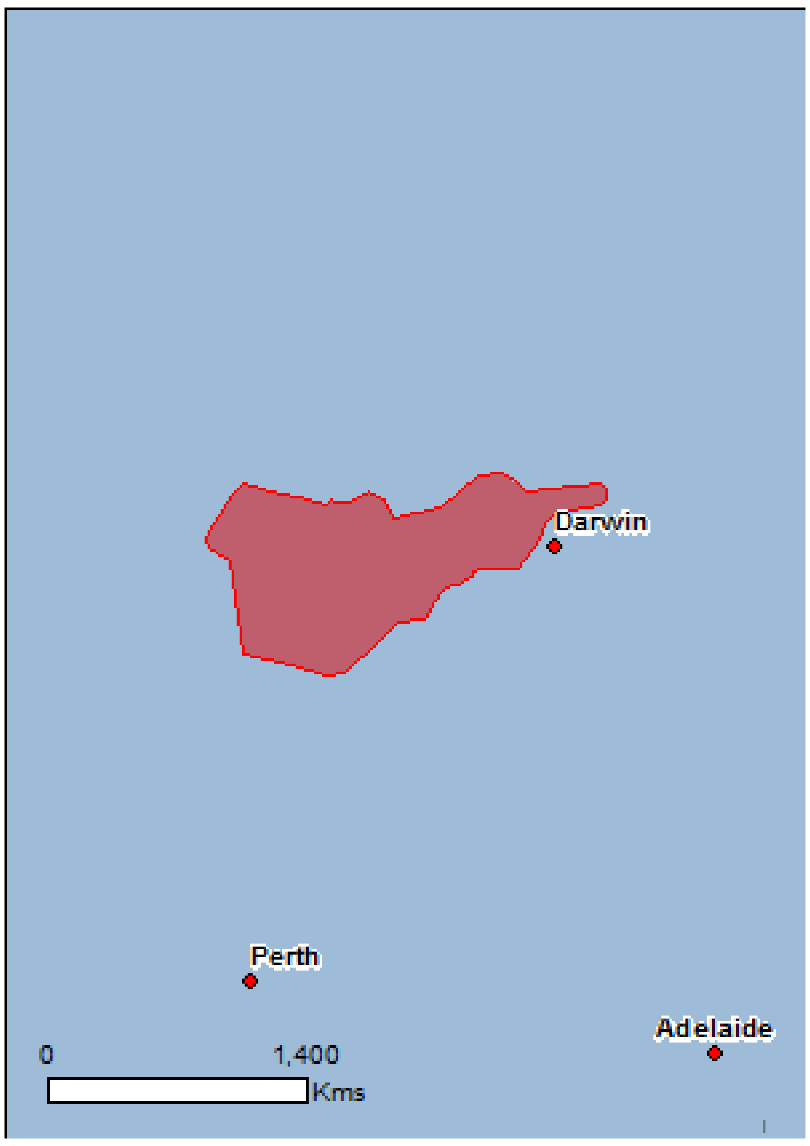

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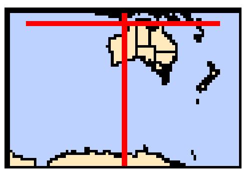

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	1
Wetlands of International Importance:	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	56
Listed Migratory Species:	75

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	3
Listed Marine Species:	134
Whales and Other Cetaceans:	29
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	15

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	9
Regional Forest Agreements:	None
Invasive Species:	16
Nationally Important Wetlands:	2
Key Ecological Features (Marine)	12

Details

Matters of National Environmental Significance

National Heritage Properties [Resource Information]

Name	State	Status
Natural		
The West Kimberley	WA	Listed place

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Ashmore reef national nature reserve	Within Ramsar site

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea
Extended Continental Shelf

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North
North-west

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Breeding known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat known to occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Erythrura gouldiae Gouldian Finch [413]	Endangered	Species or species habitat likely to occur within area
Falcunculus frontatus whitei Crested Shrike-tit (northern), Northern Shrike-tit [26013]	Vulnerable	Species or species habitat likely to occur within area
Geophaps smithii blaauwi Partridge Pigeon (western) [66501]	Vulnerable	Species or species habitat likely to occur within area
Geophaps smithii smithii Partridge Pigeon (eastern) [64441]	Vulnerable	Species or species habitat likely to occur within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat may occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	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 known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Tyto novaehollandiae kimberli Masked Owl (northern) [26048]	Vulnerable	Species or species habitat likely to occur within area
Tyto novaehollandiae melvillensis Tiwi Masked Owl, Tiwi Islands Masked Owl [26049]	Endangered	Species or species habitat known to occur within area
Mammals		
Antechinus bellus Fawn Antechinus [344]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Conilurus penicillatus Brush-tailed Rabbit-rat, Brush-tailed Tree-rat, Pakooma [132]	Vulnerable	Species or species habitat known to occur within area
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat known to occur within area

Name	Status	Type of Presence
Isoodon auratus auratus Golden Bandicoot (mainland) [66665]	Vulnerable	Species or species habitat likely to occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Mesembriomys gouldii gouldii Black-footed Tree-rat (Kimberley and mainland Northern Territory), Djintamoonga, Manbul [87618]	Endangered	Species or species habitat may occur within area
Mesembriomys gouldii melvillensis Black-footed Tree-rat (Melville Island) [87619]	Vulnerable	Species or species habitat known to occur within area
Petrogale concinna monastria Nabarlek (Kimberley) [87607]	Endangered	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
Phascogale tapoatafa kimberleyensis Kimberley brush-tailed phascogale, Brush-tailed Phascogale (Kimberley) [88453]	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 likely to occur within area
Sminthopsis butleri Butler's Dunnart [302]	Vulnerable	Species or species habitat known to occur within area
Xeromys myoides Water Mouse, False Water Rat, Yirrkoo [66]	Vulnerable	Species or species habitat known to occur within area
Plants		
Burmannia sp. Bathurst Island (R.Fensham 1021) [82017]	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
Reptiles		
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 known to occur within area
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat known to occur within area

Name	Status	Type of Presence
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	Species or species habitat known to occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Lepidochelys olivacea		
Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Sharks		
Carcharodon carcharias		
White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Glyphis garricki		
Northern River Shark, New Guinea River Shark [82454]	Endangered	Species or species habitat may occur within area
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 known to occur within area
Pristis zijsron		
Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus		
Common Noddy [825]		Breeding known to occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna pacifica		
Wedge-tailed Shearwater [84292]		Breeding known to occur within area
Calonectris leucomelas		
Streaked Shearwater [1077]		Species or species habitat known to occur within area
Fregata ariel		
Lesser Frigatebird, Least Frigatebird [1012]		Breeding known to occur within area

Name	Threatened	Type of Presence
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Breeding known to occur within area
Hydroprogne caspia Caspian Tern [808]		Breeding known to occur within area
Onychoprion anaethetus Bridled Tern [82845]		Breeding known to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding known to occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sternula albifrons Little Tern [82849]		Breeding known to occur within area
Sula dactylatra Masked Booby [1021]		Breeding known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
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	Species or species habitat known to occur within area
Dugong dugon Dugong [28]		Breeding known to occur within area

Name	Threatened	Type of Presence
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Isurus oxyrinchus		
Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus		
Longfin Mako [82947]		Species or species habitat likely to occur within area
Lepidochelys olivacea		
Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding known to occur within area
Manta alfredi		
Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat known to occur within area
Manta birostris		
Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat likely to occur within area
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
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
Pristis clavata		
Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis pristis		
Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron		
Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sousa chinensis		
Indo-Pacific Humpback Dolphin [50]		Breeding 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 known to occur within area

Name	Threatened	Type of Presence
Hirundo rustica Barn Swallow [662]		Species or species habitat known to occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
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 known to occur within area
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris alba Sanderling [875]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius phaeopus Whimbrel [849]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Species or species habitat known to occur within area
Pluvialis squatarola Grey Plover [865]		Species or species habitat known to occur within area
Thalasseus bergii Crested Tern [83000]		Breeding known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa totanus Common Redshank, Redshank [835]		Species or species habitat known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Species or species habitat known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Natural		
Ashmore Reef National Nature Reserve	EXT	Listed place
Mermaid Reef - Rowley Shoals	WA	Listed place
Scott Reef and Surrounds - Commonwealth Area	EXT	Listed place

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Acrocephalus orientalis Oriental Reed-Warbler [59570]		Species or species habitat known to occur

Name	Threatened	Type of Presence
		within area
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous minutus Black Noddy [824]		Breeding known to occur within area
Anous stolidus Common Noddy [825]		Breeding known to occur within area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Breeding known to occur within area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris alba Sanderling [875]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat known to occur

Name	Threatened	Type of Presence
		within area
[Charadrius ruficapillus](#) Red-capped Plover [881]		Species or species habitat known to occur within area
[Charadrius veredus](#) Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
[Chrysococcyx osculans](#) Black-eared Cuckoo [705]		Species or species habitat known to occur within area
[Fregata ariel](#) Lesser Frigatebird, Least Frigatebird [1012]		Breeding known to occur within area
[Fregata minor](#) Great Frigatebird, Greater Frigatebird [1013]		Breeding known to occur within area
[Glareola maldivarum](#) Oriental Pratincole [840]		Species or species habitat may occur within area
[Haliaeetus leucogaster](#) White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
[Heteroscelus brevipes](#) Grey-tailed Tattler [59311]		Species or species habitat known to occur within area
[Hirundo daurica](#) Red-rumped Swallow [59480]		Species or species habitat may occur within area
[Hirundo rustica](#) Barn Swallow [662]		Species or species habitat known to occur within area
[Larus novaehollandiae](#) Silver Gull [810]		Breeding known to occur within area
[Limosa lapponica](#) Bar-tailed Godwit [844]		Species or species habitat known to occur within area
[Limosa limosa](#) Black-tailed Godwit [845]		Species or species habitat known to occur within area
[Merops ornatus](#) Rainbow Bee-eater [670]		Species or species habitat may occur within area
[Motacilla cinerea](#) Grey Wagtail [642]		Species or species habitat known to occur within area
[Motacilla flava](#) Yellow Wagtail [644]		Species or species habitat known to occur within area
[Numenius madagascariensis](#) Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
[Numenius phaeopus](#) Whimbrel [849]		Species or species habitat known to occur within area
[Pandion haliaetus](#) Osprey [952]		Breeding known to occur within area

Name	Threatened	Type of Presence
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding known to occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Species or species habitat known to occur within area
Pluvialis squatarola Grey Plover [865]		Species or species habitat known to occur within area
Puffinus pacificus Wedge-tailed Shearwater [1027]		Breeding known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Sterna albifrons Little Tern [813]		Breeding known to occur within area
Sterna anaethetus Bridled Tern [814]		Breeding known to occur within area
Sterna bengalensis Lesser Crested Tern [815]		Breeding known to occur within area
Sterna bergii Crested Tern [816]		Breeding known to occur within area
Sterna caspia Caspian Tern [59467]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sterna fuscata Sooty Tern [794]		Breeding known to occur within area
Sterna nereis Fairy Tern [796]		Breeding known to occur within area
Stiltia isabella Australian Pratincole [818]		Species or species habitat known to occur within area
Sula dactylatra Masked Booby [1021]		Breeding known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa totanus Common Redshank, Redshank [835]		Species or species

Name	Threatened	Type of Presence
		habitat known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Species or species habitat known to occur within area
Fish		
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys 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
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

Name	Threatened	Type of Presence
		habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus nitidus Glittering Pipefish [66224]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys 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 angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Hippocampus trimaculatus Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
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

Name	Threatened	Type of Presence
		area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Mammals		
Dugong dugon Dugong [28]		Breeding known to occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus fuscus Dusky Seasnake [1119]		Species or species habitat known to occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Aipysurus tenuis Brown-lined Seasnake [1121]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus johnstoni Freshwater Crocodile, Johnston's Crocodile, Johnston's River Crocodile [1773]		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	Species or species habitat known to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
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
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Hydrelaps darwiniensis Black-ringed Seasnake [1100]		Species or species habitat may occur within area
Hydrophis atriceps Black-headed Seasnake [1101]		Species or species habitat may occur within area
Hydrophis coggeri Slender-necked Seasnake [25925]		Species or species habitat may occur within area
Hydrophis czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis inornatus Plain Seasnake [1107]		Species or species habitat may occur within area
Hydrophis mcdowelli null [25926]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Hydrophis pacificus Large-headed Seasnake, Pacific Seasnake [1112]		Species or species habitat may occur within area
Lapemis hardwickii Spine-bellied Seasnake [1113]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	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]
Name	Status	Type of Presence
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Delphinus delphis Common Dophin, 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
Indopacetus pacificus Longman's Beaked Whale [72]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia simus Dwarf Sperm Whale [58]		Species or species habitat may occur within area
Lagenodelphis hosei Fraser's Dolphin, Sarawak Dolphin [41]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Mesoplodon ginkgodens Gingko-toothed Beaked Whale, Gingko-toothed Whale, Gingko Beaked Whale [59564]		Species or species habitat may occur within area
Orcaella brevirostris Irrawaddy Dolphin [45]		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

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 chinensis Indo-Pacific Humpback Dolphin [50]		Breeding 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]

Name	Label
Arafura	Multiple Use Zone (IUCN VI)
Argo-Rowley Terrace	Multiple Use Zone (IUCN VI)
Argo-Rowley Terrace	National Park Zone (IUCN II)
Argo-Rowley Terrace	Special Purpose Zone (Trawl) (IUCN VI)
Ashmore Reef	Recreational Use Zone (IUCN IV)
Ashmore Reef	Sanctuary Zone (IUCN Ia)
Cartier Island	Sanctuary Zone (IUCN Ia)
Kimberley	Habitat Protection Zone (IUCN IV)
Kimberley	Multiple Use Zone (IUCN VI)
Kimberley	National Park Zone (IUCN II)
Mermaid Reef	National Park Zone (IUCN II)
Oceanic Shoals	Habitat Protection Zone (IUCN IV)
Oceanic Shoals	Multiple Use Zone (IUCN VI)
Oceanic Shoals	National Park Zone (IUCN II)
Oceanic Shoals	Special Purpose Zone (Trawl) (IUCN VI)

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Adele Island	WA
Browse Island	WA
Dambimangari	WA
Dambimangari	WA
Lacepede Islands	WA
Low Rocks	WA
Unnamed WA41775	WA
Unnamed WA44673	WA
Uunguu	WA

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Rattus exulans Pacific Rat, Polynesian Rat [79]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Plants		
Andropogon gayanus Gamba Grass [66895]		Species or species habitat likely to occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area

Name	Status	Type of Presence
Lantana camara		
Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Mimosa pigra		
Mimosa, Giant Mimosa, Giant Sensitive Plant, ThornySensitive Plant, Black Mimosa, Catclaw Mimosa, Bashful Plant [11223]		Species or species habitat likely to occur within area
Pennisetum polystachyon		
Mission Grass, Perennial Mission Grass, Missiongrass, Feathery Pennisetum, Feather Pennisetum, Thin Napier Grass, West Indian Pennisetum, Blue Buffel Grass [21194]		Species or species habitat may occur within area
Reptiles		
Hemidactylus frenatus		
Asian House Gecko [1708]		Species or species habitat likely to occur within area
Ramphotyphlops braminus		
Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat likely to occur within area

Nationally Important Wetlands [Resource Information]

Name	State
Ashmore Reef	EXT
Mermaid Reef	EXT

Key Ecological Features (Marine) [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Carbonate bank and terrace system of the Van	North
Pinnacles of the Bonaparte Basin	North
Shelf break and slope of the Arafura Shelf	North
Tributary Canyons of the Arafura Depression	North
Ancient coastline at 125 m depth contour	North-west
Ashmore Reef and Cartier Island and surrounding	North-west
Canyons linking the Argo Abyssal Plain with the	North-west
Carbonate bank and terrace system of the Sahul	North-west
Continental Slope Demersal Fish Communities	North-west
Mermaid Reef and Commonwealth waters	North-west
Pinnacles of the Bonaparte Basin	North-west
Seringapatam Reef and Commonwealth waters in	North-west

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-10.412 133.093,-10.8223 130.769,-11.321 130.287,-12.0653 130.095,-13.4114 128.953,-13.4169 127.362,-13.6287 126.851,-13.8758 126.78,-14.0347 126.48,-14.07 126.303,-14.2736 126.162,-14.2364 125.845,-14.3853 125.51,-14.559 125.188,-14.8629 125.064,-15.0552 124.772,-15.4584 124.642,-15.8368 124.394,-16.0291 123.116,-16.8231 122.241,-18.3237 120.479,-18.5355 119.614,-18.0413 117.867,-17.4868 115.617,-13.0392 114.934,-12.4313 113.849,-11.9971 113.762,-9.8384 115.083,-9.4104 115.592,-9.9377 117.422,-10.081 118.361,-10.4127 119.566,-10.1394 119.927,-10.2893 120.059,-10.3458 120.85,-9.7633 121.767,-10.1526 122.471,-10.9902 122.907,-10.5223 125.209,-8.9514 127.045,-8.8102 128.21,-9.7986 129.41,-9.4411 133.049,-9.6951 133.3,-10.0968 133.244,-10.412 133.093

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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Fauna Type	Conservation management documents	Summary of relevant aspects/threats identified from conservation management documents	Summary of relevant actions from conservation management documents	Relevant exposure / risk evaluation section of EP
EPBC-listed fishes and sharks	Whale shark management. 2013 Wildlife management program no. 57. Department of Parks and Wildlife. State of Western Australia. Threatened Species Scientific Committee. 2015. Approved Conservation Advice for Rhincodon typus (whale shark). Commonwealth of Australia. Department of Sustainability, Environment, Water, Population and Communities. 2013. Recovery Plan for the White Shark (Carcharodon carcharias). Commonwealth of Australia. Threatened Species Scientific Committee. 2014. Approved Conservation Advice for Glyphis garricki (northern river shark). Commonwealth of Australia. Threatened Species Scientific Committee. 2009. Commonwealth Conservation Advice on Pristis clavata (Dwarf Sawfish). Commonwealth of Australia. Threatened Species Scientific Committee. 2008. Approved Conservation Advice for Pristis zijsron (Green Sawfish). Commonwealth of Australia. Department of the Environment. 2015. Sawfish and River Sharks - Multispecies Recovery Plan. Commonwealth of Australia. Department of Environment and Energy. 2018. Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans. Commonwealth of Australia. Department of Sustainability, Environment, Water, Population and Communities (DSEWPac). 2012. Marine bioregional plan for the North-west Marine Region. DSEWPac, Canberra, ACT. Department of Sustainability, Environment, Water, Population and Communities (DSEWPac). 2012. Marine bioregional plan for the North Marine Region. DSEWPac, Canberra, ACT. Threatened Species Scientific Committee. 2014. Approved Conservation Advice for Glyphis glyphis (speartooth shark). Commonwealth of Australia.	• Waste / marine debris • Noise and vibration • Introduced Marine Species • Vessel strike • Benthic habitat degradation / seabed disturbance • Emissions and discharges • Oil spill	• Identify populations and areas of high conservation priority (sawfishes). • Ensure there is no anthropogenic disturbance / implement measures to reduce adverse impacts of habitat degradation and/or modification (northern river shark). • Ensure all future developments will not significantly impact upon sawfish and river shark habitats critical to the survival of the species or impede upon the migration of individual sawfish or river sharks. Implement measures to reduce adverse impacts of habitat degradation and/or modification. • Review and assess the potential threat of introduced species, pathogens and pollutants. • Minimise offshore developments and transit time of large vessels in areas close to marine features likely to correlate with whale shark aggregations (Ningaloo Reef,) and along the northward migration route that follows the northern WA coastline along the 200 m isobath. • Contribute to the long-term prevention of the incidence of harmful marine debris.	• EP Section 7.2. – Waste management, • EP Section 7.3 - Noise and vibration • EP Section 7.4.1 - Introduction of invasive marine species • EP Section 7.4.2 - Interaction with marine fauna • EP Section 7.5 - Seabed disturbance • EP Section 7.1.3 - Routine discharges • EP Section 8 - Emergency conditions (oil spills).

Fauna Type	Conservation management documents	Summary of relevant aspects/threats identified from conservation management documents	Summary of relevant actions from conservation management documents	Relevant exposure / risk evaluation section of EP
EPBC-listed marine reptiles	Department of the Environment and Energy 2017. Recovery Plan for Marine Turtles in Australia, Commonwealth of Australia 2017. Threatened Species Scientific Committee. 2011. Commonwealth Conservation Advice on Aipysurus apraefrontalis (Short-nosed Seasnake). Commonwealth of Australia. Threatened Species Scientific Committee. 2011. Commonwealth Conservation Advice on Aipysurus foliosquama (Leaf-scaled Seasnake). Commonwealth of Australia. Department of Environment and Energy. 2018. Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans. Commonwealth of Australia. Department of Sustainability, Environment, Water, Population and Communities (DSEWPac). 2012. Marine bioregional plan for the North-west Marine Region. DSEWPac, Canberra, ACT. Department of Sustainability, Environment, Water, Population and Communities (DSEWPac). 2012. Marine bioregional plan for the North Marine Region. DSEWPac, Canberra, ACT. Department of the Environment and Energy. 2020. Light pollution guidelines – National light pollution guidelines for wildlife: Including marine turtles, seabirds and migratory shorebirds. Commonwealth of Australia, Canberra, ACT.	• Waste / marine debris • Noise and vibration • Introduced Marine Species • Vessel strike • Benthic habitat degradation / seabed disturbance • Emissions and discharges • Oil spill • Light emissions	• Manage artificial light from onshore and offshore sources to ensure biologically important behaviours of nesting adults and dispersing hatchlings can continue. • Artificial light within or adjacent to habitat critical to the survival of marine turtles will be managed such that marine turtles are not displaced from these habitats and implementation of best practice light management guidelines for developments adjacent to marine turtle nesting beaches. • Identify the cumulative impact on turtles from multiple sources of onshore and offshore light pollution. • Support retrofitting of lighting at coastal communities and industrial developments, including imposing restrictions around nesting seasons. • Manage anthropogenic activities to ensure marine turtles are not displaced from identified habitat critical for survival. • Contribute to the reduction in the source of marine debris. • Ensure that spill risk strategies and response programs include management for turtles and their habitats, particularly in reference to slow to recover habitats, e.g. seagrass meadows or corals. • Implement best practices to minimise impacts to turtle health and habitats from chemical discharges. • Identify populations and areas of high conservation priority (sea snakes). • Ensure there is no anthropogenic disturbance / implement measures to reduce adverse impacts of habitat degradation and/or modification (sea snakes).	• EP Section 7.1.1 - Light emissions • EP Section 7.2. – Waste management, • EP Section 7.3 - Noise and vibration • EP Section 7.4.1 - Introduction of invasive marine species • EP Section 7.4.2 - Interaction with marine fauna • EP Section 7.5 - Seabed disturbance • EP Section 7.1.3 - Routine discharges • EP Section 8 - Emergency conditions (oil spills).
EPBC-listed seabirds and shorebirds	Department of the Environment. 2015. EPBC Act Policy Statement 3.21 - Industry guidelines for avoiding, assessing and mitigating impacts on EPBC listed migratory shorebird species. Department of the Environment. 2015. Wildlife conservation plan for migratory shorebirds. Commonwealth of Australia.	• Waste / marine debris • Noise and vibration • Introduced Marine Species • Introduced Terrestrial Pests (rodents)	• Reduce risk of rodents gaining access to key vessels at key ports • Contribute to the long-term prevention of the incidence of harmful marine debris • Identify threats to important (migratory shorebird) habitat and develop conservation measures for managing them.	• EP Section 7.1.1 - Light emissions • EP Section 7.2. – Waste management, • EP Section 7.3 - Noise and vibration • EP Section 7.4.1 - Introduction of invasive marine species • EP Section 8 - Emergency conditions (oil spills)

Fauna Type	Conservation management documents	Summary of relevant aspects/threats identified from conservation management documents	Summary of relevant actions from conservation management documents	Relevant exposure / risk evaluation section of EP
	Department of the Environment. 2015. Draft referral guideline for 14 birds listed as migratory under the EPBC Act. Commonwealth of Australia. Department of Sustainability, Environment, Water, Population and Communities. 2012. Species group report card - seabirds and migratory shorebirds. Supporting the marine bioregional plan for the North-west Marine Region. Prepared under the Environment Protection and Biodiversity Conservation Act 1999. Commonwealth of Australia. Department of the Environment, Water, Heritage and the Arts. 2009. Threat abatement plan to reduce the impacts of exotic rodents on biodiversity on Australian offshore islands of less than 100 000 hectares. Commonwealth of Australia. Department of Environment and Energy. 2018. Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans. Commonwealth of Australia. Department of Sustainability, Environment, Water, Population and Communities (DSEWPac). 2012. Marine bioregional plan for the North-west Marine Region. DSEWPac, Canberra, ACT. Department of Sustainability, Environment, Water, Population and Communities (DSEWPac). 2012. Marine bioregional plan for the North Marine Region. DSEWPac, Canberra, ACT. Threatened Species Scientific Committee. 2016. Calidris tenuirostris (Great Knot) Approved Conservation Advice. Commonwealth of Australia. Threatened Species Scientific Committee. 2016. Calidris canutus (Red Knot) Approved Conservation Advice. Commonwealth of Australia. Threatened Species Scientific Committee. 2016. Charadrius leschenaultii (Greater Sand Plover) Approved Conservation Advice. Commonwealth of Australia. Threatened Species Scientific Committee. 2016. Charadrius mongolus (Lesser Sand Plover) Approved Conservation Advice. Commonwealth of Australia.	• Benthic habitat degradation / seabed disturbance • Emissions and discharges • Oil spill • Light emissions	• Avoid degradation of migratory shorebird habitat that may occur through the introduction of exotic species, changes to hydrology or water quality (including toxic inflows), fragmentation of habitat or exposure to litter, pollutants and acid sulphate soils. Minimise human disturbance, a major threat to migratory shorebirds • Best practice waste management should be implemented.	• EP Section 7.1.3 - Routine discharges.

Fauna Type	Conservation management documents	Summary of relevant aspects/threats identified from conservation management documents	Summary of relevant actions from conservation management documents	Relevant exposure / risk evaluation section of EP
	Threatened Species Scientific Committee. 2015. Calidris ferruginea (Curlew Sandpiper) Approved Conservation Advice. Commonwealth of Australia. Threatened Species Scientific Committee. 2001. Commonwealth listing advice on Macronectes giganteus. Commonwealth of Australia. Threatened Species Scientific Committee. 2015. Papasula abbotti — Abbott's Booby. Approved Conservation Advice. Commonwealth of Australia. Department of the Environment. 2015. Conservation advice Numenius madagascariensis (eastern curlew). Commonwealth of Australia. Threatened Species Scientific Committee. 2015. Approved Conservation Advice for Anous tenuirostris melanops (Australian lesser noddy). Commonwealth of Australia. Threatened Species Scientific Committee. 2002. Commonwealth Listing Advice on Sterna albifrons sinensis (Little Tern (western Pacific)). Commonwealth of Australia. Threatened Species Scientific Committee. 2016. Limosa lapponica menzbieri — Northern Siberian Bar-tailed Godwit. Approved Conservation Advice. Commonwealth of Australia. Threatened Species Scientific Committee. 2002. Commonwealth Listing Advice on Sterna albifrons sinensis (Little Tern (western Pacific)). Commonwealth of Australia. Department of Sustainability, Environment, Water, Population and Communities. 2013. Approved Conservation Advice for Rostratula australis (Australian painted snipe). Canberra, ACT. Department of Sustainability, Environment, Water, Population and Communities. 2011. Approved Conservation Advice for Sternula nereis nereis (Fairy Tern). Canberra, ACT.			
EPBC-listed cetaceans	Department of the Environment. 2015. Conservation Management Plan for the Blue Whales - A Recovery Plan under the Environment Protection and Biodiversity	• Waste / marine debris • Noise and vibration • Introduced Marine Species	• Ensure all vessel strike incidents are reported in the National Ship Strike Database.	• EP Section 7.2. – Waste Management, • EP Section 7.3 - Noise and Vibration • EP Section 7.4.1 - Introduction of invasive marine species

Fauna Type	Conservation management documents	Summary of relevant aspects/threats identified from conservation management documents	Summary of relevant actions from conservation management documents	Relevant exposure / risk evaluation section of EP
	Conservation Act 1999 (2015-2025). Commonwealth of Australia. Threatened Species Scientific Committee. 2015. Balaenoptera borealis (Sei Whale) Conservation Advice. Commonwealth of Australia. Threatened Species Scientific Committee. 2015. Approved Conservation Advice for Megaptera novaeangliae (humpback whale). Commonwealth of Australia. Threatened Species Scientific Committee. 2015. Approved Conservation Advice for Balaenoptera physalus — Fin Whale. Commonwealth of Australia. EPBC Act Regulations 2000. Part 8 Interacting with cetaceans and whale watching. Division 8.1 Interacting with cetaceans. Commonwealth of Australia. Department of the Environment and Heritage, 2005. Australian National Guidelines for Whale and Dolphin Watching - Information Sheet. Commonwealth of Australia. Department of Environment and Energy. 2018. Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans. Commonwealth of Australia. Department of Sustainability, Environment, Water, Population and Communities (DSEWPac). 2012. Marine bioregional plan for the North-west Marine Region. DSEWPac, Canberra, ACT. Department of Sustainability, Environment, Water, Population and Communities (DSEWPac). 2012. Marine bioregional plan for the North Marine Region. DSEWPac, Canberra, ACT.	• Vessel strike • Benthic habitat degradation / seabed disturbance • Emissions and discharges • Oil spill	• 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. • Protect habitat important to the survival of the species (humpback whales); assess and manage physical disturbance and development activities (such as ship-strike and pollution). • Ensure the risk of vessel strike on humpback whales is considered when assessing actions that increase vessel traffic in areas where humpback whales occur and, if required appropriate mitigation measures are implemented to reduce the risk of vessel strike. • Environmental assessment processes must ensure that existing information about coastal habitat requirements of humpback whales, environmental suitability of coastal locations, historic high use and emerging areas are taken into consideration. • Contribute to the long-term prevention of the incidence of harmful marine debris • if a whale or dolphin surfaces in the vicinity of a vessel travelling for a purpose other than whale and dolphin watching, take all care necessary to avoid collisions. This may include stopping, slowing down and/or steering away from the animal.	• EP Section 7.4.2 - Physical presence of vessels and interaction with marine fauna • EP Section 7.5 - Seabed disturbance • EP Section 7.1.3 - Routine discharges • EP Section 8 - Emergency conditions (oil spills).

Appendix C
Stakeholder Consultation Log

STAKEHOLDER	Date of Correspondence	Type of Correspondence	Activity of Relevance	Attachments	Summary of Correspondence	Assessment of Merit and Relevant Matters
Authorities						
Australian Border Force (ABF), Broome Office (Cwth)	5/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development Fact Sheet	Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs. Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and contro systems (scheduled to commence from 2021). INPEX welcomed feedback, and requested any is provided by 16 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	Not a relevant matter - correspondence sent by INPEX.
Australian Border Force (ABF), Darwin Office (Cwth)	6/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development Fact Sheet	Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs. Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and contro systems (scheduled to commence from 2021). INPEX welcomed feedback, and requested any is provided by 16 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	Not a relevant matter - correspondence sent by INPEX.
Australian Border Force, Canberra (Cwth)	6/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development Fact Sheet	Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs. Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and contro systems (scheduled to commence from 2021). INPEX welcomed feedback, and requested any is provided by 16 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	Not a relevant matter - correspondence sent by INPEX.
Australian Fisheries Management Authority (AFMA) (Cwth)	5/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development fact sheet - North West Slope Trawl Fishery map	Email informed the stakeholder that INPEX plans to develop and submit EPs to NOPSEMA for further development well drilling and installation of umbilicals, risers and flowlines (URF) in production licence area WA-50-L. The purpose of the engagement was explained to the stakeholder and feedback requested by Friday 6th September 2019. The proposed field development activities were summarised and the stakeholder was referred to the attached Ichthys LNG field development activities fact sheet for further information. INPEX summarised its process of identifying and engaging with commercial fishery stakeholders, noting that commercial fishing activities in the vicinity of production licence area WA-50-L are understood to be limited. A summary of the only Commonwealth-managed fishery that operates in the vicinity of WA-50-L, the North West Slope Trawl Fishery, was also provided including a map of the fishery licence area relative to the location of WA-50-L.	Not a relevant matter - correspondence sent by INPEX.

STAKEHOLDER	Date of Correspondence	Type of Correspondence	Activity of Relevance	Attachments	Summary of Correspondence	Assessment of Merit and Relevant Matters
					INPEX advised that licence holders of the NDSMF and relevant fishing industry associations, including the Commonwealth Fisheries Association and the Western Australian Fishing Industry Council, are being invited to provide feedback on the proposed Ichthys LNG field development activities. INPEX summarised the potential impacts and proposed control measures for managing interactions and impacts to commercial fishers, including: - Physical presence of the MODU and support vessels, including associated safety zones and Notice to Mariners; - Planned discharges, including management of discharges in accordance with legislative requirements and INPEX's chemical selection process; - Prohibition of recreational fishing on any INPEX-operated facility/vessel or contracted vessel. INPEX requested that the stakeholder advise of any information/comments that is not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	
	9/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	Yes: - Ichthys 2019 Update fact sheet	Informed stakeholder that they are receiving this information as they have been identified as a stakeholder whose activities, functions or interests may be affected by Ichthys LNG activities. Advised that this update provides information regarding ongoing Ichthys LNG offshore activities being undertaken in accordance with previously accepted environment plans (EPs), and does not relate to any new activities or EPs. Advised this update is separate from recent correspondence regarding INPEX's proposed field development activities and associated EPs. Advised INPEX do not require any specific information, however welcomed ongoing feedback and provided contact details to do so.	Not a relevant matter - correspondence sent by INPEX.
Australian Maritime Safety Authority (AMSA) - Nautical Advice (Cwth)	6/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development Fact Sheet	Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs. Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and contro systems (scheduled to commence from 2021). INPEX welcomed feedback and requested that the stakeholder advise of any information/comments that are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	Not a relevant matter - correspondence sent by INPEX.
	7/08/2019	Email / letter from stakeholder	Ichthys LNG Field Development	No	AMSA responded with the following information: The Master should notify AMSA's Joint Rescue Coordination Centre (JRCC) by e-mail for promulgation of radio-navigation warnings at least 24-48 hours before operations commence. AMSA's JRCC will require the vessel details, satellite communications details, area of operation, requested clearance from other vessels and any other information that may contribute to safety at sea. JRCC will also need to be advised when operations start and end. Contact the Australian Hydrographic Office no less than four working weeks before operations, with details relevant to the operations. The AHO will promulgate the appropriate Notice to Mariners (NTM), which will ensure other vessels are informed of your activities. Advised that if INPEX would like to obtain a vessel traffic plot showing Automatic Identification System (AIS) traffic data, they can visit AMSA's spatial data gateway and Spatial@AMSA portal to download digital data sets and maps.	Relevant matter – stakeholder has provided information relevant to the petroleum activity and/or the stakeholder's functions, interests or activities. This information has been incorporated into Section 7.6.1 of the EP. Relevant matter – stakeholder has requested to be notified of activity commencement or other project activities. This has been incorporated into Section 9 of the EP.

STAKEHOLDER	Date of Correspondence	Type of Correspondence	Activity of Relevance	Attachments	Summary of Correspondence	Assessment of Merit and Relevant Matters
Australian Maritime Safety Authority (AMSA) - Marine Environment Pollution Response (Cwth)	7/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development Fact Sheet	Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs. Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and contro systems (scheduled to commence from 2021). INPEX welcomed feedback and provided contact details to do so. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	Not a relevant matter - correspondence sent by INPEX.
Department of Agriculture and Water Resources (DAWR) – Biosecurity (Marine Pests) (Cwth)	6/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development Fact Sheet - Additional information required by DAWR	Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs. Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and contro systems (scheduled to commence from 2021). Advised INPEX has attached a letter to address the information requirements outlined on the DAWR website, including: - Titleholder details - Proposed dates the activity is being undertaken - Map of area the activity is being undertaken - Type of activity being undertaken - Types of vessels that will be servicing the offshore installation and their origin and destination (domestic or international movements). - A description of the marine environment that may be affected by planned aspects of the activity. This may include information of water depth, the surrounding marine habitat (reef, sandy, rocky), and proximity to island or shoals. - Details and an evaluation of the environmental impacts including the risks of introducing/spreading an IMS into Australian waters. The titleholder must identify the risks relevant to marine pest biosecurity branch of the departments, and propose appropriate control measures prior to consultation. If the risk is uncertain or unknown the titleholder must identify perceived risks or specific sections of the EP that they wish to enquire about. - A demonstrated understanding of how Australia's ballast water and biofouling requirements apply to the facility and/or vessel(s). - Details of the control measures that will be in place to reduce the risk of introducing or spreading marine pests. Control measures should represent best practice, and includes, but is not limited to, vessel ballast water management plans and certificates (in line with the Australian - - Ballast Water Management Requirements), and biofouling management plans (in line with the IMO biofouling guidelines and Australian biofouling management guidelines). INPEX welcomed feedback, and requested any is provided by 16 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	Not a relevant matter - correspondence sent by INPEX.

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	12/08/2019	Email / letter from stakeholder	Ichthys LNG Field Development	Yes: - Exposed conveyances exceptions determination - Offshore Installations - Biosecurity Guide	DAWR - Biosecurity (Marine Pests) replied, advising the Quarantine Act 1908 was replaced by the Biosecurity Act in 2015. DAWR advised that now where domestic conveyances become exposed through interactions with persons, goods or conveyances outside of Australian Territorial Sea, they automatically become subject to biosecurity control upon their return. If the Department of Agriculture concludes that the level of biosecurity risk associated with the offshore installation is low within the meaning of the determination (attached), an exposed conveyance (the support vessels to the offshore installation) may be eligible for exemption from biosecurity control. This assessment is regarding the topside of the offshore installation only and does not address the marine biosecurity management – which is addressed elsewhere. DAWR noted the commencement dates and requested that if INPEX are intending to apply for the low biosecurity risk status for the INPEX proposed activities, DWAR can assist with the application. DAWR attached the installations guide. Advised DAWR representative will be in Perth next week and could meet INPEX to go through any initial questions on biosecurity requirements for offshore installations and their support vessels.	Relevant matter – stakeholder has provided information relevant to the petroleum activity and/or the stakeholder's functions, interests or activities. This information has been incorporated into Section 7.4.1 of the EP.
	13/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	No	Advised INPEX has been through the process of obtaining 'low risk status' for facilities during earlier phases of the Ichthys project and have taken the biosecurity requirements into account for the next phase. Organised to meet with DAWR on 21/08/2019	Not a relevant matter - correspondence sent by INPEX.
	21/08/2019	Meeting with stakeholder	Ichthys LNG Field Development	No	INPEX and DAWR met to discuss INPEX's biosecurity management approach, which has been developed and implemented in accordance with regulation and industry guidelines as per previous offshore works. Discussions were around biosecurity management implications of the proposed offshore developments. No issues or concerns were raised by DAWR.	Not a relevant matter - general correspondence only
	22/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - slides presented yesterday - an Abstract on Biofouling management - a copy of INPEX's Domestic Biofouling risk assessment process (developed in consultation with DPIRD) - an example of a Biosecurity risk assessment	INPEX provided documents that were discussed during the meeting, including: a copy of the slides presented yesterday; a copy of INPEX's recent APPEA presentation; an Abstract on Biofouling management; a copy of INPEX's Domestic Biofouling risk assessment process developed in consultation with DPIRD; and an example of a Biosecurity risk assessment INPEX prepared for a small scope of work proposed last year.	Not a relevant matter - correspondence sent by INPEX.
	11/09/2019	Email / letter from stakeholder	Ichthys LNG Field Development	No	Another officer from the Marine Pests branch responded to the original fact sheet provided 06/08/2019, advising the Marine Biosecurity Unit has reviewed these documents and is comfortable with the management practices specified to manage ballast water and biofouling. Advised Marine Pests branch had contacted the Seaports team and the Inspection Group in Western Australia and they do not have any comments on the documents either.	Not a relevant matter - general correspondence only.

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Department of Agriculture and Water Resources (DAWR) – Biosecurity (Vessels, aircraft and personnel) (Cwth)	6/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development Fact Sheet - Additional information required by DAWR	Advised INPEX has attached a letter that was sent to the Marine Pest team addressing the additional information requirements stated on the DAWR website. Advised INPEX's plans and controls will be consistent with work recently completed. The same contractor that performed the initial subsea installation will be completing the next phase of subsea installation work, and a new drilling contractor will be conducting the drilling. Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs. Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and contro systems (scheduled to commence from 2021). INPEX welcomed feedback, and requested any is provided by 16 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	Not a relevant matter - correspondence sent by INPEX.
	13/08/2019	Email / letter from stakeholder	Ichthys LNG Field Development	No	Advised that international vessels involved with the drilling and subsea work that have interactions with domestic conveyances will need to put in place processes that will allow them to gain Biosecurity Low Risk status, if the domestic conveyances wish to claim exemption from biosecurity reporting when returning to the Australian mainland.	Not a relevant matter - correspondence sent by INPEX.
Department of Agriculture and Water Resources (DAWR) - Fisheries (Cwth)	5/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development fact sheet - North West Slope Trawl Fishery map	Email informed the stakeholder that INPEX plans to develop and submit EPs to NOPSEMA for further development well drilling and installation of umbilicals, risers and flowlines (URF) in production licence area WA-50-L. The purpose of the engagement was explained to the stakeholder and feedback requested by Friday 6th September 2019. The proposed field development activities were summarised and the stakeholder was referred to the attached Ichthys LNG field development activities fact sheet for further information. INPEX summarised its process of identifying and engaging with commercial fishery stakeholders, noting that commercial fishing activities in the vicinity of production licence area WA-50-L are understood to be limited. A summary of the only Commonwealth-managed fishery that operates in the vicinity of WA-50-L, the North West Slope Trawl Fishery, was also provided including a map of the fishery licence area relative to the location of WA-50-L. INPEX advised that licence holders of the NDSMF and relevant fishing industry associations, including the Commonwealth Fisheries Association and the Western Australian Fishing Industry Council, are being invited to provide feedback on the proposed Ichthys LNG field development activities. INPEX summarised the potential impacts and proposed control measures for managing interactions and impacts to commercial fishers, including: - Physical presence of the MODU and support vessels, including associated safety zones and Notice to Mariners; - Planned discharges, including management of discharges in accordance with legislative requirements and INPEX's chemical selection process; - Prohibition of recreational fishing on any INPEX-operated facility/vessel or contracted vessel. INPEX requested that the stakeholder advise of any information/comments that is not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	Not a relevant matter - correspondence sent by INPEX.

STAKEHOLDER	Date of Correspondence	Type of Correspondence	Activity of Relevance	Attachments	Summary of Correspondence	Assessment of Merit and Relevant Matters
	9/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	Yes: - Ichthys 2019 Update fact sheet	Informed stakeholder that they are receiving this information as they have been identified as a stakeholder, whose activities, functions or interests may be affected by Ichthys LNG activities. Advised that this update provides information regarding ongoing Ichthys LNG offshore activities being undertaken in accordance with previously accepted environment plans (EPs), and does not relate to any new activities or EPs. Advised this update is separate from recent correspondence regarding INPEX's proposed field development activities and associated EPs. Advised INPEX do not require any specific information, however welcomed ongoing feedback and provided contact details to do so.	Not a relevant matter - correspondence sent by INPEX.
Department of Biodiversity Conservation and Attractions (DBCA) - Environmental Management Branch (WA)	5/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development Fact Sheet	Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs. Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and contro systems (scheduled to commence from 2021). INPEX welcomed feedback, and requested any is provided by 10 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	Not a relevant matter - correspondence sent by INPEX.
	22/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	Yes: - Ichthys 2019 Update Fact Sheet	Informed stakeholder that they are receiving this information as they have been identified as a stakeholder, whose activities, functions or interests may be affected by Ichthys LNG activities. Advised that this update provides information regarding ongoing Ichthys LNG offshore activities being undertaken in accordance with previously accepted environment plans (EPs), and does not relate to any new activities or EPs. INPEX welcomed ongoing feedback and provided contact details to do so.	Not a relevant matter - correspondence sent by INPEX.
	6/09/2019	Email / letter from stakeholder	Ichthys LNG Field Development	No	Confirmed receipt of information provided 05/08/2019. Advised that based on the information provided, DBCA has no comments to provide in relation to its responsibilities under the Conservation and Land Management Act 1984 and Biodiversity Conservation Act 2016.	Not a relevant matter - general correspondence only
Department of Defence, Directorate of Property Acquisition, Mining and Native Title (Cwth)	6/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development Fact Sheet	Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs. Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and contro systems (scheduled to commence from 2021). INPEX welcomed feedback, and requested any is provided by 16 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	Not a relevant matter - correspondence sent by INPEX.
Department of Defence, RAN Australian Hydrographic Office (AHO) (Cwth)	7/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development Fact Sheet	Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs. Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and contro systems (scheduled to commence from 2021). INPEX welcomed feedback, and requested any is provided by 16 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	Not a relevant matter - correspondence sent by INPEX.

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	7/08/2019	Email / letter from stakeholder	Ichthys LNG Field Development	No	Automated confirmation of receipt.	Not a relevant matter - general correspondence only
Department of Environment and Energy (DEE)	6/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development Fact Sheet	Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs. Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and contro systems (scheduled to commence from 2021). INPEX welcomed feedback, and requested any is provided by 10 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	Not a relevant matter - correspondence sent by INPEX.
	9/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	Yes: - Ichthys 2019 Update Fact Sheet	Informed stakeholder that they are receiving this information as they have been identified as a stakeholder, whose activities, functions or interests may be affected by Ichthys LNG activities. Advised that this update provides information regarding ongoing Ichthys LNG offshore activities being undertaken in accordance with previously accepted environment plans (EPs), and does not relate to any new activities or EPs. Advised INPEX do not require any specific information, however welcomed ongoing feedback and provided contact details to do so.	Not a relevant matter - correspondence sent by INPEX.
Department of Foreign Affairs and Trade (DFAT)	9/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development Fact Sheet	Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs. Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and control systems (scheduled to commence from 2021). Advised that in accordance with Australian Government Guidance regarding consultation with relevant Australian Government agencies on offshore petroleum and greenhouse gas activities, INPEX believe that it should engage DFAT on Ichthys LNG offshore activities, specifically where: a proposed activity poses any oil spill or other environmental risks that could result in impacts to other international jurisdictions; and relevant persons that may be impacted by a proposed activity include foreign individuals or governments. Informed INPEX is aware of the notification arrangements outlined in the N*ational Plan Guidance: Coordination of International Incidents: Notification Arrangements Guidance* (NP–GUI–007), which stipulate that 'in the event a pollution incident is affecting or is likely to affect another country, the Control Agency (in the case of pollution from a ship or unknown source) and the Department of Industry, Innovation and Science (in the case of pollution from an offshore petroleum facility) will contact DFAT as soon as practicable through the contact point advised by DFAT.' Accordingly, INPEX will reflect these arrangements in all offshore oil pollution emergency plans (OPEPs) for the proposed Ichthys LNG field development activities, and will consult AMSA to ensure that roles and responsibilities in all possible scenarios are understood. INPEX welcomed feedback, and requested any is provided by 16 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	Not a relevant matter - correspondence sent by INPEX.

STAKEHOLDER	Date of Correspondence	Type of Correspondence	Activity of Relevance	Attachments	Summary of Correspondence	Assessment of Merit and Relevant Matters
Department of Industry, Innovation and Science (DIIS) (Cwth)	6/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development Fact Sheet	Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs. Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and contro systems (scheduled to commence from 2021). INPEX welcomed feedback, and requested any is provided by 16 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	Not a relevant matter - correspondence sent by INPEX.
Department of Mines, Industry Regulation and Safety (DMIRS) (WA)	6/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development Fact Sheet	Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs. Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and contro systems (scheduled to commence from 2021). Advised INPEX will inform DMIRS of the commencement and cessation of these activities at the appropriate time. INPEX welcomed feedback, and requested any is provided by 16 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	Not a relevant matter - correspondence sent by INPEX.
	15/08/2019	Email / letter from stakeholder	Ichthys LNG Field Development	No	Advised that DMIRS has reviewed the information provided and acknowledged the proposed drilling and completions activities and installation of umbilicals, risers and flowlines will be regulated by NOPSEMA under the provisions of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009. Advised no further information is required at this stage but requested INPEX send through activity commencement and cessation notifications.	Relevant matter - stakeholder has requested to be notified of activity commencement or other project activities. This has been incorporated into Section 9 of the EP.
Department of Planning, Lands and Heritage (DPLH) (WA)	19/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development Fact Sheet	Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs. Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and contro systems (scheduled to commence from 2021). INPEX welcomed feedback, and requested any is provided by 16 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	Not a relevant matter - correspondence sent by INPEX.
	21/08/2019	Email / letter from stakeholder	Ichthys LNG Field Development	No	DPLH confirmed that a review of the Register of Places and Objects as well as the Department of Planning, Lands and Heritage (DPLH) Aboriginal Heritage Database concludes that the proposed works as described in the attached document DO NOT intersect the "Restricted Boundary" of any Aboriginal Sites or Places as administered DPLH. As such, the proposed activity does not affect the heritage values of any DPLH Aboriginal Sites or Places and no statutory approvals are required.	Not a relevant matter - general correspondence only

STAKEHOLDER	Date of Correspondence	Type of Correspondence	Activity of Relevance	Attachments	Summary of Correspondence	Assessment of Merit and Relevant Matters
	27/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	Yes: - Ichthys 2019 Update Fact Sheet	Informed stakeholder that they are receiving this information as they have been identified as a stakeholder, whose activities, functions or interests may be affected by Ichthys LNG activities. Advised that this update provides information regarding ongoing Ichthys LNG offshore activities being undertaken in accordance with previously accepted environment plans (EPs), and does not relate to any new activities or EPs. Advised INPEX do not require any specific information, however welcomed ongoing feedback and provided contact details to do so.	Not a relevant matter - correspondence sent by INPEX.
Department of Primary Industries and Regional Development (DPIRD) - Aquatic Environment section (WA)	5/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development fact sheet - Northern Demersal Scalefish Managed Fishery map	Email informed the stakeholder that INPEX plans to develop and submit EPs to NOPSEMA for further development well drilling and installation of umbilicals, risers and flowlines (URF) in production licence area WA-50-L. The purpose of the engagement was explained to the stakeholder and feedback requested by Friday 6th September 2019. The proposed field development activities were summarised and the stakeholder was referred to the attached Ichthys LNG field development activities fact sheet for further information. INPEX summarised its process of identifying and engaging with commercial fishery stakeholders, noting that commercial fishing activities in the vicinity of production licence area WA-50-L are understood to be limited. A summary of the only WA-managed fishery that operates in the vicinity of WA-50-L, the Northern Demersal Scalefish Managed Fishery, was also provided including a map of the fishery licence area relative to the location of WA-50-L. INPEX advised that licence holders of the NDSMF and relevant fishing industry associations, including the Commonwealth Fisheries Association and the Western Australian Fishing Industry Council, are being invited to provide feedback on the proposed Ichthys LNG field development activities. INPEX summarised the potential impacts and proposed control measures for managing interactions and impacts to commercial fishers, including: - Physical presence of the MODU and support vessels, including associated safety zones and Notice to Mariners; - Planned discharges, including management of discharges in accordance with legislative requirements and INPEX's chemical selection process; - Prohibition of recreational fishing on any INPEX-operated facility/vessel or contracted vessel. INPEX requested that the stakeholder advise of any information/comments that is not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	Not a relevant matter - correspondence sent by INPEX.
	9/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	Yes: - Ichthys 2019 Update fact sheet	Informed stakeholder that they are receiving this information as they have been identified as a stakeholder, whose activities, functions or interests may be affected by Ichthys LNG activities. Advised that this update provides information regarding ongoing Ichthys LNG offshore activities being undertaken in accordance with previously accepted environment plans (EPs), and does not relate to any new activities or EPs. Advised this update is separate from recent correspondence regarding INPEX's proposed field development activities and associated EPs. Advised INPEX do not require any specific information, however welcomed ongoing feedback and provided contact details to do so.	

STAKEHOLDER	Date of Correspondence	Type of Correspondence	Activity of Relevance	Attachments	Summary of Correspondence	Assessment of Merit and Relevant Matters
Department of Primary Industries and Regional Development (DPIRD) - Sustainability and Biosecurity section (WA)	5/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development Fact Sheet	Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs. Advised INPEX will continue to implement the Biofouling risk management controls in place for the Ichthys field and apply lessons learned from the initial development phase. Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and contro systems (scheduled to commence from 2021). Informed stakeholder that to date INPEX have not identified any new IMS as result of our visua observations on vessels and the facility hulls. INPEX welcomed feedback, and requested any is provided by 10 September 2019. Finally, INPEX requested that the stakeholder advise if any information/comments they provide are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	Not a relevant matter - correspondence sent by INPEX.
	22/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	Yes: - Ichthys 2019 Update Fact Sheet	Informed stakeholder that this email was park of ongoing consultation on accepted offshore environment plans (EPs) for the Ichthys activities under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations. Advised that INPEX can provide an overview of recen data/footage collected as pert of the Invasive Marine species monitoring program and domestic vessel assessment if it is of interest to the Department.	Not a relevant matter - correspondence sent by INPEX.
	5/08/2019	Email / letter from stakeholder	Ichthys LNG Field Development	No	Requested clarification on a statement in the fact sheet “In 2019 INPEX will….to support continued field development for Ichthys” - Enquired whether this meant more infrastructure is being installed associated with Ichthys, whether this refers to separate developments.	Not a relevant matter - general correspondence only
	22/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	No	INPEX clarified it is currently in the planning phase for future expansion of the Ichthys subsea system. This will just feed in to the existing CPF and FPSO assets. Advised the subsea installation work is unlikely to happen until 2021 but there is a new Drill rig coming in next year to drill additional wells. INPEX offered to discuss the proposed controls we will put in place for the new activities which include management of biofouling.	Not a relevant matter - correspondence sent by INPEX.
	2/09/2019	Email / letter to stakeholder	Ichthys LNG Field Development	No	Follow up with stakeholder to see if DPIRD received the additional information and check if DPIRD had any comments or queries.	Not a relevant matter - correspondence sent by INPEX.
Department of Transport - Marine (WA DoT) (WA)	6/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development Fact Sheet	Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs. Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and contro systems (scheduled to commence from 2021). Advised DoT that INPEX will be in touch with details the required by the guidance note and a copy of the OPEP for each activity once it has been drafted. INPEX welcomed feedback and provided contact details to do so. Finally, INPEX requested that the stakeholder advise if any information/comments they provide are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	Not a relevant matter - correspondence sent by INPEX.
	20/02/2020	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Draft OPEP - Completed consultation appendix as per Industry Guidance Note requirements - Link to draft EP via file share	In relation to the specific URF and SPS Installation actvities EP, INPEX provided the Department with a copy of the draft OPEP, a link to the draft EP (sent as file transfer link) and the completed appendix from the WA DoT industry guidance note.	Not a relevant matter - correspondence sent by INPEX.

STAKEHOLDER	Date of Correspondence	Type of Correspondence	Activity of Relevance	Attachments	Summary of Correspondence	Assessment of Merit and Relevant Matters
Department of Water and Environment Regulation (DWER) (WA) Hazard Management Branch Contaminated Sites Branch	6/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development Fact Sheet	Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs. Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and contro systems (scheduled to commence from 2021). INPEX welcomed feedback and requested any be provided by 15 September 2019. Finally, INPEX requested that the stakeholder advise if any information/comments they provide are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but	Not a relevant matter - correspondence sent by INPEX.
Indonesian Ministry for Marine Affairs and Fisheries (MMAF)	5/08/2019	Email / letter to stakeholder	Both Ichthys LNG Field Development and Ichthys 2019	Yes: - Ichthys LNG Field Development Fact Sheet - Ichthys 2019 Update Fact	INPEX advised the stakeholder of the purpose of engagement, including its commitment to keep stakeholders informed of INPEX's activities and regulatory requirement to consult with stakeholders. INPEX advised the attached fact sheets provide details on a proposed and current activities that may be of interest to the MMAF. INPEX noted the location of these activities overlaps the Australia–Indonesia Memorandum of Understanding (MOU) Box relating to the operations of Indonesian traditional fishermen in the Australian Fishing Zone. INPEX welcomed	Not a relevant matter - correspondence sent by INPEX.
Kimberley Land Council (KLC)	19/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development Fact Sheet	Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs. Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and contro systems (scheduled to commence from 2021). INPEX welcomed feedback, and requested any is provided by 16 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	Not a relevant matter - correspondence sent by INPEX.
	27/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	Yes: - Ichthys 2019 Update Fact Sheet	Informed stakeholder that they are receiving this information as they have been identified as a stakeholder, whose activities, functions or interests may be affected by Ichthys LNG activities. Advised that this update provides information regarding ongoing Ichthys LNG offshore activities being undertaken in accordance with previously accepted environment plans (EPs), and does not relate to any new activities or EPs. Advised INPEX do not require any specific information, however welcomed ongoing feedback and provided contact details to do so.	Not a relevant matter - correspondence sent by INPEX.
National Native Title Tribunal (NNTT) (Cwth)	15/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development Fact Sheet	Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs. Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and contro systems (scheduled to commence from 2021). INPEX expressed understanding that it is not the NNTT's position to make comment on offshore activities (in line with recommendations of past years). Advised INPEX proposes to provide the attached information sheet to the Kimberley Land Council as the Representative Aboriginal/Torres Strait Islander Body with jurisdiction for Commonwealth waters off the coast of Western Australia. INPEX welcomed feedback, and requested any is provided by 16 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	Not a relevant matter - correspondence sent by INPEX.

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	15/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	Yes: - Ichthys 2019 Update Fact Sheet	Informed stakeholder that they are receiving this information as they have been identified as a stakeholder, whose activities, functions or interests may be affected by Ichthys LNG activities. Advised that this update provides information regarding ongoing Ichthys LNG offshore activities being undertaken in accordance with previously accepted environment plans (EPs), and does not relate to any new activities or EPs. INPEX expressed understanding that it is not the NNTT's position to make comment on offshore activities (in line with recommendations of past years). Advised INPEX proposes to provide the attached information sheet to the Kimberley Land Council and Northern Land Council as Representative Aboriginal/Torres Strait Islander Bodies with jurisdiction for Commonwealth waters off the coast of Western Australia and Northern Territory. Enquired whether Tiwi Land Council's jurisdiction extends to Commonwealth waters; and if so, how far it extends? Advised INPEX do not require any specific information, however welcomed ongoing feedback and provided contact details to do so.	Not a relevant matter - correspondence sent by INPEX.
National Offshore Petroleum Titles Administrator (NOPTA) (Cwth)	6/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development Fact Sheet	Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs. Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and contro systems (scheduled to commence from 2021). INPEX welcomed feedback, and requested any is provided by 16 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	Not a relevant matter - correspondence sent by INPEX.
	6/08/2019	Email / letter from stakeholder	Ichthys LNG Field Development	No	Confirmation of receipt of the above correspondence.	Not a relevant matter - general correspondence only
Northern Land Council	19/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	Yes: - Ichthys 2019 Update Fact Sheet	Informed stakeholder that they are receiving this information as they have been identified as a stakeholder, whose activities, functions or interests may be affected by Ichthys LNG activities. Advised that this update provides information regarding ongoing Ichthys LNG offshore activities being undertaken in accordance with previously accepted environment plans (EPs), and does not relate to any new activities or EPs. Advised INPEX do not require any specific information, however welcomed ongoing feedback and provided contact details to do so.	Not a relevant matter - correspondence sent by INPEX.
NT Department of Environment and Natural Resources (DENR)	6/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development Fact Sheet	Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs. Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and contro systems (scheduled to commence from 2021). INPEX welcomed feedback provided contact details to do so. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	Not a relevant matter - correspondence sent by INPEX.

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NT Department of Infrastructure, Planning and Logistics - Transport - Marine Safety Branch (DIPL)	6/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development Fact Sheet	Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs. Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and contro systems (scheduled to commence from 2021). INPEX welcomed feedback, and requested any is provided by 10 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	Not a relevant matter - correspondence sent by INPEX.
	12/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	Yes: - Ichthys 2019 Update fact sheet	Informed stakeholder that they are receiving this information as they have been identified as a stakeholder, whose activities, functions or interests may be affected by Ichthys LNG activities. Advised that this update provides information regarding ongoing Ichthys LNG offshore activities being undertaken in accordance with previously accepted environment plans (EPs), and does not relate to any new activities or EPs. Advised INPEX do not require any specific information, however welcomed ongoing feedback and provided contact details to do so.	Not a relevant matter - correspondence sent by INPEX.
NT Department of Primary Industry and Resources (DPIR) - Biosecurity	5/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	Yes: - Ichthys 2019 Update fact sheet	Informed stakeholder that they are receiving this information as they have been identified as a stakeholder, whose activities, functions or interests may be affected by Ichthys LNG activities. Advised that this update provides information regarding ongoing Ichthys LNG offshore activities being undertaken in accordance with previously accepted environment plans (EPs), and does not relate to any new activities or EPs. Advised INPEX do not require any specific information, however welcomed ongoing feedback and provided contact details to do so.	Not a relevant matter - correspondence sent by INPEX.
	6/08/2019	Email / letter from stakeholder	Ichthys 2019 Update	No	Confirmation of receipt of the above correspondence.	Not a relevant matter - general correspondence only
NT Department of Primary Industry and Resources (DPIR) - Fisheries	9/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	Yes: - Ichthys 2019 Update fact sheet	Informed stakeholder that they are receiving this information as they have been identified as a stakeholder, whose activities, functions or interests may be affected by Ichthys LNG activities. Advised that this update provides information regarding ongoing Ichthys LNG offshore activities being undertaken in accordance with previously accepted environment plans (EPs), and does not relate to any new activities or EPs. Advised INPEX do not require any specific information, however welcomed ongoing feedback and provided contact details to do so.	Not a relevant matter - correspondence sent by INPEX.
NT Department of Tourism and Culture - Parks and Wildlife Commission (NT PaWC)	5/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	Yes: - Ichthys 2019 Update fact sheet	Informed stakeholder that they are receiving this information as they have been identified as a stakeholder, whose activities, functions or interests may be affected by Ichthys LNG activities. Advised that this update provides information regarding ongoing Ichthys LNG offshore activities being undertaken in accordance with previously accepted environment plans (EPs), and does not relate to any new activities or EPs. INPEX welcomed ongoing feedback and provided contact details to do so.	Not a relevant matter - correspondence sent by INPEX.
Office of the Director of National Parks (Cwth)	6/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development Fact Sheet	Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs. Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and contro systems (scheduled to commence from 2021). INPEX welcomed feedback, and requested any is provided by 10 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	Not a relevant matter - correspondence sent by INPEX.
	9/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	Yes: - Ichthys 2019 Update fact sheet	Informed stakeholder that they are receiving this information as they have been identified as a stakeholder, whose activities, functions or interests may be affected by Ichthys LNG activities. Advised that this update provides information regarding ongoing Ichthys LNG offshore activities being undertaken in accordance with previously accepted environment plans (EPs), and does not relate to any new activities or EPs. INPEX welcomed ongoing feedback and provided contact details to do so.	Not a relevant matter - correspondence sent by INPEX.
	6/09/2019	Email / letter from stakeholder	Ichthys LNG Field Development	No	DNP observed that the planned activities do not overlap any Australian Marine Parks, and that the activity is approximately 105 km, 145 km and 175 km to Kimberley, Cartier Island and Ashmore Reef marine parks respectively. Advised that therefore there are no authorisation requirements from the DNP.	Not a relevant matter - general correspondence only

STAKEHOLDER	Date of Correspondence	Type of Correspondence	Activity of Relevance	Attachments	Summary of Correspondence	Assessment of Merit and Relevant Matters
					DNP highlighted the NOPSEMA guidance note that outlines what titleholders need to consider and evaluate in relation to AMPs. DNP advised that when preparing the EP, INPEX should consider the Australian marine parks and their representativeness. INPEX should identify and manage 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. The EP should clearly demonstrates that the activity will not be inconsistent with the management plan.	Relevant matter – stakeholder has provided information relevant to the petroleum activity and/or the stakeholder's functions, interests or activities. NOPSEMA's guidance note that outlines what titleholders need to consider and evaluate in relation to AMPs has been considered in Sections 7 and 8 of the EP.
					DNP advised the North-west Marine Parks Network Management Plan 2018 provides further information on values for Kimberley, Cartier Island and Ashmore Reef marine parks. Advised information on the values for the marine parks is also located on the Australian Marine Parks Science Atlas. Advised specific values for the Kimberley, Cartier Island and Ashmore Reef marine parks include (but are not limited to): • the ancient coastline at the 125m depth contour containing diverse and biologically important benthic habitats; • continental slope habitat supporting a high diversity and endemism of demersal fish communities; • critical and biologically important areas for species, including marine turtles (inter-nesting and nesting habitat), seabirds (breeding and foraging habitat), inshore dolphin (breeding, calving and foraging habitat) humpback whales (nursing habitat and migratory pathways), pygmy blue • whales (migratory pathways), dugong (foraging habitat) and whale sharks (foraging habitat); • habitat for an internationally significant abundance and diversity of sea snakes; • coral reef and seagrass ecosystems; • parts of the Kimberly Marine Park is sea country of the Wunambal Gaambera, Dambimangari and Bardi Jawi people.	Relevant matter – stakeholder has provided information relevant to the petroleum activity and/or the stakeholder's functions, interests or activities. Values for Kimberley, Cartier Island and Ashmore Reef marine parks have been identified in Section 4.3 of the EP. Potential impacts to these AMPs are considered in Sections 7 and 8 of the EP.
					DNP confirmed that it does not require further notification of progress made in relation to this activity unless details regarding the activity change and result in an overlap with or new impact to a marine park, or for emergency responses (see details below).	Not a relevant matter - general correspondence only
					Advised the DNP should be made aware of oil/gas pollution incidences which occur within a marine park or are likely to impact on a marine park as soon as possible. Notification should be provided to the 24 hour Marine Compliance Duty Officer on 0419 293 465. The notification should include: • titleholder details • time and location of the incident (including name of marine park likely to be effected) • proposed response arrangements as per the Oil Pollution Emergency Plan (e.g. dispersant, containment, etc.) • confirmation of providing access to relevant monitoring and evaluation reports when available; and • contact details for the response coordinator.	Relevant matter – stakeholder has provided information relevant to the petroleum activity and/or the stakeholder's functions, interests or activities. Stakeholder's request to be made aware of oil/gas pollution incidences which occur within a marine park or are likely to impact on a marine park have been incorporated in Section 9 of the EP.
Australian Marine Oil Spill Centre (AMOSC)	6/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development Fact Sheet	Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs. Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and control systems (scheduled to commence from 2021). INPEX welcomed feedback and requested any be provided by 10 September 2019. Finally, INPEX requested that the stakeholder advise if any information/comments they provide are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	Not a relevant matter - correspondence sent by INPEX.

	STAKEHOLDER	Date of Correspondence	Type of Correspondence	Activity of Relevance	Attachments	Summary of Correspondence	Assessment of Merit and Relevant Matters
Bu	Oil Spill Response Limited (OSRL)	6/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development Fact Sheet	Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs. Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and contro systems (scheduled to commence from 2021). INPEX welcomed feedback and requested any be provided by 10 September 2019. Finally, INPEX requested that the stakeholder advise if any information/comments they provide are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	Not a relevant matter - correspondence sent by INPEX.
	RPS Asia-Pacific Applied Science Associates (RAPASA) (formerly APASA)	6/08/2019	Email / letter to stakeholder	Both Ichthys LNG Field Development and Ichthys 2019 Update	Yes: - Ichthys LNG Field Development fact sheet - Ichthys 2019 Update fact sheet	Advised that a service provider for INPEX's spill response, RAPASA has been identified as a relevant stakeholder to INPEX's activities. Provided RAPASA with the fact sheets on the 2019 Ichthys Project updates and Ichthys Field Development.	Not a relevant matter - correspondence sent by INPEX.
		6/08/2019	Email / letter from stakeholder	Both Ichthys LNG Field Development and Ichthys 2019 Update	No	Acknowledgement of above correspondence.	Not a relevant matter - general correspondence only
	Industry Associations						
Co	Commonwealth Fisheries Association	5/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development fact sheet - North West Slope Trawl Managed Fishery map	Email informed the stakeholder that INPEX plans to develop and submit EPs to NOPSEMA for further development well drilling and installation of umbilicals, risers and flowlines (URF) in production licence area WA-50-L. The purpose of the engagement was explained to the stakeholder and feedback requested by Friday 6th September 2019. The proposed field development activities were summarised and the stakeholder was referred to the attached Ichthys LNG field development activities fact sheet for further information. INPEX summarised its process of identifying and engaging with commercial fishery stakeholders, noting that commercial fishing activities in the vicinity of production licence area WA-50-L are understood to be limited. A summary of the Commonwealth-managed North West Slope Trawl Fishery (NWSTF) was provided including a map of the fishery licence area relative to the location of WA-50-L.	Not a relevant matter - correspondence sent by INPEX.

STAKEHOLDER	Date of Correspondence	Type of Correspondence	Activity of Relevance	Attachments	Summary of Correspondence	Assessment of Merit and Relevant Matters
					INPEX advised that licence and concession holders of the NWSTF are being invited to provide feedback on the proposed Ichthys LNG field development activities. INPEX noted that other fisheries' licence areas overlap WA-50-L, but as no fishing activities occur in these locations, licence holders in these fisheries are not being contacted . INPEX summarised the potential impacts and proposed control measures for managing interactions and impacts to commercial fishers, including: - Physical presence of the MODU and support vessels, including associated safety zones and Notice to Mariners; - Planned discharges, including management of discharges in accordance with legislative requirements and INPEX's chemical selection process; - Prohibition of recreational fishing on any INPEX-operated facility/vessel or contracted vessel. INPEX requested that the stakeholder advise of any information/comments that is not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	
	9/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	Yes: - Ichthys 2019 Update fact sheet	Informed stakeholder that they are receiving this information as they have been identified as a stakeholder, whose activities, functions or interests may be affected by Ichthys LNG activities. Advised that this update provides information regarding ongoing Ichthys LNG offshore activities being undertaken in accordance with previously accepted environment plans (EPs), and does not relate to any new activities or EPs. Advised this update is separate from recent correspondence regarding INPEX's proposed field development activities and associated EPs. Advised INPEX do not require any specific information, however welcomed ongoing feedback and provided contact details to do so.	Not a relevant matter - correspondence sent by INPEX.
Pearl Producers Association of WA (PPA)	9/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	Yes: - Ichthys 2019 Update fact sheet	Informed stakeholder that they are receiving this information as they have been identified as a stakeholder, whose activities, functions or interests may be affected by Ichthys LNG activities. Advised that this update provides information regarding ongoing Ichthys LNG offshore activities being undertaken in accordance with previously accepted environment plans (EPs), and does not relate to any new activities or EPs. Advised INPEX do not require any specific information, however welcomed ongoing feedback and provided contact details to do so.	Not a relevant matter - correspondence sent by INPEX.
Western Australian Fishing Industry Council (WAFIC)	30/07/2019	Phone call with stakeholder	Ichthys LNG Field Development	No	Phone call to inform stakeholder of INPEX's intention to pursue development drilling in the WA-50-L permit area. WAFIC confirmed that fishing licence holders should only be consulted if they have fished in the permit area in the last 5-8 years. WAFIC confirmed that if fishers didn't fall within this category, the could be excluded from receiving activity information but should be retained on a list of potentially affected parties within the EMBA. WAFIC recommended that INPEX contact AFMA to receive a heat map showing effort of Commonwealth fisheries.	Not a relevant matter - general correspondence only (related to relevant stakeholder identification)
	31/07/2019	Email / letter to stakeholder	Ichthys LNG Field Development	No	INPEX provided a summary of the above phone conversation. INPEX advised that it has analysed FishCube data for individual fisheries to confirm whether fishing had occurred in WA-50-L title block. INPEX advised that no fisheries fish within the title area, however the North West Slope Trawl Fisher and the Northern Demersal Scalefish Managed Fishery both fish in close proximity. INPEX proposed to limit WA/Commonwealth fisheries stakeholder consultation to these two fisheries, excluding the rest due to the planned drilling and construction activities not presenting a risk to the resource overlap with fishing activates. Finally, INPEX provided a table summarising/justifying the relevance of each fishery to the activity. The table included information on the gear used, target species and whether fishing occurs within the permit area.	Not a relevant matter - correspondence sent by INPEX.
	5/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development fact sheet - Northern Demersal Scalefish Managed Fishery map - North West Slope Trawl Managed Fishery map	Email informed the stakeholder that INPEX plans to develop and submit EPs to NOPSEMA for further development well drilling and installation of umbilicals, risers and flowlines (URF) in production licence area WA-50-L. The purpose of the engagement was explained to the stakeholder and feedback requested by Friday 6th September 2019. The proposed field development activities were summarised and the stakeholder was referred to the attached Ichthys LNG field development activities fact sheet for further information. INPEX summarised its process of identifying and engaging with commercial fishery stakeholders, noting that commercial fishing activities in	Not a relevant matter - correspondence sent by INPEX.

STAKEHOLDER	Date of Correspondence	Type of Correspondence	Activity of Relevance	Attachments	Summary of Correspondence	Assessment of Merit and Relevant Matters
					INPEX advised that licence and concession holders of the NDSMF and NWSTF are being invited to provide feedback on the proposed Ichthys LNG field development activities. INPEX noted that other fisheries' licence areas overlap WA-50-L, but as no fishing activities occur in these locations, licence holders in these fisheries are not being contacted . INPEX summarised the potential impacts and proposed control measures for managing interactions and impacts to commercial fishers, including: - Physical presence of the MODU and support vessels, including associated safety zones and Notice to Mariners; - Planned discharges, including management of discharges in accordance with legislative requirements and INPEX's chemical selection process; - Prohibition of recreational fishing on any INPEX-operated facility/vessel or contracted vessel. INPEX requested that the stakeholder advise of any information/comments that is not suitable for public disclosure - such information will be	
	9/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	Yes: - Ichthys 2019 Update fact sheet	Informed stakeholder that they are receiving this information as they have been identified as a stakeholder, whose activities, functions or interests may be affected by Ichthys LNG activities. Advised that this update provides information regarding ongoing Ichthys LNG offshore activities being undertaken in accordance with previously accepted environment plans (EPs), and does not relate to any new activities or EPs. Advised this update is separate from recent correspondence regarding INPEX's proposed field development activities and associated EPs. Advised INPEX do not require any specific information, however welcomed ongoing feedback and provided contact details to do so.	Not a relevant matter - correspondence sent by INPEX.
	9/08/2019	Email / letter from stakeholder	Ichthys 2019 Update	No	Acknowledgement of receipt of correspondence regarding the 2019 Update, dated 09/08/2019.	Not a relevant matter - general correspondence only
NPF Industry Pty Ltd (NPFI)	9/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	Yes: - Ichthys 2019 Update fact sheet	Informed stakeholder that they are receiving this information as they have been identified as a stakeholder, whose activities, functions or interests may be affected by Ichthys LNG activities. Advised that this update provides information regarding ongoing Ichthys LNG offshore activities being undertaken in accordance with previously accepted environment plans (EPs), and does not relate to any new activities or EPs. Advised INPEX do not require any specific information, however welcomed ongoing feedback and provided contact details to do so.	Not a relevant matter - correspondence sent by INPEX.
WA Seafoods	9/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	Yes: - Ichthys 2019 Update fact sheet	Informed stakeholder that they are receiving this information as they have been identified as a stakeholder, whose activities, functions or interests may be affected by Ichthys LNG activities. Advised that this update provides information regarding ongoing Ichthys LNG offshore activities being undertaken in accordance with previously accepted environment plans (EPs), and does not relate to any new activities or EPs. Advised INPEX do not require any specific information, however welcomed ongoing feedback and provided contact details to do so.	Not a relevant matter - correspondence sent by INPEX.
Northern Territory Seafood Council (NTSC)	9/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	Yes: - Ichthys 2019 Update fact sheet	Informed stakeholder that they are receiving this information as they have been identified as a stakeholder, whose activities, functions or interests may be affected by Ichthys LNG activities. Advised that this update provides information regarding ongoing Ichthys LNG offshore activities being undertaken in accordance with previously accepted environment plans (EPs), and does not relate to any new activities or EPs. Advised INPEX do not require any specific information, however welcomed ongoing feedback and provided contact details to do so.	Not a relevant matter - correspondence sent by INPEX.
Commonwealth Managed Fisheries						
North West Slope Trawl Fishery	2/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development fact sheet - North West Slope Trawl Managed Fishery map	Letter informed licence and concession holders of the North West Slope Trawl Fishery that INPEX plans to develop and submit EPs to NOPSEMA for further development well drilling and installation of umbilicals, risers and flowlines (URF) in production licence area WA-50-L. The purpose of the engagement was explained to the stakeholder and feedback requested by Friday 6th September 2019. The proposed field development activities were summarised and the stakeholder was referred to the enclosed Ichthys LNG field development activities fact sheet for further information. INPEX summarised its process of identifying and engaging with commercial fishery stakeholders, noting that commercial fishing activities in the vicinity of production licence area WA-50-L are understood to be limited. A summary of the Commonwealth-managed North West Slope Trawl Fishery was provided including a map of the fishery licence area relative to the location of WA-50-L. INPEX noted that fishing activities do not typically occur in WA-50-L.	Not a relevant matter - correspondence sent by INPEX.

STAKEHOLDER	Date of Correspondence	Type of Correspondence	Activity of Relevance	Attachments	Summary of Correspondence	Assessment of Merit and Relevant Matters
					INPEX summarised the potential impacts and proposed control measures for managing interactions and impacts to commercial fishers, including: - Physical presence of the MODU and support vessels, including associated safety zones and Notice to Mariners; - Planned discharges, including management of discharges in accordance with legislative requirements and INPEX's chemical selection process; - Prohibition of recreational fishing on any INPEX-operated facility/vessel or contracted vessel. INPEX requested that the stakeholder advise of any information/comments that is not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	
	2/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	- Ichthys 2019 Update fact sheet	Letter provided fishery licence and concession holders with an update on the offshore INPEX Ichthys LNG activities, as part of ongoing consultation related to the Project's accepted offshore environment plans (EPs). The letter referred to the enclosed Ichthys 2019 Update fact sheet and summarised key activities of relevance to commercial fisheries, specifically all offshore facilities are now operational and that an inspection of the gas export pipeline (GEP) is scheduled to occur in Q4 2019 and take approximately 4-5 weeks to complete. The letter explained that the existing Ichthys Petroleum Safety Zone (PSZ) continues to apply and provided links for further information on the PSZ. INPEX welcomed feedback and provided contact details.	Not a relevant matter - correspondence sent by INPEX.
Northern Prawn Fishery	2/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	- Ichthys 2019 Update fact sheet	Letter provided fishery licence and concession holders with an update on the offshore INPEX Ichthys LNG activities, as part of ongoing consultation related to the Project's accepted offshore environment plans (EPs). The letter referred to the enclosed Ichthys 2019 Update fact sheet and summarised key activities of relevance to commercial fisheries, specifically all offshore facilities are now operational and that an inspection of the gas export pipeline (GEP) is scheduled to occur in Q4 2019 and take approximately 4-5 weeks to complete. The letter explained that the existing Ichthys Petroleum Safety Zone (PSZ) continues to apply and provided links for further information on the PSZ. INPEX welcomed feedback and provided contact details.	Not a relevant matter - correspondence sent by INPEX.
WA Managed Fisheries						
Mackerel Managed Fishery	2/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	- Ichthys 2019 Update fact sheet	Letter provided fishery licence and concession holders with an update on the offshore INPEX Ichthys LNG activities, as part of ongoing consultation related to the Project's accepted offshore environment plans (EPs). The letter referred to the enclosed Ichthys 2019 Update fact sheet and summarised key activities of relevance to commercial fisheries, specifically all offshore facilities are now operational and that an inspection of the gas export pipeline (GEP) is scheduled to occur in Q4 2019 and take approximately 4-5 weeks to complete. The letter explained that the existing Ichthys Petroleum Safety Zone (PSZ) continues to apply and provided links for further information on the PSZ. INPEX welcomed feedback and provided contact details.	Not a relevant matter - correspondence sent by INPEX.

STAKEHOLDER	Date of Correspondence	Type of Correspondence	Activity of Relevance	Attachments	Summary of Correspondence	Assessment of Merit and Relevant Matters
Northern Demersal Scalefish Managed Fishery	2/08/2019	Email / letter to stakeholder	Ichthys LNG Field Development	Yes: - Ichthys LNG Field Development fact sheet - Northern Demersal Scalefish Managed Fishery Map	Letter informed licence holders of the Northern Demersal Scalefish Managed Fishery that INPEX plans to develop and submit EPs to NOPSEMA for further development well drilling and installation of umbilicals, risers and flowlines (URF) in production licence area WA-50-L. The purpose of the engagement was explained to the stakeholder and feedback requested by Friday 6th September 2019. The proposed field development activities were summarised and the stakeholder was referred to the enclosed Ichthys LNG field development activities fact sheet for further information. INPEX summarised its process of identifying and engaging with commercial fishery stakeholders, noting that commercial fishing activities in the vicinity of production licence area WA-50-L are understood to be limited. A summary of the WA-managed Northern Demersal Scalefish Managed Fishery was provided including a map of the fishery licence area relative to the location of WA-50-L. INPEX noted that WA-50-L and the proposed field development activities are located in Area C of the fishery and understood that fishing activities do not typically occur in this location and water depth. INPEX summarised the potential impacts and proposed control measures for managing interactions and impacts to commercial fishers, including: - Physical presence of the MODU and support vessels, including associated safety zones and Notice to Mariners; - Planned discharges, including management of discharges in accordance with legislative requirements and INPEX's chemical selection process; - Prohibition of recreational fishing on any INPEX-operated facility/vessel or contracted vessel. INPEX requested that the stakeholder advise of any information/comments that is not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA.	Not a relevant matter - correspondence sent by INPEX.
	2/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	- Ichthys 2019 Update fact sheet	Letter provided fishery licence and concession holders with an update on the offshore INPEX Ichthys LNG activities, as part of ongoing consultation related to the Project's accepted offshore environment plans (EPs). The letter referred to the enclosed Ichthys 2019 Update fact sheet and summarised key activities of relevance to commercial fisheries, specifically all offshore facilities are now operational and that an inspection of the gas export pipeline (GEP) is scheduled to occur in Q4 2019 and take approximately 4-5 weeks to complete. The letter explained that the existing Ichthys Petroleum Safety Zone (PSZ) continues to apply and provided links for further information on the PSZ. INPEX welcomed feedback and provided contact details.	Not a relevant matter - correspondence sent by INPEX.
WA North Coast Shark IOE & Northern Shark Fishery	2/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	- Ichthys 2019 Update fact sheet	Letter provided fishery licence and concession holders with an update on the offshore INPEX Ichthys LNG activities, as part of ongoing consultation related to the Project's accepted offshore environment plans (EPs). The letter referred to the enclosed Ichthys 2019 Update fact sheet and summarised key activities of relevance to commercial fisheries, specifically all offshore facilities are now operational and that an inspection of the gas export pipeline (GEP) is scheduled to occur in Q4 2019 and take approximately 4-5 weeks to complete. The letter explained that the existing Ichthys Petroleum Safety Zone (PSZ) continues to apply and provided links for further information on the PSZ. INPEX welcomed feedback and provided contact details.	Not a relevant matter - correspondence sent by INPEX.

STAKEHOLDER	Date of Correspondence	Type of Correspondence	Activity of Relevance	Attachments	Summary of Correspondence	Assessment of Merit and Relevant Matters
NT Managed Fisheries						
Aquarium Fishery (from coast out to AFZ)	2/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	- Ichthys 2019 Update fact sheet	Letter provided fishery licence and concession holders with an update on the offshore INPEX Ichthys LNG activities, as part of ongoing consultation related to the Project's accepted offshore environment plans (EPs). The letter referred to the enclosed Ichthys 2019 Update fact sheet and summarised key activities of relevance to commercial fisheries, specifically all offshore facilities are now operational and that an inspection of the gas export pipeline (GEP) is scheduled to occur in Q4 2019 and take approximately 4-5 weeks to complete. The letter explained that the existing Ichthys Petroleum Safety Zone (PSZ) continues to apply and provided links for further information on the PSZ. INPEX welcomed feedback and provided contact details.	Not a relevant matter - correspondence sent by INPEX.
Coastal Line Fishery (out to 15nm)	2/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	- Ichthys 2019 Update fact sheet	Letter provided fishery licence and concession holders with an update on the offshore INPEX Ichthys LNG activities, as part of ongoing consultation related to the Project's accepted offshore environment plans (EPs). The letter referred to the enclosed Ichthys 2019 Update fact sheet and summarised key activities of relevance to commercial fisheries, specifically all offshore facilities are now operational and that an inspection of the gas export pipeline (GEP) is scheduled to occur in Q4 2019 and take approximately 4-5 weeks to complete. The letter explained that the existing Ichthys Petroleum Safety Zone (PSZ) continues to apply and provided links for further information on the PSZ. INPEX welcomed feedback and provided contact details.	Not a relevant matter - correspondence sent by INPEX.
Demersal Fishery	2/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	- Ichthys 2019 Update fact sheet	Letter provided fishery licence and concession holders with an update on the offshore INPEX Ichthys LNG activities, as part of ongoing consultation related to the Project's accepted offshore environment plans (EPs). The letter referred to the enclosed Ichthys 2019 Update fact sheet and summarised key activities of relevance to commercial fisheries, specifically all offshore facilities are now operational and that an inspection of the gas export pipeline (GEP) is scheduled to occur in Q4 2019 and take approximately 4-5 weeks to complete. The letter explained that the existing Ichthys Petroleum Safety Zone (PSZ) continues to apply and provided links for further information on the PSZ. INPEX welcomed feedback and provided contact details.	Not a relevant matter - correspondence sent by INPEX.
Offshore Net and Line Fishery (from coast out to AFZ)	2/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	- Ichthys 2019 Update fact sheet	Letter provided fishery licence and concession holders with an update on the offshore INPEX Ichthys LNG activities, as part of ongoing consultation related to the Project's accepted offshore environment plans (EPs). The letter referred to the enclosed Ichthys 2019 Update fact sheet and summarised key activities of relevance to commercial fisheries, specifically all offshore facilities are now operational and that an inspection of the gas export pipeline (GEP) is scheduled to occur in Q4 2019 and take approximately 4-5 weeks to complete. The letter explained that the existing Ichthys Petroleum Safety Zone (PSZ) continues to apply and provided links for further information on the PSZ. INPEX welcomed feedback and provided contact details.	Not a relevant matter - correspondence sent by INPEX.
Pearl Oyster (from coast out to AFZ)	2/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	- Ichthys 2019 Update fact sheet	Letter provided fishery licence and concession holders with an update on the offshore INPEX Ichthys LNG activities, as part of ongoing consultation related to the Project's accepted offshore environment plans (EPs). The letter referred to the enclosed Ichthys 2019 Update fact sheet and summarised key activities of relevance to commercial fisheries, specifically all offshore facilities are now operational and that an inspection of the gas export pipeline (GEP) is scheduled to occur in Q4 2019 and take approximately 4-5 weeks to complete. The letter explained that the existing Ichthys Petroleum Safety Zone (PSZ) continues to apply and provided links for further information on the PSZ. INPEX welcomed feedback and provided contact details.	Not a relevant matter - correspondence sent by INPEX.

STAKEHOLDER	Date of Correspondence	Type of Correspondence	Activity of Relevance	Attachments	Summary of Correspondence	Assessment of Merit and Relevant Matters
Spanish Mackerel Fishery (from coast out to AFZ)	2/08/2019	Email / letter to stakeholder	Ichthys 2019 Update	- Ichthys 2019 Update fact sheet	Letter provided fishery licence and concession holders with an update on the offshore INPEX Ichthys LNG activities, as part of ongoing consultation related to the Project's accepted offshore environment plans (EPs). The letter referred to the enclosed Ichthys 2019 Update fact sheet and summarised key activities of relevance to commercial fisheries, specifically all offshore facilities are now operational and that an inspection of the gas export pipeline (GEP) is scheduled to occur in Q4 2019 and take approximately 4-5 weeks to complete. The letter explained that the existing Ichthys Petroleum Safety Zone (PSZ) continues to apply and provided links for further information on the PSZ. INPEX welcomed feedback and provided contact details.	Not a relevant matter - correspondence sent by INPEX.

Appendix D
Oil Pollution Emergency Plan

Umbilicals, Risers and Flowlines and Subsea Production Systems Installation
Oil Pollution Emergency Plan

Document No.: E075-AH-PLN-70001
Security Classification: Public

Rev	Date	Description	Prepared	Checked	Endorsed	Approved
0	20/03/2020	Submitted to NOPSEMA	D. Hazel	J. Prout	J. Carrant	D. Manku

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I Initial Response Requirements

An overview of the initial response requirements for vessel masters (VM), client site representative (CSR) and the INPEX incident management team (IMT) is provided in Table I-1.

Table I-1 has been developed to guide the response personnel through the key steps of this OPEP during a Level 2 or Level 3 spill (defined in Section 2.1).

Table I-1 contains an initial response guide for vessel spills, where either the Australian Maritime Safety Authority (AMSA) or INPEX is the Control Agency.

Information to support the initial response requirements is included in this OPEP.

Table I-1: Initial Response Requirements – vessel spills

Action by			Spill from vessel (AMSA Control Agency) Definitions for 'Action by' persons are as follows: **VM** – Vessel Master (Contractor) **CSR** – Client Site Representative (INPEX) **IMT** – Incident Management Team (INPEX)		
VM	CSR	IMT	Immediate Response Actions	Information/Resources	Comments
■			Stop the spill.	Activate vessel shipboard oil pollution emergency plan (SOPEP).	
■			Classify the spill incident level.	See Section 2.1 Spill classification. Table 2-1: Incident classification.	
■			Verbally notify AMSA.	See Section 2.4.2 External agencies notification. Table 2-2: Jurisdictional boundaries and Jurisdictional Authority and Control Agencies. Table 2-3: External notifications matrix. INPEX Emergency Contact Directory (PER-2153095942).	AMSA is the designated Control Agency for oil spills from vessels within Commonwealth jurisdiction and are to be notified immediately of all ship-sourced incidents through the AMSA Rescue Coordination Centre (RCC) Australia on +61 2 6230 6811. Upon notification of an incident involving a ship, AMSA will assume control of the incident and respond in accordance with AMSA's National Plan for Maritime Environmental Emergencies.
■			Verbally notify the CSR.	See Section 2.4.1 Initial spill notification.	
■	■		Deploy satellite tracking buoys as close to the spill source as is safely practicable.	See Section 4.4.1 Operational Monitoring and Evaluation.	Tracker buoys will be located on the CPF and FPSO during the URF & SPS installation activity. The location of satellite tracking buoys is maintained in the Oil Spill Preparedness and Response Register (PER-2153236568), available on DMS.
	■	■	INPEX CSR to notify IMT Leader via INPEX Emergency Call Centre. IMT Leader notify INPEX Crisis Management Team (CMT) Leader. IMT Leader to activate IMT.	Activate via INPEX Emergency Call Centre. (See Section 2.4.1 Initial spill notification). INPEX Emergency Contact Directory (PER-2153095942).	INPEX Emergency Call Centre 24-hour activation numbers are: 1800 305 789. +61 8 6213 6350 +61 439 694 175
■	■		Prepare marine pollution report (POLREP), submit to AMSA and copy to CSR. CSR to forward POLREP to IMT Leader.	POLREP. (See Table 5-1: Oil Spill Response Forms).	
		■	IMT to contact AMSA and confirm receipt of POLREP. IMT to confirm Control Agency status (either INPEX or AMSA). If AMSA are Control Agency, IMT to offer support as per memorandum of understanding (MOU).	See Section 2.2 Jurisdictional Authority and Control Agency.	If vessel was classified as a 'facility' or 'associated offshore place' at the time of event, INPEX is the Control Agency, and INPEX IMT is to progress with the steps below this row.

Action by			Spill from vessel (AMSA Control Agency) Definitions for 'Action by' persons are as follows: **VM** – Vessel Master (Contractor) **CSR** – Client Site Representative (INPEX) **IMT** – Incident Management Team (INPEX)		
VM	CSR	IMT	Immediate Response Actions	Information/Resources	Comments
					If the vessel was classified as a 'vessel' at the time of event, AMSA is the Control Agency. AMSA and INPEX acknowledge that AMSA retains Control Agency responsibility for all ship sourced marine pollution incidents. INPEX agrees to provide all available support to AMSA in AMSA's performance of its Control Agency responsibilities under the National Plan for Maritime Environmental Emergencies. All resources and capabilities within this OPEP can be implemented upon AMSAs request. Should AMSA request INPEX IMT support, INPEX IMT to progress with the steps below this row.
		■	Develop situational awareness.	See Section 3.1 Gain situational awareness.	During the initial phase of a spill, obtaining and communicating information to allow the establishment of situational awareness is critical for response planning.
		■	Notify Australian Marine Oil Spill Centre (AMOSC).	INPEX Emergency Contact Directory (PER-2153095942).	AMOSC will provide support and guidance to the INPEX IMT during any Level 2 or Level 3 spill event. AMOSC's 24-hour mobile number is +61 (0) 438 379 328; email amosc@amosc.com.au Telephone call and e-mail confirmation to AMOSC required for mobilisation of response personnel and equipment, and call-out authorities will be required to confirm they are the IMT Leader to AMOSC. AMOSC will email a service contract for the request of AMOSC resources/personnel. This contract must be completed and signed by the IMT Leader and emailed to AMOSC, prior to AMOSC mobilisation.
		■	Notify additional regulators and stakeholders.	See Section 2.4.2 External agencies notification. Table 2-3: External notifications matrix. INPEX Emergency Contact Directory (PER-2153095942).	External agencies contact information is available in the INPEX Emergency Contact Directory (PER-2153095942).
		■	Initiate 'Immediate Response Measures' – Operational Monitoring and Evaluation – aerial, vessel, and satellite (as appropriate)	See Section 4.4.1 Operational Monitoring and Evaluation.	Must be implemented as a priority, prior to the development of Incident Action Plans. Additional details on Operational Monitoring and Evaluation are also provided in Appendix A – OM03.
		■	Obtain long-term weather forecasts.	For weather forecast service provider see the INPEX Emergency Contact Directory (PER-2153095942).	Site–specific, long-term weather forecasts are available through the INPEX subscription to the Bureau of Meteorology (BOM).
		■	Identify protection priorities.	See Section 3.3 Identify protection priorities.	Figures of the environmental sensitivities and values as defined in the Environment Plan are attached to this checklist in IMT Room 'Environment' folder.
		■	Validate Operational spill impact mitigation assessment (SIMA) template to generate Operational SIMA.	See Section 3.4 Operational SIMA.	
		■	Develop Incident Action Plan (IAP).	See Section 3.5 Develop an incident action plan.	Resources descriptions, capabilities and activation processes are provided in Section 4 Spill Response Resources. Utilise this information during the development of the IAP.

Action by			**Spill from vessel (AMSA Control Agency)** Definitions for 'Action by' persons are as follows: **VM** – Vessel Master (Contractor) **CSR** – Client Site Representative (INPEX) **IMT** – Incident Management Team (INPEX)		
VM	CSR	IMT	Immediate Response Actions	Information/Resources	Comments
				Appendix B: INPEX Incident Action Plan template.	
■		■	Implement IAP.	See Section 4 Spill response resources.	
		■	Use spill surveillance and reconnaissance data (OM03) to update oil spill trajectory modelling (OM01) outputs.	See Section 4.4.1 Operational monitoring and evaluation. Section 4.7 Operational and scientific monitoring.	
		■	Use oil monitoring (OM) program data to determine scientific monitoring (SM) activation.	See Section 4.7.2 Scientific monitoring and Appendix A.	
		■	Terminate response.	See Section 3.6 Response termination and Section 4 Spill response resources.	General response termination considerations are provided in Section 3.6 Response termination. Response strategy specific termination criteria considerations are provided in Section 4 Spill response resources. OMs and SMs termination criteria are provided in Appendix A.

II Abbreviations and acronyms

Abbreviation/acronym	Description
AFR	Aerotech First Response Ltd
AIMS	Australian Institute of Marine Science
ALARP	as low as reasonably practicable
AMOSC	Australian Marine Oil Spill Centre
AMP	Australian Marine Park
AMSA	Australian Maritime Safety Authority
ANZG	Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
AODN	Australian Ocean Data Network
AOP	associated offshore place
ARP	applied research program
ASTM	American Society for Testing and Materials
ASV	accommodation support vessel
BACI	before–after, control–impact
BIA	biologically important area
BOM	Bureau of Meteorology
CASA	Civil Aviation Safety Authority
CMT	crisis management team

Abbreviation/acronym	Description
CSR	client site representative
Cwlth	Commonwealth
DAWE	Department of Agriculture, Water and the Environment (Cwlth) (formerly the Cwlth Department of Environment and Energy)
DENR	Department of Environment and Natural Resources (NT)
DWER	Department of Water and Environmental Regulation (WA)
DIIS	Department of Industry, Innovation and Science (Cwlth)
DIPL	Department of Infrastructure, Planning and Logistics (NT)
DMS	document management system
DMIRS	Department of Mines, Industry Regulation and Safety (WA)
DNP	Director of National Parks (Cwlth)
DPaW	Department of Parks and Wildlife (WA) now WA DBCA
DPC	Darwin Port Corporation
EEZ	exclusive economic zone
EMBA	environment that may be affected
EP	environment plan
EPA	Environment Protection Authority (NT)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cwlth)

Abbreviation/acronym	Description
ERT	emergency response team
ESP	environmental service provider
FOB	forward operating base
FWAD	Fixed wing dispersant application
GPS	global positioning system
HSE	health, safety and environment
IAP	incident action plan
IC	Incident Controller
I-GEM	Industry–Government Environmental Metadata
IMG	incident management guide
IMT	incident management team
ITOPF	International Tanker Owners Pollution Federation Limited
JHA	job hazard analysis
LAT	lowest astronomical tide
MARPOL 73/78	International Convention for the Prevention of Pollution from Ships, 1973/1978
MNES	Matter of National Environmental Significance
MoU	memorandum of understanding
NATA	National Association of Testing Authorities

Abbreviation/acronym	Description
National Plan (NatPlan)	National Plan for Maritime Environmental Emergencies
NAXA	Northern Australia Exercise Area
NOAA	National Oceanic and Atmospheric Administration (US)
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority (Cwlth)
nm	nautical mile
NT	Northern Territory
NT DIPL	Department of Planning, Infrastructure and Logistics (NT)
NT EPA	Environment Protection Authority (NT)
NT OSCP	Northern Territory Oil Spill Contingency Plan
NT PaWC	Parks and Wildlife Commission (NT)
OM	operational monitoring
OPEP	oil pollution emergency plan
OPGGS (E) Regulations	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cwlth)
OSCP	oil spill contingency plan
OSMP	operational and scientific monitoring program
OSRL	Oil Spill Response Limited
OSTM	oil spill trajectory modelling
OWR	oiled wildlife response

Abbreviation/acronym	Description
PEARS	People, Environment, Assets, Reputation and Sustainability
PEZ	potential exposure zone
POLREP	marine pollution report
PPE	personal protective equipment
PTW	permit to work
RCC	Rescue Coordination Centre
ROV	remotely operated underwater vehicle
SAR	synthetic aperture radar
SCAT	shoreline clean-up and assessment technique
SIMA	spill impact mitigation assessment
SITREP	situation report
SM	scientific monitoring
SHP-MEE	State Hazard Plan – Maritime Environmental Emergencies
SOP	standard operating procedures
SOPEP	shipboard oil pollution emergency plan
TBOSIET	tropical basic offshore safety induction and emergency training
US EPA	United States Environmental Protection Agency
UXO	unexploded ordnance

Abbreviation/acronym	Description
VM	vessel master
WA	Western Australia
WA DBCA	Department of Biodiversity, Conservation and Attractions (WA)
WA DoT	Department of Transport (WA)

1 Introduction

1.1 Purpose

In accordance with Regulation 14(8) of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS (E) Regulations), the implementation strategy for an environment plan (EP) must include an oil pollution emergency plan (OPEP).

This OPEP has been developed specifically to respond to emergency conditions as described and defined in the Umbilicals, Risers and Flowlines and Subsea Production Systems Installation EP (Doc. No. E075-AH-PLN-70000); hereafter referred to as the EP. The scope of this OPEP is consistent with the activities described in Section 3 of the EP.

The purpose of this OPEP is to:

- describe the oil spill emergency response arrangements and capabilities that are in place for the duration of the petroleum activity
- provide high-level guidance and process support for the INPEX Incident Management Team (IMT)
- demonstrate that the intent of Regulation 14(8) of the OPGGS (E) Regulations has been met.

1.2 Plan scope

INPEX defines an Emergency Condition as:

‘A hazardous situation (or threat of a hazardous situation) where Company standard operating procedures will not resolve the situation safely or prevent harm to the people, environment or assets. Successful management of an emergency situation will require coordinated action to control the event, correct the consequences and return the function to a safe condition.’

The emergency conditions identified in the EP which are managed under this OPEP are:

- vessel collision, resulting in a Group II (diesel) or Group IV (HFO) spill to the marine environment at the sea surface.

All activities will be undertaken within the production licence area, WA-50-L, located in Commonwealth waters as shown in Figure 1-1.

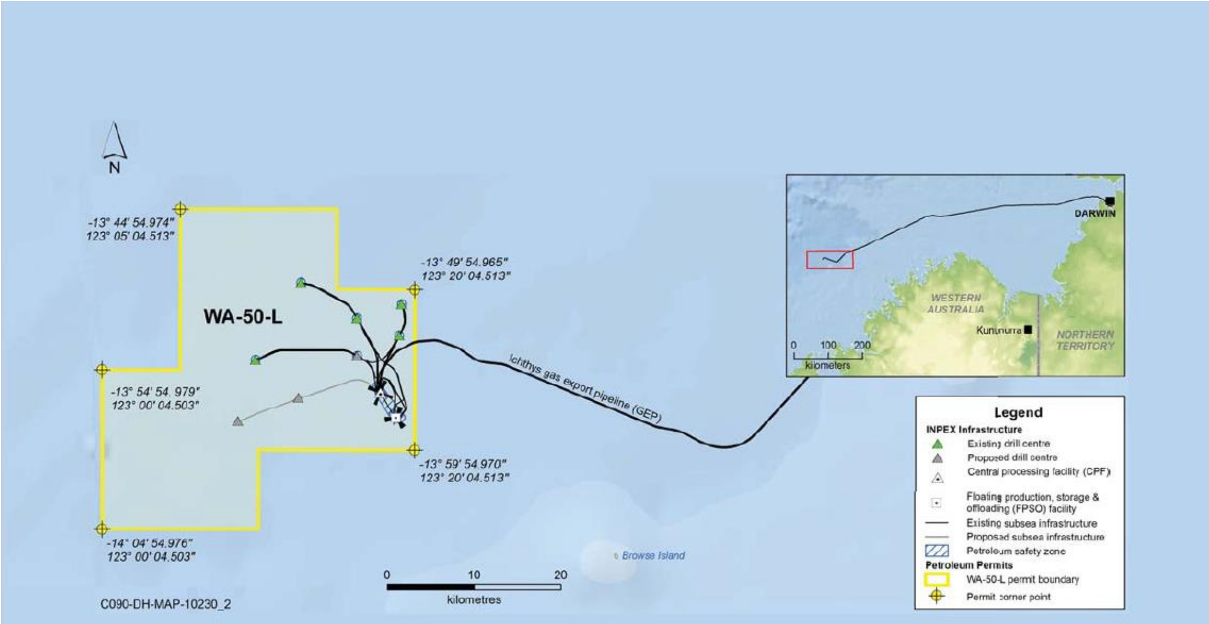

Figure 1-1: Location and coordinates of WA-50-L

2 Spill classification and responsible agencies

2.1 Spill classification

Under the National Plan for Maritime Environmental Emergencies (AMSA 2019; NatPlan), marine hydrocarbon spills and their response requirements are categorised into three levels, based on a combination of factors:

- the known or inferred spill size, scale and complexity
- the likely fate of the spill
- environmental and socioeconomic values within the vicinity
- the capability of equipment in the field in regard to the spill, and the level of support required to respond.

Table 2-1 summarises the hydrocarbon spill level response models adopted for this OPEP.

In the event of a spill occurring where effective response is considered beyond the immediate response capabilities of INPEX (i.e. a spill above Level 1), the response will be escalated immediately to the next level. Spill volumes are a guide only and not to be strictly applied.

Table 2-1: Incident classification

Incident level	Spill volume (m^3)	Description
1	<10	Generally can be resolved through the application of local or initial response resources (first strike response).
2	10 to 1000	Typically more complex in size, duration, resource management and risk than Level 1 incidents. May require deployment of resources beyond the first strike response.
3	>1000	Characterised by a high degree of complexity, requiring strategic leadership and response coordination. May require national and international response resources.

2.2 Jurisdictional authority and control agency

The NatPlan defines the State/Territory and Commonwealth agencies in the following terms.

Jurisdictional Authority

Any agency which has jurisdictional or legislative responsibilities for maritime environmental emergencies is obligated to work closely with the Control Agency to ensure that incident response actions are adequate.

Control Agency

The organisation that directs and manages the spill response (with response assistance provided by other parties under the direction of the Control Agency). The Control Agency responsibility does not always coincide with that of a Jurisdictional Authority. The Control Agency has the operational responsibility to take action in order to respond to an oil spill in the marine environment in accordance with the relevant contingency plan.

Table 2-2 defines the Jurisdictional Authority and Control Agency responsibilities within relevant jurisdictions.

Control Agency in Commonwealth Waters

The NatPlan specifies that for spills in Commonwealth waters, resulting from a 'Facility', the Operator (INPEX) shall become the Control Agency. Where the spill is not from a Facility (i.e. a vessel spill), AMSA will become the Control Agency.

The *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (OPGGS Act), Schedule 3, Clause 4 provides high-level definitions of whether a vessel is acting as a 'Facility' or as an AOP. More specific definitions are provided in the OPGGS (Safety) Regulations 2009, Regulations 1.6 and 1.7.

In the instance that AMSA is the control agency, INPEX has committed, under Clause 7 of a memorandum of understanding (MoU) between INPEX and AMSA, that INPEX: "agrees to provide all available support to AMSA in AMSA's performance of its Combat (Control) Agency responsibilities" (AMSA & INPEX 2013).

The MoU further states that for ship-sourced marine pollution events:

- AMSA is the designated Combat (Control) Agency for oil spills from vessels within the Commonwealth jurisdiction. Upon notification of an incident involving a ship, AMSA will assume control of the incident and respond in accordance with AMSA's Marine Pollution Response Plan.
- AMSA's Marine Pollution Response Plan is the operational response plan for the management of ship-sourced incidents.
- AMSA is to be notified immediately of all ship-sourced incidents through RCC Australia on +61 2 6230 6811.

2.2.1 Cross jurisdictional arrangements

Incidents involving an oil spill response could result in more than one agency having jurisdictional control across the oil spill response area. This situation is possible where a significant spill (Level 2 or 3) originates from a vessel in Commonwealth waters (where INPEX is the Control Agency) and transitions into (or threatens) WA/NT State/Territory waters/shorelines.

Cross jurisdictional spill arrangements for WA and NT are described below.

Western Australia

Detailed cross jurisdiction arrangements (which are summarised below), are available in the WA State Hazard Plan - Maritime Environmental Emergencies (SHP-MEE) (WA DoT 2018).

This includes:

- WA DoT nominating officers to facilitate aligned communications, share situation awareness and coordinate response actions with the INPEX IMT.
- WA DoT also establishing an Incident Control Centre in Fremantle and INPEX providing a number of emergency management support personnel to work within the WA DoT IMT (the INPEX IMT would still function and lead the response in Commonwealth waters and liaise with WA DoT IMT).

INPEX has prepared a Browse Island Oil Spill Incident Management Guide (IMG) X060-AH-GLN-60015. The IMG provides details of how INPEX would support WA DoT in managing a spill in State waters and demonstrates how the INPEX IMT would integrate into the WA DoT IMT, in accordance with the SHP-MEE (WA DoT 2018), including detailed organisational charts and roles and responsibilities descriptions.

This document also provides specific guidance on logistics and tactics for responses at Browse Island, or other similar offshore island locations in the Browse Basin or remote north west coastlines.

Northern Territory

Consultation (17 April 2019) has confirmed the following interim cross jurisdictional arrangements with the Northern Territory government.

It should be noted that the consultation states:

Review of the NT OSCP has been triggered by change to Departmental structure and change to legislative authority. A new NT OSCP steering committee is being formed to oversee redevelopment of the NT OSCP and to allocate roles under the NT OSCP across NT government. The revised NT OSCP will be a sub-plan under the 'all-hazards' Territory Emergency Plan (TEP). This will align with Territory emergency management arrangements and the National Plan. The revised NT OSCP is likely to be distributed for stakeholder consultation before it is finalised.

The NT Department for Environment and Natural Resources (DENR) has provided interim arrangements for the chain-of-command and communication under the NT OSCP, which are to be implemented until the revised NT OSCP is issued. The Jurisdictional Authority and Control Agency responsibilities under the 'interim arrangements' are detailed below and summarised in Table 2-2.

For a spill originating from an INPEX activity, as soon as possible, and in any case, within 24 hours of INPEX becoming aware of an incident/spill that could reach in NT coastal waters, INPEX will notify the NT Pollution Response Hotline and the NT Regional Harbour Master.

Upon notification, the Territory Marine Pollution Coordinator (TMPC) will appoint an NT Incident Controller (NT IC), who in turn will call on competent personnel to form an incident management team appropriate to the scale of the incident. This may include the NT IC calling upon support from that National Response Team.

In effect, for Level 2/3 spills that cross from Commonwealth waters into NT waters, it is expected that the NT IC will appoint INPEX to form the IMT and the INPEX IMT will provide all operational taskings or Incident Action Plans (IAPs) to the NT IC for approval prior to their release/implementation by the INPEX IMT.

The NT IC with advice from NT Environment, Scientific & Technical advisors will work with the INPEX IMT (Perth) to agree protection priorities and determine the most appropriate response in NT waters.

For Level 2/3 spills that contact NT shorelines, the NT IC will assume the role of Control Agency. An NT IMT will be established in Darwin, made up of staff from across NT

Government. The NT IMT will be supported by existing Northern Territory emergency response arrangements, as defined in the NT *Emergency Management Act 2013,* through the Territory Emergency Management Council and the NT Government Functional Groups. INPEX will provide support to the NT IMT, from the INPEX IMT (Perth), and support from an INPEX forward operating base and other INPEX resources in Darwin.

At the request of the TMPC, INPEX will be required to provide all necessary resources, including personnel and equipment, to assist the NT IMT in performing its duties as the Control Agency for NT shoreline response. This may include the provision of personnel to work within the NT IMT located in Darwin, to assist response activities such as shoreline protection and clean-up and oiled wildlife response, with the required numbers to be determined based on the nature and scale of the spill and response requirements at the time.

To facilitate coordination between NT Statutory and Control Agencies and INPEX IMT during a response, the NT IMT and INPEX forward operating base (FOB) will be established to ensure alignment of objectives and provide a mechanism for de-conflicting priorities and resourcing requests directly between the INPEX IMT in Perth and NT IMT in Darwin. The lines of communication between the INPEX and the NT Government are shown in Figure 2-1.

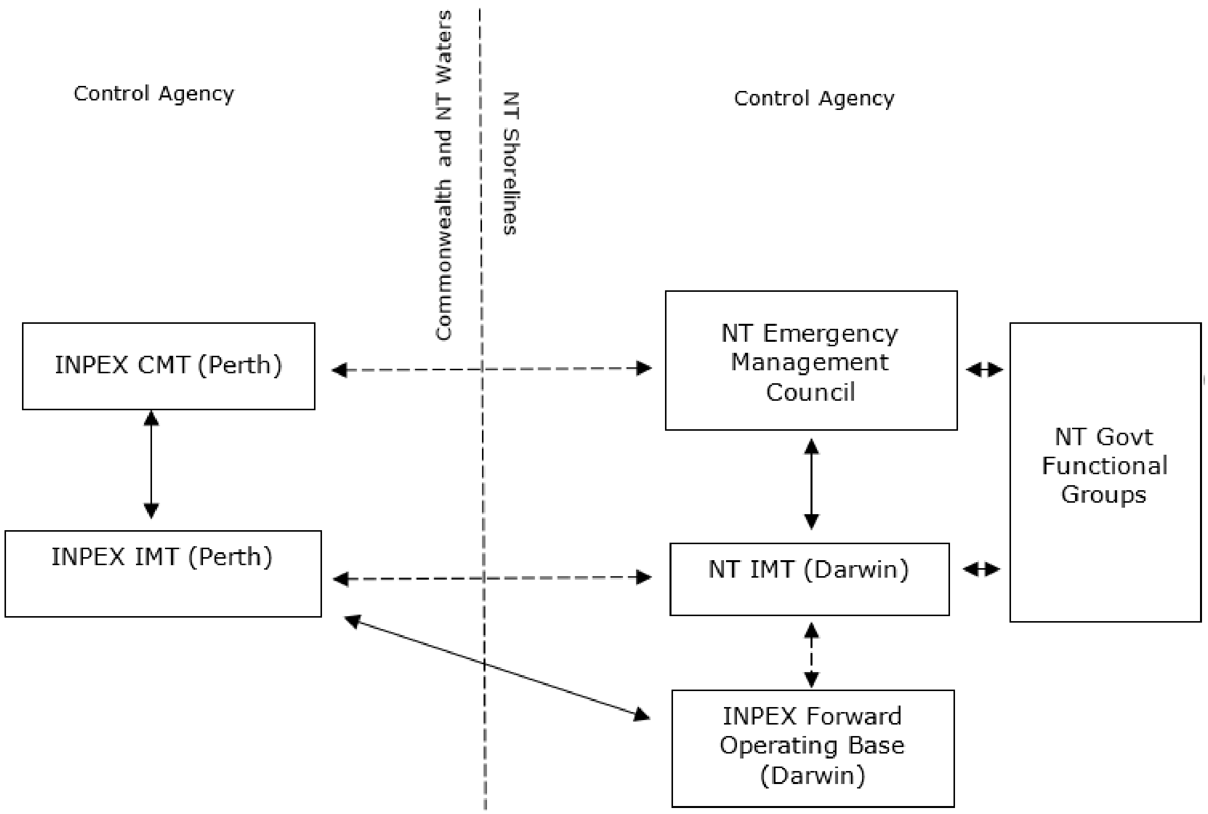

Figure 2-1: Lines of communication between INPEX and NT Government

Table 2-2: Jurisdictional boundaries and Jurisdictional Authority and Control Agencies

Jurisdictional boundary	Spill source	Jurisdictional Authority	Control Agency			Relevant documentation
			Level 1	Level 2*	Level 3	
Commonwealth waters (3 to 200 nautical miles from territorial sea baseline).	Vessel within the production licence area WA-50-L.	AMSA	AMSA With support from vessel contractor and INPEX if required.	AMSA With support from vessel contractor, INPEX and AMOSC if required.	AMSA With support from vessel contractor, INPEX and AMOSC if required.	Vessel SOPEP, NatPlan and (this) INPEX OPEP
	Spill from URF vessel conducting an activity as a 'Facility' or 'AOP'.	NOPSEMA	INPEX Level 1 spill response from support vessels.	INPEX With support from AMOSC and AMSA.	INPEX With support from, AMOSC, AMSA and Oil Spill Response Limited (OSRL).	(This) INPEX OPEP.
Northern Territory (NT) waters (territorial sea baseline to 3 nautical miles and some areas around offshore atolls and islands (i.e. Tiwi Islands)).	Spill from URF vessel conducting an activity as a 'Facility or AOP', spill from Commonwealth waters travelling into NT waters.	NT Department of Infrastructure, Planning and Logistics (NT DIPL).	INPEX Level 1 spill response from support vessels.	NT DoT With support from INPEX and AMOSC, if required.	NT DoT With support from INPEX and AMOSC and OSRL, if required.	(This) INPEX OPEP and NT Oil Spill Contingency Plan (OSCP).
	Spill from URF vessel not conducting an activity as a 'Facility or AOP', spill from Commonwealth waters travelling into NT waters.	NT DIPL	NT DIPL With support from INPEX.	NT DIPL With support from INPEX (including AMOSC), if required.	NT DIPL With support from INPEX (including AMSA, AMOSC and OSRL), if required.	(This) INPEX OPEP and NT OSCP.
WA waters and shoreline/waters (territorial sea baseline to 3 nautical miles and some areas around offshore atolls and islands (i.e. Browse Island)).	Spill from URF vessel conducting an activity as a 'Facility or AOP', spill from Commonwealth waters travelling into WA waters.	WA DoT	INPEX Level 1 spill response from support vessels.	WA DoT With support from INPEX (including AMOSC), if required.	WA DoT With support from INPEX, AMSA, AMOSC and OSRL.	(This) INPEX OPEP and WA DoT State Hazard Plan–Maritime Environmental Emergencies.
	Spill from URF vessel not conducting an activity as a 'Facility or AOP', spill from Commonwealth waters travelling into WA waters.	WA DoT	WA DoT[1] With support from INPEX.	WA DoT[2] With support from INPEX (including AMOSC), if required.	WA DoT With support from INPEX, (including AMSA, AMOSC and OSRL), if required.	(This) INPEX OPEP and WA DoT State Hazard Plan–Maritime Environmental Emergencies.

*AMOSC and government agencies may assist the relevant Control Agency for Level 2 and Level 3 spills, as appropriate to the spill characteristics.

§ WA's DoT has advised that, in the event of a spill, under the *Emergency Management Act 2005*, it has the power to take over the role of Control Agency. Under the State Hazard Plan – Maritime Environmental Emergencies (SHP-MEE), the DoT will not have the full support from all agencies unless the DoT is the Control Agency.

2.3 INPEX response team activation

Where a spill is assessed to be Level 2 or Level 3, the IMT shall be activated by the INPEX Client Site Representative (CSR) via the INPEX Emergency Call Centre.

Once the IMT has been activated it shall provide support to AMSA (as Control Agency for vessels spills) for implementing spill response control measures, interaction with regulatory authorities and support agencies, monitoring, reporting and response termination.

Further information regarding the INPEX emergency and crisis management organisation can be found within Section 9 of the EP.

2.4 Incident notification

2.4.1 Initial spill notification

The spill observer shall raise the alarm and take action to stop the spill, if possible:

- for a spill observed or detected from a vessel, the Vessel Master shall be notified
- the Vessel Master shall alert the INPEX CSR
- the INPEX CSR shall alert the IMT Leader (who then will decide whether to activate the IMT)
- the IMT Leader shall consult with the CMT (crisis management team) Leader, and jointly determine whether to activate only the IMT or both the IMT and the CMT.

2.4.2 External agencies notification

The Vessel Master, CSR and IMT Leader (as relevant) shall provide verbal notifications of Level 2 or Level 3 spill events from Vessel, Facility or AOP, to the organisations listed in Table 2-3.

The IMT Leader, in consultation with AMSA, should consider additional stakeholder notifications, based on values and sensitivities affected. Additional stakeholders for consideration include those listed in Table 5-1 of the EP.

If written forms are required as part of a notification, they can be found in Table 5-1 of this OPEP.

If activated, the IMT shall notify AMOSC of the spill event. AMOSC shall provide technical support to assist and shall also provide access to oil spill response equipment and personnel, if required. Details of resource availability are provided in Section 4 of this OPEP.

2.4.3 INPEX emergency contacts directory

All relevant contact details required of this OPEP are contained within the INPEX Emergency Contacts Directory (Doc. No. PER-2153095942), a hard copy of which is maintained in the IMT Room with an electronic copy available on the incident management system (EMQNet).

The INPEX Emergency Contacts Directory is reviewed at least annually to check all relevant call-off contracts, described in sections 4.1 and 4.2, are included and all contact numbers are kept up to date.

Table 2-3: External notifications matrix

Contact	Comments	Method	Timing	Responsibility
Spill in any location				
AMOSC (may assist as a support response agency).	Level 2/Level 3 spill – response agency. Alert and put on standby, as required. Activate if spill response escalates in order to mobilise spill-response resources.	Phone call and email. Service contract with AMOSC to be signed by IMT Leader. Refer to Table 5-1.	As soon as practicable.	IMT Leader or delegate.
OSRL (may assist as a support response agency).	Level 2/Level 3 spill – response agency. Alert and put on standby as required. Activate if spill response escalates in order to mobilise spill-response resources.	Phone call and email.	As soon as practicable.	IMT Leader or delegate.
Oil spill modelling service provider.	Provide POLREP and other relevant event information to enact real-time spill modelling as soon as practicable.	Initial phone call followed by email of modelling request form. Spill modelling request / activation forms. Refer to Table 5-1.	As soon as practicable (must be activated within 2 hours of IMT formation)	IMT Leader of delegate.
Spill in Commonwealth waters				
AMSA duty officer.	Notification is required as soon as possible after the occurrence of the event. If AMSA has already been notified by the vessel ERT, IMT to confirm situational awareness and Control Agency responsibility with AMSA.	Phone call, within two hours. From vessel, the message must begin with the code word "POLREP", then the vessel name, the IMO number and the call sign of the ship. Written report within 24 hours of a request from AMSA, via POLREP form. Refer to Table 5-1. Written update via SITREP as required, via SITREP form. Refer to Table 5-1.	Verbally, within two hours. Written POLREP, within 24 hours. SITREP as required.	Vessel Master, CSR and IMT Leader or delegate (as relevant).
NOPSEMA.	Notification of reportable incidents is required under OPPGS (E) Regulations 2009, Regulations 26, 26A and 26AA.	Phone call, as soon as possible and not later than 2 hours after the occurrence of a Level 2 or Level 3 event only. Written report within three days. Use NOPSEMA report form Report of an accident, dangerous occurrence or environmental incident (FM0831). Refer to Table 5-1.	Verbally, within 2 hours. Written within three days.	INPEX CSR or INPEX IMT Leader or delegate (as relevant).
Commonwealth Department of Agriculture, Water and the Environment (DAWE).	Notification is required in cases where matters of national environmental significance (MNES) are at risk including not only listed species but also heritage properties and Ramsar wetlands, and/ or where there is death or injury to protected species.	Phone call notification within 24 hours of becoming aware of the incident or non-conformance resulting in impacts to MNES. Written / email report within 3 days.	Verbally, within 24 hours. Written, within 3 days.	IMT Leader or delegate (as relevant).

Contact	Comments	Method	Timing	Responsibility
	Permits from DAWE are required to enter and undertake activities in Australian marine parks (AMPs), heritage properties or Ramsar wetlands.			
Spill within or heading towards an Australian Marine Park				
Director National Parks (DNP).	Notification is required for any oil/gas pollution incidences within or likely to impact an Australian marine park (AMP) as soon as possible. INPEX to confirm details of the time and location of the event, any marine parks that are likely to be impacted and will confirm proposed response arrangements and contact details for the IMT. It is acknowledged that some of the information requested by the DNP may not be available at the point of the initial verbal notification and therefore updates will be ongoing throughout the duration of any response that may impact on a marine park.	Phone call to the DNP 24-hour Marine Compliance Duty Officer: 0419 293 465. The notification should include: • titleholder details • time and location of the incident (including name of marine park likely to be affected) • proposed response arrangements as per the Oil Pollution Emergency Plan (e.g. dispersant, containment, etc.) • confirmation of providing access to relevant monitoring and evaluation reports when available; and • contact details for the response coordinator.	Verbally, as soon as possible and prior to action being taken within an AMP.	IMT Leader or delegate (as relevant).
Administrator of the Australian Indian Ocean Territories (IOT).	The Australian Government, through the Department of Infrastructure, Regional Development and Cities, administers Ashmore reef and Cartier Island. On behalf of the Department, the WA Department of Water and Environmental Regulation provides pollution response capability and advice for pollution incidents for Indian Ocean Territories. Notifications as noted below for WA DWER.	Phone call, as soon as practicable by calling the WA DWER pollution watch hotline Email: pollutionwatch@dwer.wa.gov.au	As required.	IMT Leader or delegate (as relevant).
Spill heading towards WA State waters (e.g. Browse Island, Kimberley coastline)				
WA Department of Transport (WA DoT).	Jurisdictional Authority and Control Agency for spills in WA waters. Notification is required in the event of a hydrocarbon spill which is predicted to enter WA State waters.	Phone call to WA DoT Maritime Environmental Emergency Response (MEER) pollution hotline. Written notification by POLREP. Written update via SITREP, as required. Refer to Table 5-1.	Verbally, within two hours. Written POLREP, within 24 hours. SITREP, as required.	IMT Leader or delegate.
WA Department of Water and Environment Regulation (DWER).	Contact in the event of a hydrocarbon spill which is predicted to cause contamination of shorelines.	Phone call, as soon as practicable. Email: pollutionwatch@dwer.wa.gov.au Written report within 21 days.	As required.	IMT Leader or delegate.
Spill heading towards NT waters (e.g. Tiwi islands)				

Contact	Comments	Method	Timing	Responsibility
NT DIPL	Jurisdictional authority for spills in NT waters. Notification is required as soon as practicable in the event of a hydrocarbon spill which is predicted to enter NT waters. The NT OSCP operates within the framework of the National Plan and consists of the NT Marine Oil Pollution Manual, the NT OSCP and supporting port OSCPs.	Phone call, as soon as practicable by calling the marine pollution coordinator (TMPC). Written notification by POLREP. Written update via SITREP, as required. Refer (Table 5-1).	Verbally, as soon as practicable. Written POLREP, within 24 hours. SITREP, as required.	IMT leader or delegate.
Northern Territory Environment Protection Authority (NT EPA).	The NT EPA acts as the environmental science coordinator in the NT, and would provide advice to the incident controller during any spill response in the NT. Notification is required as soon as practicable in the event of a hydrocarbon spill which is predicted to enter NT waters.	Phone call and email.	Verbally and by email, as soon as practicable.	IMT leader or delegate.
Spill heading towards defence areas e.g. Northern Australia Exercise Area (NAXA)				
Department of Defence.	Notification is required as soon as practicable in the event of a hydrocarbon spill which is predicted to enter defence areas such as NAXA, Yampi Sound or any other defence area. Notification may be required if significant vessel mobilisations or activities are required within the defence areas to ensure response vessels have clearance to access any currently active Defence Practice Areas. Notification may also be required regarding access restrictions within defence areas in relation to hazardous zones such as unexploded ordnance (UXO).	Phone call to Department of Defence – Defence Switchboard. Relevant contacts: Director General Maritime Operations, Headquarters Joint Operations Command. Assistant Secretary, Property Management Branch.	As soon as practicable.	IMT Leader or delegate.
Spill heading towards Indonesia or East Timorese waters				
Department of Industry, Innovation and Science (DIIS).	In the event that a spill is predicted to enter Indonesian or East Timorese waters, or the Joint Petroleum Development Area (JPDA), the Australian Government is required to notify the international governments. DIIS will notify the Department of Foreign Affairs and Trade, who will notify the relevant foreign government.	Phone call to DIIS.	As soon as practicable.	IMT Leader or delegate, in consultation with CMT.

2.5 Pollution report (POLREP)

A marine pollution report (POLREP) is required to be sent to AMSA for any vessel-based spill.

The POLREP should also be sent to the IMT, as it contains the relevant information necessary for the IMT to gain initial situational awareness.

The following information shall be included in the POLREP regarding any vessel spill for reporting and response planning purposes:

- the name of vessel
- the date and time of the spill
- the location of the spill
- details of the spilled material
- the source and cause of the spill
- an estimated volume of the spill
- the vessel status (stability, condition of the ship etc.)
- the estimated rate of release and maximum credible volume if the spill is ongoing
- the condition of the spill, i.e. stopped/ongoing, contained/uncontained
- the meteorological conditions:
  - air temperature
  - wind speed and direction
  - visibility
- the oceanographic conditions:
  - sea temperature
  - current speed and direction
  - Beaufort sea state.

See Table 5-1 for further information regarding POLREP template and submission timeframes.

2.6 Immediate (first strike) response measures

The immediate response has been predetermined by the Operational SIMA (see Section 3.4) and must be implemented as soon as practicable, before the development of IAPs.

The immediate response for all Level 2 and Level 3 spill events is Operational Monitoring and Evaluation, as detailed in Section 4.4.1 of this OPEP.

Further details are also provided in Appendix A (OM01 and OM03).

3 Incident action plan (IAP) development

The process for identifying appropriate IAPs is illustrated in Figure 3-1.

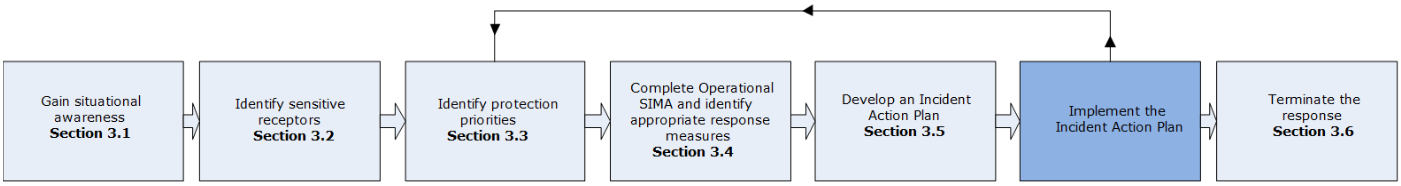

Figure 3-1: Typical response procedure

3.1 Gain situational awareness

The IMT will gain situational awareness from all available sources including:

- Operational Monitoring and Evaluation data
- vessel POLREP
- ongoing updates from the vessel
- long-term weather forecast
- Bureau of Meteorology (BOM) weather stations
- other vessels or Facilities in the vicinity
- other operators' activities.

3.2 Identify sensitive receptors

Particular values and sensitivities with the potential to be exposed to a spill event have been identified within Section 4 of the EP.

The INPEX IMT room is equipped with maps and tools to identify actual/real-time exposure risks.

Where there is a seasonal component associated with a particular value or sensitivity, it is shown in Table 3-1.

Table 3-1: Seasonality of values and sensitivities

Values and sensitivities	Example Locations	Month: Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Coral spawning (offshore reefs)	• Browse Island, Kimberley coast, Rowley Shoals, Scott Reef, Seringapatam Reef, Rowley Shoals, Hibernia Reef, Mermaid Reef												
Green turtle breeding and hatching	• Browse Island and Scott Reef (Sandy Islet)*												
	• Adele Island, Lacepede Islands, Cassini Island**												
	• Ashmore Reef and Cartier Island*												
Turtle foraging	• Turtle foraging BIA												
Hawksbill turtle nesting	• Ashmore Reef and Scott Reef*	•											
Olive ridley turtle nesting	• Kimberley coast*	•											
	• Tiwi Islands*												
Flatback Turtle Nesting	• Lacepede Islands *	•											
	• Tiwi Islands*												
	• Cassini Island *												
Humpback whale migration	• Kimberley coast							Northern then southern migration					
Humpback whale calving	• North-west Commonwealth Marine Reserves Network, Lalang-garram / Camden Sound Marine Park and humpback whale Biologically Important Areas (BIA)**							Whales present in calving grounds					
Blue whale and pygmy blue whale migration	• Open ocean (approx. 500 m depth contour)				Northern migration					Southern migration			
Whale shark	• Whale shark BIA												
Dugong and Inshore Dolphins	• WA coast, Ashmore Reef **												
Seabird feeding, aggregation and breeding	• Marine avifauna BIA (e.g Ashmore Reef Ramsar site), Cartier Island, Scott Reef, Adele Island). Nationally Important Wetland at Mermaid Reef.	•			Breeding and foraging								
Shorebird migration	• Migratory birds present in coastal habitats	•			Northern migration					Southern migration			
Shorebird breeding	• Marine avifauna BIA and WA coastline												

Values and sensitivities	Example Locations	Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Indonesian traditional fishing	• Offshore islands and reefs located within the traditional fishing MoU area.												
Recreational fishing	• Open ocean and WA coast												
Commercial fishing	• Within and adjacent to the WA-50-L.												
Legend													
	Peak occurrence/activity (reliable and predictable)												
	Intermediate occurrence/activity (less reliable and less predictable)												
	Low occurrence/activity (may vary from year to year)												
	No occurrence												

* Source: DEE (2017).

** Source: Waples et al. (2019)

3.3 Identify protection priorities

In the event of a spill, the primary aims of the response will be aligned with the NatPlan (AMSA 2019) and the INPEX People, Environment, Assets, Reputation and Sustainability (PEARS) model and include protection of the following, in descending order of priority:

- human health and safety
- habitat and cultural resources (environmental sensitivities)
- rare and/or endangered flora and fauna (environmental sensitivities)
- commercial resources
- amenities.

Table 3-2 illustrates how shoreline protection priorities are determined. Each shoreline location is evaluated based on predicted time to contact and consequence of contact.

The level of consequence associated with identified values and sensitivities is defined within Section 8 of the EP.

Time to contact during a spill event will be based on the location and trajectory (model outputs) and visual observations of the spill.

Table 3-2: Protection priority matrix

		Time to contact			
		<24 hours	24-48 hours	48-72 hours	>72 hours
	Multiplier	4	3	2	1
Catastrophic	6	24	18	12	6
Major	5	20	15	10	5
Significant	4	16	12	8	4
Moderate	3	12	9	6	3
Minor	2	8	6	4	2
Insignificant	1	4	3	2	1

Based on the modelling results for the Group II (diesel) (APASA 2014a) and Group IV (HFO) (APASA 2014b) spill scenarios, the shoreline protection priorities are shown in Table 3-3.

Note that only locations with a minimum time to exposure of 336 hours or less were included in the table as anything over two weeks (14 days) is considered outside of the early IMT planning and IAP development cycles.

Table 3-3: Protection priorities for Group II/Group IV spill event

Location	Minimum time to exposure	Worst-case consequence evaluation (See Section 8 of the EP)	Priority
Ashmore Reef	237 hours (Group IV)	Significant	Low (4)
Browse Island	28 hours (Group II) 33 hours (Group IV)	Moderate Significant	Medium (9) Medium (12)
Cartier Island	161 hours (Group IV)	Significant	Low (4)
Cassini Island	192 hours (Group IV)	Significant	Low (4)
Kimberley MP	109 hours (Group II)	Significant	Low (4)
Scott Reef	129 hours (Group IV)	Significant	Low (4)

In the event of a spill, the protection priorities identified should be confirmed by reviewing the specific information relating to the spill received from Operational Monitoring and Evaluation data and predicted time to exposure based on spill modelling outputs.

Note that WA DoT/NT DENR are the Control Agency in the event of a spill in WA State/Territory waters and have the final decision regarding protection priorities, response strategies and tactics.

3.4 Operational SIMA

Strategic spill impact mitigation assessments (SIMAs) for the vessel collision spill scenarios are discussed in Section 8 of the EP. This OPEP provides an 'Operational SIMA Template' for each relevant spill scenario (i.e. Group II (diesel) and Group IV (HFO)). The Operational SIMA template includes a summary of key points from the Strategic SIMA.

During an oil spill emergency event, the IMT will develop an Operational SIMA by evaluating the validity of the assumptions of the Strategic SIMA, which are summarised in the Operational SIMA template including relevant ALARP considerations from Section 8 of the EP. The Operational SIMA would need to consider the specific conditions of the spill event, such as the oil type, spill location and trajectory, the sea state and weather forecast, environmental sensitivities and seasonality, which may have a bearing on the effectiveness and feasibility of implementing various responses.

The outcome of the Operational SIMA will be used in development of the IAP(s).

The Operational SIMA shall remain as a record of the reasoning behind the selection or elimination of various response measures during an actual event.

The Operational SIMA and IAP may need to be revised if additional information arises.

See Table 3-4 and Table 3-5 for the Operational SIMA templates for Group II spills and Group IV spills respectively.

Table 3-4: Operational SIMA template - Group II (diesel) spills

Response measure	Strategic SIMA Summary	ALARP Summary	Operational SIMA comments	IMT Leader sign-off
Operational Monitoring and Evaluation	Operational Monitoring and Evaluation will provide timely information to the IMT, enabling situational awareness to assist with IAP development, implementation and termination of oil spill response strategies. Operational monitoring and evaluation **shall** be implemented for any Level 2/3 spill.	Prioritise the activation of the following activities: Oil Spill Trajectory Modelling (OSTM), Aerial Surveillance, and deployment of oil spill tracker buoys. When deploying tracker buoys, preferably deploy 3 during the initial stages (hours) of the spill, in close proximity to each other. Consider the explosive risks and VOC exposure for any oil spill tracker buoy deployments and aerial/vessel observation tasks. Use of crew change helicopters for aerial surveillance should only be during initial stages of a spill, and only when helicopters are not required for other emergency tasks. Longer-term aerial surveillance operations should utilise fixed-wing aircraft. Trained aerial observers should be arranged for longer-term aerial surveillance operations. Vessel surveillance is less efficient than aerial surveillance. Data from opportunistic vessels sightings can be collected, but this should not be a primary strategy for visual observations of slicks over large areas. Consider satellite imagery acquisition to complement longer-term aerial surveillance programs and support OSTM validation.		
Shoreline clean-up	Shoreline clean-up has been consistently found to not enhance ecological recovery of oiled coastlines (Sell et al. 1995) but it may protect other resources in the area, such as birds, marine mammals or subtidal habitats including coral reefs or fish farms (CSIRO 2016). Choosing a particular clean-up technique is dependent on factors such as shoreline type, exposure, sensitivity, amount of oil, persistence of oil, toxicity of oil and rate of natural oil removal (IPIECA 2015a). The clean-up of Group II spills on a shoreline is likely to be difficult, generating high volumes of waste in comparison to the volume of oil recovered. Most offshore island shorelines would be expected to 'self-clean' any accumulated Group II oils, due to the lack of adhesiveness of these oil types, the coarse substrate, the high wave energy and high tidal regime. Sensitive shorelines with lower energy, such as mudflats and mangroves on the WA/NT coastline and any coral reefs would likely be damaged by the physical activities associated with shoreline clean-up, and therefore these locations would also be left to self-clean.	Weathered diesel is a relatively non-adhesive oil and is not expected to form a thick adhesive layer on a shoreline. Utilise Operational Monitoring and Evaluation data (including shoreline clean-up assessments) to determine the likely success of any shoreline clean-up response compared to allowing natural weathering to occur. Shoreline clean-up techniques should focus on manual clean-up techniques, such as the use of rakes and shovels. Mechanical clean-up equipment (graders, loaders etc) should not be used to physically collect oil. However, small mechanical aids (e.g. rubber tracked bob-cats) can be used to assist in moving collected oily waste around a shoreline. Careful planning of track routes is required to avoid disturbance of any turtle/bird nesting sites. Personnel and equipment transport to and from the shoreline would be by small utility helicopter and/or vessels. Low sea-states and calm weather are required for use of vessels for shoreline landings. Tide forecasts should also be consulted to ensure appropriate and safe vessel activities. A large support vessel or Facility (with a helicopter pad, if relevant) would need to be used as the accommodation and logistics base for shoreline response personnel at remote locations. Upon successful clean-up of the shoreline, bulka bags/IBCs containing oily contaminated waste would be transferred by helicopter or landing barge to a support vessel, for further transport to the mainland for appropriate disposal with a licenced waste contractor. In general, to reduce wildlife disturbance on small, offshore remote locations, a longer duration response with minimum numbers of response personnel required to achieve the IAP objective is desired.		

Response measure	Strategic SIMA Summary	ALARP Summary	Operational SIMA comments	IMT Leader sign-off
Pre-contact oiled wildlife response	Group II hydrocarbons are not likely to generate a thick surface layer on the ocean surface or on a shoreline. Therefore, there is reduced potential to coat adult nesting turtles or turtle hatchlings as they transit to the ocean, or coat large numbers of seabirds. Wildlife hazing can be an effective control measure when deployed across a limited geographical area and against specific wildlife population, where the surface oil resulting from a spill is largely contained, e.g. at a beach/specific shoreline. Capture and translocation of turtles (adults and hatchlings) from a shoreline to an area away from the slick may provide an environmental benefit, however minimising the time during which turtles (especially hatchlings) are in captivity is critical to success of the operation. Wildlife hazing in the open ocean is inherently unlikely to be effective due to a number of limitations, including numbers of vessels required and associated safety issues, ongoing spread and movement of the slick and hazed animals moving into adjacent areas of the slick. Attempting to capture large numbers (or an entire flock) of healthy seabirds would be very challenging, if not impossible (DPaW and AMOSC 2014), especially at a remote shoreline location (e.g. Browse Island). There is no practicable method to capture healthy seabirds at sea (DPaW and AMOSC 2014). Potential harm to healthy seabirds could occur during the capture process. Any seabirds released would likely fly back to the shoreline from which they originally were captured. Long term veterinary care (e.g. feeding) would be required for any successfully captured birds, until spill weathering or remediation has occurred, and it was safe to release the animals. Animals would be under stress while in veterinary care/rehabilitation facilities and potentially exposed to human and zoonotic diseases, which could be spread to wild populations upon their release.	Wildlife hazing or wildlife capture and translocation in the open ocean should only be considered when Operational Monitoring and Evaluation data clearly indicates that a positive outcome could be achieved. The merits of wildlife hazing or wildlife capture and translocation at a shoreline should be considered by the IMT when Operational Monitoring and Evaluation data indicates that populations of wildlife on a shoreline may be at risk of an inbound spill and conditions are suitable for this activity to occur. There are significant manual handling risks associated with translocating adult turtles, (adult green turtles are often >100kg), which need to be evaluated and managed if this activity is to occur. Therefore, translocation of turtle hatchlings is more likely to be successful. Wildlife response personnel and equipment transport to and from the shoreline would be by small utility helicopter and/or vessels. Low sea-states and calm weather are required for use of vessels for shoreline landings. Tide forecasts should also be consulted to ensure appropriate and safe vessel activities. A large support vessel or Facility (with a helicopter pad, if relevant) would need to be used as the accommodation and logistics base for shoreline response personnel. In general, to reduce wildlife disturbance on small, offshore remote locations, a longer duration response with minimum numbers of response personnel required to achieve the IAP objective is desired.		
Post-contact oiled wildlife response	Group II hydrocarbons are relatively non-adhesive compared to crude oils, and generally not considered an oil product that would 'coat' the feathers of birds, requiring a full wildlife cleaning response on a shoreline. They are also not likely to generate a thick surface barrier on a shoreline which would coat adult nesting turtles or turtle hatchlings as they transit to the ocean. Capture, relocation, assessment, cleaning and rehabilitation of oiled wildlife has the ability to increase the survival of individuals (IPIECA 2017).	Oiled wildlife capture in the open ocean should only be considered when Operational monitoring and evaluation data clearly indicates that a positive outcome could be achieved. The merits of wildlife capture, cleaning and rehabilitation at a shoreline should be considered by the IMT when Operational Monitoring and Evaluation data indicates that populations of wildlife on a shoreline have been impacted by the spill and conditions are suitable for this activity to occur. Wildlife response personnel and equipment transport to and from the shoreline would be by small utility helicopter and/or vessels.		

Response measure	Strategic SIMA Summary	ALARP Summary	Operational SIMA comments	IMT Leader sign-off
	ITOPF (2011) note that there are many cases where oiled turtles have been cleaned successfully and returned to the water. Once oiled, it is generally agreed that the bird species present in the Browse Basin region will have very low survival rates, even when rescue and cleaning is attempted. Any seabirds captured, cleaned and released would likely fly back to the shoreline from which they were originally captured. Therefore, long-term veterinary care (e.g. rehabilitation, feeding, etc.) would be required for any successfully captured birds, until spill weathering or remediation had occurred, and it was safe to release the seabirds. Animals would be under stress while in veterinary care/rehabilitation facilities and potentially exposed to human and zoonotic diseases, which could be spread to wild populations upon their release.	Low sea-states and calm weather are required for use of vessels for shoreline landings. Tide forecasts should also be consulted to ensure appropriate and safe vessel activities. A large support vessel or Facility (with a helicopter pad, if relevant) would need to be used as the accommodation and logistics base for shoreline response personnel, including temporary oiled wildlife stabilisation facility. In general, to reduce wildlife disturbance on small, offshore remote locations, a longer duration response with minimum numbers of response personnel required to achieve the IAP objective is desired.		

Table 3-5: Operational SIMA template – Group IV (HFO) spills

Response measure	Strategic SIMA Summary	ALARP Summary	Operational SIMA comments	IMT Leader sign-off
Operational Monitoring and Evaluation	Operational Monitoring and Evaluation will provide timely information to the IMT, enabling situational awareness to assist with IAP development, implementation and termination of oil spill response strategies. Operational monitoring and evaluation **shall** be implemented for any Level 2/3 spill.	Prioritise the activation of the following activities: Oil Spill Trajectory Modelling (OSTM), Aerial Surveillance, and deployment of oil spill tracker buoys. When deploying tracker buoys, preferably deploy 3 during the initial stages (hours) of the spill, in close proximity to each other. Consider the explosive risks and VOC exposure for any oil spill tracker buoy deployments and aerial/vessel observation tasks. Use of crew change helicopters for aerial surveillance should only be during initial stages of a spill, and only when helicopters are not required for other emergency tasks. Longer term aerial surveillance operations should utilise fixed-wing aircraft. Trained aerial observers should be arranged for longer-term aerial surveillance operations. Vessel surveillance is cost and time intensive and is far less efficient than aerial surveillance. Data from opportunistic vessels sightings can be collected, but this should not be a primary strategy for visual observations of slicks over large areas. Consider satellite imagery acquisition to complement longer-term aerial surveillance programs and support OSTM validation.		
Shoreline clean-up	Shoreline clean-up has been consistently found to not enhance ecological recovery of oiled coastlines (Sell et al. 1995) but it may protect other resources in the area, such as birds, marine mammals or subtidal habitats including coral reefs or fish farms (CSIRO 2016). Choosing a particular clean-up technique is dependent on factors such as shoreline type, exposure, sensitivity, amount of oil, persistence of oil, toxicity of oil and rate of natural oil removal (IPIECA 2015). Weathered HFO (including emulsions) has relatively high viscosity and is expected to form a thick adhesive layer on a shoreline. The clean-up of Group IV spills on a shoreline is likely to be difficult, generating high volumes of waste in comparison to the volume of oil recovered. Most offshore island shorelines (beaches) would be expected to have ability to 'self-clean' accumulated Group IV oils, due to the coarse substrate, the high wave energy and high tidal regime. However, due to the high viscosity, adhesiveness, and persistence of Group IV oils, they may contaminate the shoreline for a long period (weeks to months). Therefore, shoreline clean-up should be considered depending on the quantity of oil on the shore.	Utilise Operational Monitoring and Evaluation data (including shoreline clean-up assessments) to determine the likely success of any shoreline clean-up response compared to allowing natural weathering to occur. Shoreline clean-up techniques should focus on manual clean-up techniques, such as the use of rakes and shovels. Mechanical clean-up equipment (graders, loaders etc) should not be used to physically collect oil. However, small mechanical aids (e.g. rubber tracked bob-cats) can be used to assist in moving collected oily waste around a shoreline. Careful planning of track routes is required to avoid disturbance of any turtle/bird nesting sites. Low sea-states and calm weather are required for use of vessels for shoreline landings. Tide forecasts should also be consulted to ensure appropriate and safe vessel activities. A large support vessel or Facility (with a helicopter pad, if relevant) would need to be used as the accommodation and logistics base for shoreline response personnel at remote locations. Upon successful clean-up of the shoreline, bulka bags/IBCs containing oily contaminated waste would be transferred by helicopter or landing barge to a support vessel, for further transport to the mainland for appropriate disposal with a licenced waste contractor. In general, to reduce wildlife disturbance on small, offshore remote locations, a longer duration response with minimum numbers of response personnel required to achieve the IAP objective is desired.		

Response measure	Strategic SIMA Summary	ALARP Summary	Operational SIMA comments	IMT Leader sign-off
	Sensitive shorelines with lower energy, such as mudflats and mangroves on the WA/NT coastline and any coral reefs would likely be damaged by the physical activities associated with shoreline clean-up, and therefore these locations should also be left to self-clean.			
Pre-contact oiled wildlife response	Pre-contact oiled wildlife response includes wildlife hazing, wildlife capture and translocation. Group IV oils are likely to generate a thick surface layer on the ocean surface and on a shoreline. Therefore, there is a high potential to coat adult nesting turtles and turtle hatchlings as they transit to the ocean, or coat large numbers of seabirds. Wildlife hazing can be an effective control measure when deployed across a limited geographical area and against specific wildlife population, where the surface oil resulting from a spill is largely contained, e.g. at a beach/specific shoreline. Capture and translocation of turtles (adults and hatchlings) from a shoreline to an area away from the slick may provide an environmental benefit, however minimising the time during which turtles (especially hatchlings) are in captivity is critical to success of the operation. Wildlife hazing in the open ocean is inherently unlikely to be effective due to a number of limitations, including numbers of vessels required and associated safety issues, ongoing spread and movement of the slick and hazed animals moving into adjacent areas of the slick. Attempting to capture large numbers (or an entire flock) of healthy seabirds would be very challenging, if not impossible (DPaW and AMOSC 2014), especially at a remote shoreline location (e.g. Browse Island). There is no practicable method to capture healthy seabirds at sea (DPaW and AMOSC 2014). Potential harm to healthy seabirds could occur during the capture process. Any seabirds released would likely fly back to the shoreline from which they originally were captured. Long term veterinary care (e.g. feeding) would be required for any successfully captured birds, until spill weathering or remediation has occurred, and it was safe to release the animals. Animals would be under stress while in veterinary care/rehabilitation facilities and potentially exposed to human and zoonotic diseases, which could be spread to wild populations upon their release.	Wildlife hazing or wildlife capture and translocation in the open ocean should only be considered when Operational Monitoring and Evaluation data clearly indicates that a positive outcome could be achieved. The IMT should consider the merits of wildlife hazing, wildlife capture or translocation at a shoreline in consultation with WA/NT Control Agencies, when Operational Monitoring and Evaluation data indicates that populations of wildlife on a shoreline may be at risk of an inbound spill and conditions are suitable for this activity to occur. Translocation of turtle hatchlings is likely to be successful. However, there are significant manual handling risks associated with translocating adult turtles, (adult green turtles are often >100kg), which need to be evaluated and managed if this activity is to occur. Low sea-states and calm weather are required for use of vessels for shoreline landings. Tide forecasts should also be consulted to ensure appropriate and safe vessel activities. A large support vessel or Facility (with a helicopter pad, if relevant) would need to be used as the accommodation and logistics base for shoreline response personnel. In general, to reduce wildlife disturbance on small, offshore remote locations, a longer duration response with minimum numbers of response personnel required to achieve the IAP objective is desired.		
Post-contact wildlife response	Group IV hydrocarbons have a relatively high viscosity, which could generally result in mortality of seabirds and turtles. Group IV oils have the potential to coat the feathers of seabirds and create thick deposits on shorelines which could impact adult and juvenile turtles as they traverse the intertidal zone.	Oiled wildlife capture in the open ocean should only be considered when Operational monitoring and evaluation data clearly indicates that a positive outcome could be achieved.		

Response measure	Strategic SIMA Summary	ALARP Summary	Operational SIMA comments	IMT Leader sign-off
	Capture, relocation, assessment, cleaning and rehabilitation of oiled wildlife can increase the survival of individuals IPIECA 2017). ITOPF (2011) note that there are many cases where oiled turtles have been cleaned successfully and returned to the water. Once oiled, it is generally agreed that the bird species present in the Browse Basin region will have very low survival rates, even when rescue and cleaning is attempted. Any seabirds captured, cleaned and released would likely fly back to the shoreline from which they were originally captured. Therefore, long-term veterinary care (e.g. rehabilitation, feeding, etc.) would be required for any successfully captured birds, until spill weathering or remediation had occurred, and it was safe to release the seabirds. Animals would be under stress while in veterinary care/rehabilitation facilities and potentially exposed to human and zoonotic diseases, which could be spread to wild populations upon their release.	The merits of wildlife capture, cleaning and rehabilitation at a shoreline should be considered by the IMT when Operational Monitoring and Evaluation data indicates that populations of wildlife on a shoreline have been impacted by the spill and conditions are suitable for this activity to occur. The recommended method for capture of oiled birds at sea is with the use of hand nets (DPaW 2014). Due to the general size of vessels to be used offshore, manoeuvring close to oiled birds and successful capture would be difficult and present significant HSE hazards to response personnel. The launching and use of small vessels, especially for wildlife capture in the open ocean also presents significant HSE risks, and therefore any attempt for open ocean capture of oiled wildlife would require significant evaluation of the environmental benefit of the activity against the HSE risks to personnel. The West Kimberly Oiled Wildlife Response Plan (DPaW & AMOSC 2015), Appendix 7 (Rowley Shoals and Offshore Island Nature Reserves), focuses the post-contact wildlife response purely on capture and rehabilitation of wildlife at, or near, shorelines, rather than searching and attempting open-ocean oiled wildlife response. The IMT will need to consider, in consultation with WA/NT Control Agencies, the practicalities, likely success and risks associated with a post-contact wildlife response operation. Wildlife response personnel and equipment transport to and from the shoreline would be by small utility helicopter and/or vessels. Low sea-states and calm weather are required for use of vessels for shoreline landings. Tide forecasts should also be consulted to ensure appropriate and safe vessel activities. A large support vessel or Facility (with a helicopter pad, if relevant) would need to be used as the accommodation and logistics base for shoreline response personnel, including temporary oiled wildlife stabilisation facility. In general, to reduce wildlife disturbance on small, offshore remote locations, a longer duration response with minimum numbers of response personnel required to achieve the IAP objective is desired.		
Protect and deflect	Booms could be used to protect and deflect spills away from sensitive habitats and are generally effective against Group IV spills, however are less effective in areas of high wave energy or strong currents, which are prevalent at offshore islands in the Browse Basin. Given the size of the offshore island shorelines (e.g. Browse Island intertidal zone is 3km in diameter), substantial numbers of booms would need to be deployed to protect the shorelines. Anchoring of booms would most likely result in additional damage to the subsurface environment (coral reef) which surround most offshore islands. Booms could potentially be held in place by vessels. However due to widths of shorelines requiring protection, this would most likely require an unfeasibly large number of vessels.	If Operational monitoring and evaluation data demonstrated a tangible, positive outcome, and with weather conditions permitting and conducive to a protect and deflect operation, there is the potential to undertake this response activity within a nearshore/intertidal environment. The WA/NT Control Agencies will make the final decision to undertake protect and deflect activities in WA/NT waters. Protect and deflect equipment and personnel to operate the equipment is available through AMOSC, with stockpiles of equipment located in Broome, Exmouth and other locations throughout Australia. Protect and deflect equipment transport to and from the shoreline would be by small vessels. Low sea-states and calm weather are required for use of vessels for intertidal / nearshore activities. Tide forecasts should also be consulted to ensure appropriate and safe vessel activities.		

Response measure	Strategic SIMA Summary	ALARP Summary	Operational SIMA comments	IMT Leader sign-off
	Booms themselves would also move around on the coral intertidal reef during periods of lower tides, potentially resulting in significant physical damage to the benthos of the reef platform. Due to the types of shorelines that would be impacted by spills in the EMBA/PEZ (offshore, high energy beaches / intertidal reef platforms), protect and deflect would under most circumstances, not be considered to result in a net environmental benefit. However, if the Operational Monitoring and Evaluation data informed the Operational SIMA and demonstrated a tangible, positive outcome, and with weather conditions permitting and conducive to a protect and deflect operation, there is the potential to undertake this response activity.	A large support vessel or Facility (with a helicopter pad, if relevant) would need to be used as the accommodation and logistics base for protect and deflect response personnel. In general, to reduce wildlife disturbance on small, offshore remote locations, a longer duration response with minimum numbers of response personnel required to achieve the IAP objective is desired.		
Contain and recover	Group IV oils do not spread rapidly, and as such, booming and recovery with skimmers is considered a viable response option in a sheltered environment with non-emulsified heavy oils (IPIECA 2015b). The strategy is relatively labour-intensive when the effort is considered against overall effectiveness in reducing the spill volume (i.e. only covers a small area of spill with 1 or 2 vessels deploying booms, plus numerous personnel). Contain and Recovery often only recovers a total of <5% of the spilled oil. In addition, due to a large number of limitations, including ineffectiveness at >0.7 to 1 knot current speeds (often experienced in the Browse Basin); ineffectiveness in adverse sea states (common in the open ocean of the NWMR); skimmer ineffectiveness in open ocean and logistical issues associated with recovered waste at sea (ITOPF 2011); containment and recovery is unlikely to be an effective response strategy against Group IV oil spills in Zone 1. Containment and recovery would not be considered where chemical dispersion had been used. However, under certain circumstances, including very calm weather conditions over several days, or an ongoing Group IV spill event (i.e. ongoing leak from a vessel), contain and recover could be a feasible response operation. Therefore, if the Operational Monitoring and Evaluation data informed the Operational SIMA and demonstrated a tangible, positive outcome, and with weather conditions permitting and conducive to a contain and recovery operation, there is the potential to undertake contain and recovery of Group IV spills.	Contain and Recover activities in the open ocean should only be considered when Operational monitoring and evaluation data clearly indicates that a positive outcome could be achieved. A period of relatively calm sea-states and an oil amendable to recovery with skimmers would be required to undertake a successful response. Containment and recovery equipment and personnel to operate the equipment is available through AMOSC, with stockpiles of equipment located in Broome, Exmouth and other locations throughout Australia. The final decision by the INPEX IMT to undertake containment and recovery activities in Commonwealth waters should be undertaken in consultation with AMOSC. The WA/NT Control Agency will make the final decision to undertake containment and recovery activities in WA/NT waters.		

Response measure	Strategic SIMA Summary	ALARP Summary	Operational SIMA comments	IMT Leader sign-off
Chemical dispersant surface application (vessel and/or aerial based)	Group IV floating slicks have a high viscosity and will not rapidly spread into sheens. Dispersant can be effective at reducing the surface expression of Group IV hydrocarbons, under specific circumstances (IPIECA 2015c). The reduction in the surface expression of Group IV spills would reduce the risk of contact with shoreline or intertidal sensitivities and would therefore also benefit the values and sensitivities such as marine avifauna, marine megafauna (particularly air-breathing animals), turtles (particularly nesting activities), intertidal corals, and intertidal traditional fisheries. Dispersants have an inherent level of toxicity. In addition, chemically dispersed hydrocarbons may, in certain instances, have a higher level of toxicity to benthic biota than the hydrocarbons themselves. Dispersant use results in increased entrainment in the water column increasing the bioavailability of the hydrocarbon. Monitoring undertaken after the Montara oil spill demonstrated dispersant application resulted in entrained hydrocarbons concentrating in the top 25 m of the water column (AMSA 2010). Values and sensitivities potentially suffering from a negative impact from dispersant application to Group IV spills (that would otherwise not have been exposed to the surface slick) include: • pelagic species – transient populations or individuals, particularly those using the upper reaches of the water column, including subtidal MNES • subtidal corals and benthic primary producer habitat in the top 25 m of the water column. All values and sensitivities deeper than 25 m are unlikely to be exposed to dispersant or the dispersed hydrocarbons, as noted in AMSA 2010. The negative impacts to BPPH would be minor if dispersant is applied at significant distance from the reef/shoal. In view of this, values and sensitivities unlikely to be impacted by dispersant or the dispersed hydrocarbons include: • Australian Martine Parks (AMPs), Key Ecological Features (KEFs) and all banks and shoals deeper than 25 m • demersal commercial fisheries.	• The Dispersant Application Decision Matrix (Table 4-8) must be completed and signed by the IMT Leader before dispersant application can commence. Chemical dispersant using aerial and/or vessel can be undertaken on fresh (non-weathered, non-emulsified) HFO slicks. Vessel-based dispersant can be rapidly mobilised using the INPEX FPSO dispersant stockpile or Prelude dispersant capability, before the oil viscosity reaches levels that make it unamenable to spraying. Vessel-based dispersant application is limited to daylight hours, good visibility and Beaufort seas-state of 2 – 7. Aerial-based dispersant applications can be undertaken; however, considerable logistical challenges exist, meaning this response option can only be implemented at least 24 hours after activation. The AMSA fixed-wing aerial dispersant (FWAD) capability located in Batchelor (NT) can be mobilised through AMOSC and it should be noted: • The most likely 'nominated airbase' would be Lombardina or Mungalalu Truscott airport • The FWAD aircraft are limited to dispersant spraying during daylight operations only • The mobilisation of FWAD capability, including all required support personnel and equipment, would take at least 24 hours • The 'window of opportunity' for effective dispersant application is generally from a few hours to a few days (before the viscosity threshold for effective dispersant application is exceeded) thereby limiting the efficacy of FWAD applications. However, for ongoing spill scenarios (e.g. a vessel slowly leaking a Group IV oil), the FWAD capability could be used • Availability of air attack support aircraft and air attack supervisors to ensure targeted/effective FWAD application may take at least 24 hours. • INPEX is required to complete a FWAD Operations Plan, and provide the air attack aircraft and SAR platform, and any additional resources required by AMSA to activate the FWAD capability.		

3.5 Develop an incident action plan

The IMT shall prepare an IAP once it has gained accurate and reliable situational awareness, reviewed protection priorities and completed the Operational SIMA. Note that this section should be read in conjunction with the INPEX Australia Incident Management Plan (0000-AH-PLN-60005) which contains descriptions of IMT roles and the emergency management competency training associated with these roles.

An IAP is typically prepared for response activities beyond the immediate response measures (first strike) timeframe.

The IAP shall:

- establish the overall incident response objectives and strategies – determine what is to be achieved, where, when and by whom?
- ensure continuity of incident control – decisions are made and agreed at one location and cascaded down
- provide for effective use of resources – usage is coordinated from one central location, facilitating more accurate planning and resource allocation.

The IAP shall be the mechanism for oil spill management from the moment it comes into force through to the termination of the response. The intent is that it is used to direct response operations while ensuring that everyone involved in the response is mitigating identified risks and working towards the same objectives and priorities. It shall therefore:

- provide responders with clear strategies on what needs to be done
- supply information on the resources, methods and protocols to be used in order to keep the entire response effective
- provide documentation regarding the decisions, strategies, safety concerns, plans and other key pieces of information critical to achieving the incident response objectives. It will be the document referred to when dealing with post-incident analysis on issues such as cost and legal requirements, as well as the overall effectiveness of the response and its personnel.

The IAP shall be documented and given a period of operational validity (from–to date and time). The plan shall be revisited and updated prior to the next operational period.

The basic steps for IAP development are provided in Table 3-6 and a copy of the INPEX IAP template (PER-20153316130) is provided in Appendix B.

Table 3-6: IAP development

Step	Action
1.	Incident objectives are set. The IMT Leader shall approve the objectives.
2.	IMT tactics meeting to develop supporting strategies and tactics to achieve incident objectives. This involves identifying strategies and tactics that when implemented will achieve incident objectives.
3.	Information is collected in preparation for a planning meeting.

Step	Action
	Includes resource identification and availability, safety requirements, environmental impact, potential and current situation reports and maps to support the plan to achieve the identified objectives.
4.	Planning meeting to compile information to complete IAP. An overview of the proposed plan is given to the full IMT. This includes the general concept, work assignments, resources, incident projections and an estimated impact of strategies in containing/controlling the incident. After review, any amendments should be captured and incorporated into an overall plan.
5.	IAP developed and approved by IMT Leader. IMT members responsible for areas of plan development provide information for inclusion in the IAP. The IAP is approved by the IMT Leader.
6.	Operations briefing. A briefing is given to inform all members of the IMT and those implementing the plan so they are aware of the planned actions and any specific task allocations they are required to complete. This shall include any safety considerations and need to provide status updates and briefings on incident progress. In early stages of an incident this may be an oral briefing only. In later stages, it is anticipated this will involve written material to support the oral briefing.
7.	IAP dissemination and execution. The IAP is circulated and planned actions and tasks to meet plan objectives are completed as per plan requirements.
8.	Progress against incident objectives is assessed. Situation reports and status briefings provide progress against the objectives and identify any obstacles to achieving objectives. This information is the commencement point for the development of the IAP for the next operational period.
9.	Return to item 1 and develop plan for next operational period as defined by the IMT Leader.

3.6 Response termination

The termination of a response to a Level 2 or Level 3 spill within Commonwealth waters shall be only when the following conditions have been fulfilled, as determined by the IMT Leader, in consultation with AMSA, DAWE and AMOSC:

- when the source of the spill has been stopped
- when the objectives of the Incident Action Plans have been met
- when there are no further practicable steps that can be taken to respond to a spill.

The termination of a response to a spill which has entered WA/NT waters will be the responsibility of WA/NT Control Agency.

Relevant factors to consider for termination of each response strategy is provided within each strategy sub-section in Section 4.

Termination criteria for the Operational and Scientific Monitoring Programs (OSMP) are detailed in Appendix A.

4 Spill response resources

4.1 Support vessel availability

INPEX maintain a range of support vessel call-off contracts with various support vessel providers. Call-off contracts allow for mobilisation of available support vessels, including for oil spill response.

Support vessel contracts range from small ~10–40 m support vessels and landing barges for coastal/nearshore, or light weight equipment activities offshore, to larger ~50–130 m offshore support vessels capable of long-duration responses activities.

Large offshore support vessels can be used as accommodation support vessels, for shoreline response activities. Large vessels with helicopter pads will facilitate faster, more efficient crew changes, which could be required during long duration response activities, or support a light utility helicopter, if required for shoreline response activities.

INPEX requires all vessels to comply with the INPEX Marine Standard (0000-AG-STD-60002) and Vessel Inspection Work Instruction (0000-AG-WIN-60029), which includes processes to enable rapid inspection and approval for use of vessels in emergency situations. In an emergency event where a vessel may be required immediately and is unable to meet marine inspection procedure requirements, the Marine Manager or delegate shall perform a suitable audit of the vessel, which may be performed as a desktop exercise.

The IMT Leader is responsible for the activation and mobilisation of support vessels under the 'manual of authorities' specified in the INPEX Emergency Management Guideline (Doc. No. PER-2150838677).

Contact details to activate the available support vessel contractors are listed in the INPEX Emergency Contacts Directory (Doc. No. PER-2153095942).

4.2 Aviation asset availability

INPEX maintains a range of aviation support call-off contracts with various fixed-wing aircraft and helicopter providers. These call-off contracts allow for mobilisation of available aviation assets, including for oil spill response.

The INPEX membership of AMOSC provides access to the fixed-wing aerial dispersant aircraft managed by AMSA.

Crew change helicopters can be used for routine crew change activities to approved helicopter pads.

Fixed wing aircraft are best suited to ongoing aerial observations.

Light utility helicopters can be mobilised for specific tasks such as mobilisation of personnel and equipment and removal of waste from remote shoreline locations, or for operational monitoring and evaluation at remote shorelines, where close inspection is required.

INPEX requires all aircrafts to comply with the INPEX Aviation Standard (Doc. No. 0000-AG-STD-60003). In an emergency event where an aircraft may be required and is unable to meet the INPEX Aviation Standard, the Aviation Manager or delegate shall perform a desktop risk assessment, taking into account the nature of the proposed activity and its urgency, before making any exemption.

Contact details for the available aviation asset contractors are listed in the INPEX Emergency Contacts Directory (Doc. No. PER-2153095942).

4.3 Oil spill preparedness and response register

INPEX maintains an internal *Oil Spill Preparedness and Response Register* (PER-2153236568).

This register is maintained on INPEX's Document Management System (DMS) https://dms.inpex.com.au/D2/?docbase=INPEX_per_prod&locateId=0901e2408085789c

It can be accessed during any spill event and includes the following information:

- INPEX oil spill response key contracts
- INPEX personnel trained in oil spill response and their level of training
- INPEX oil spill satellite tracking buoys – including their location, servicing schedule and log-in details to the satellite tracking website
- AMOSC equipment register(s) and trained aerial observers
- OSRL support capabilities and activation processes
- Broome, Darwin Port and AMSA stockpile inventory lists, including oiled wildlife response kits.

4.4 Immediate (first strike) response measures and relevant arrangements (resources and equipment)

For the recommended response strategies identified within Operational SIMAs (Section 3.4), a summary and demonstration of preparedness is provided below.

4.4.1 Operational monitoring and evaluation

Operational monitoring and evaluation does not in itself control or reduce the impacts of the spill; however, it allows response team managers/IMT to maintain situational awareness. This is vital in a number of respects as it:

- addresses some of the key information requirements necessary for spill management:
  - where the spill is
  - how big it is
  - where it is going
  - how long it will take to get there.
- facilitates internal and external initial notification and subsequent reporting
- provides information critical for identifying sensitive receptors under threat, identifies protection priorities, and informs Operational SIMA and IAP development
- identifies the trajectory of the spill and thereby defines the potential stakeholders and environment that may be affected (EMBA) or potential exposure zone (PEZ) by the oil. This will inform any subsequent scientific monitoring and recovery phase actions.

Depending on the spill type and volume, operational monitoring and evaluation techniques that may be used to gain situational awareness could include:

- oil spill trajectory modelling
- electronic surface tracking buoy(s)

- aerial surveillance
- vessel surveillance
- satellite imagery analysis.

The operational monitoring and evaluation program is effectively comprised of Oil Spill Trajectory Modelling (OM01) and Oil Spill Surveillance and Reconnaissance (OM03). Additional details are provided in Section 4.7 and Appendix A.

Termination of the response will be determined by the IMT in collaboration with relevant stakeholders. This decision will take into consideration factors such as whether:

- the source of the spill has been stopped
- the objectives of the IAPs have been met
- there are no further practicable steps that can be taken to respond to a spill
- whether cleaning techniques have become ineffective
- whether pre-agreed criteria on the level of clean have been achieved and thus situational awareness can be terminated or scaled down
- termination criteria for OM01 and OM03, as specified in Appendix A, have been met.

Oil spill trajectory modelling

Oil spill modelling can be used to forecast the trajectory and fate of oil plumes resulting from surface or subsurface releases. It can be initiated almost immediately and provides rapid results. However, its accuracy depends on the spill estimates and the predicted metocean data, as well as the reliability of forecasts of wind speed and direction.

Oil spill trajectory modelling is an iterative process, whereby real-time observations from vessel/aerial surveillance, electronic surface tracking buoy data and/or satellite imagery, is used to refine modelling predictions, using both hindcast and forecasting techniques.

INPEX maintain a contract with an oil spill trajectory modelling provider, which enables 24-hour per day access to real-time oil spill modelling capability. Contact details for the provider are contained in the INPEX Emergency Contacts Directory (PER-2153095942) and oil spill trajectory modelling activation forms can be accessed via the INPEX Oil Spill Forms Register (PER-2153332031) (Table 5-1).

Further details regarding oil spill trajectory modelling are provided in Appendix A (refer OM01).

Electronic surface tracking buoys

Electronic surface tracking buoys can be rapidly deployed at, or near to, the site of a spill, from support vessels or helicopters. Thereafter, they drift with the surface currents (their design minimises wind influence). The buoys transmit their global positioning system (GPS) location in near real-time, and the data is delivered to an online data management portal. The buoys enable the trajectory of surface oil to be tracked.

When deploying tracker buoys, preferably three should be deployed during the initial stages (hours) of the spill, in close proximity to each other as their dispersion over time will assist with longer term model validation. Note that tracker buoys are not able to provide information on the direction or strength of subsurface currents, nor the trajectory of dissolved and entrained oil resulting from a subsurface spill.

INPEX maintains ten electronic surface tracking buoys to be strategically placed across various work activities. At least one tracking buoy will remain onshore so it could be deployed from the air to any spill location. It should be noted, however, that deployment of articles from aircraft, including satellite tracking buoys, require Civil Aviation Safety Authority (CASA) permission. INPEX will consider initiating a special helicopter deployment from Broome/Darwin if required, and if CASA permission can be achieved.

For the duration of the URF installation activities, some tracker buoys will be located in WA-50-L on the CPF and FPSO, available for rapid deployment via support vessels.

Aerial surveillance

Aerial observation is a very effective way of establishing the location and extent of a spill and verifying predictions of its movement and fate. The INPEX Oil Spill Observation and Dispersant Application Guide (refer to Table 5-1) provides additional guidance on estimating extent and volume of the spill. Key considerations associated with this activity are as follows:

- flights shall be made regularly and where possible timed at the beginning or end of each day so that results can be used by the IMT and other response agencies.
- flight paths and timetables should be coordinated.
- aerial observers shall be trained, experienced and able to reliably detect, recognise and record oil pollution at sea.
- preferably, there should be a consistency of at least one observer throughout a series of flights, so that variations in reports reflect changes in the state of oil pollution and not differences between the perceptions of observers.
- aircraft used for aerial observation should preferably feature good, all-round visibility.
- over the open sea, the use of fixed-wing aircraft (rather than helicopters) is preferable, due to their superior speed and range. The extra margin of safety afforded by a twin-engine or multi-engine aircraft is essential. However, helicopter observations may be required to allow for closer inspection of shorelines, such as at Browse Island or WA/NT coastlines.
- weather conditions can affect visibility and may therefore make surveillance flying impractical.
- the minimum deployment time of surveillance aircraft and personnel is typically in the order of 24 hours.
- aircraft of opportunity with untrained observers, such as helicopter flights on crew change and Coastwatch aircraft (via AMSA) can also be requested to provide any relevant information available to them, which may improve situational awareness.

Vessel surveillance

Oil spill surveillance can be carried out from vessels, although its practicality is limited by the number of available vessels and the scale of the spill.

For smaller spills, their dimensions, direction of travel, colour and state of weathering can be reasonably well estimated and reported. For large spills, it would be difficult to accurately estimate the size of a slick from the bridge of a vessel because sight is limited to the horizon. However, it would be possible to determine what is happening to the oil, such as its colour, thickness, weathering and the slick’s direction of travel.

Satellite imagery analysis

Satellite-based remote sensors can be used to detect oil on water and, because such images cover extensive sea areas, they can provide a comprehensive picture of the overall extent of pollution from a spill. The sensors used include those operating in the visible and infrared regions of the spectrum, and synthetic aperture radar (SAR).

Optical observations of oil require clear, daylight skies, thereby severely limiting the application of such systems. SAR, on the other hand, is not limited by the presence of cloud and, since it does not rely on reflected light, remains operational at night. However, radar imagery often includes a number of anomalous features, or false positives, such as algal blooms, wind shadows and rain squalls, which can be mistaken for oil. Consequently, the imagery requires expert interpretation.

The minimum time for satellite imagery in the production licence area from commercial suppliers is anticipated to be between 24 and 48 hours.

Arrangements and capabilities

The arrangements and capabilities as described in the subsections above are summarised in Table 4-1.

Table 4-1: Arrangements and capabilities – Operational Monitoring and Evaluation

Technique	Resource capability and availability	Implementation time	Activation
Oil spill trajectory modelling (OSTM)	INPEX maintain a contracted spill modelling service provider for 24-hour support.	OSTM contractor activated within 2 hours of IMT formation.	IMT via the INPEX Emergency Contacts Directory (PER-2153095942). Trajectory modelling activation forms in Table 5-1.
Aerial surveillance	Crew change / SAR helicopters is the initial aerial surveillance capability. Fixed wing aircraft can also be mobilised for longer term aerial surveillance activities.	Crew-change helicopters commence surveillance activities at the spill location within 5 hours of IMT activation. (daylight hours only).	IMT via the INPEX Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register (PER-2153236568).
	Trained aerial observers can be sourced via AMOSC/AMSA and mobilised to an aircraft.	Commence aerial observation task from Broome/Darwin within 48 hours.	
Vessel surveillance	Small support vessels (< 40 m).	Complete mobilisation and depart Broome/Darwin wharf within 24 hours.	IMT via the INPEX Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register (PER-2153236568).
	Larger support vessels.	Complete mobilisation and depart Broome/Darwin wharf within 48 hours.	
Electronic surface tracking buoy(s)	INPEX has several surface tracking buoys positioned in WA-50-L including on the CPF and FPSO. At least one tracking buoy will be maintained onshore (i.e. at Broome or Darwin) which can be deployed from an aircraft to any spill location (provided that CASA has granted permission to undertake this aerial deployment activity).	Immediate deployment to support vessel from the CPF/FPSO.	Tracking buoy locations managed via the Oil Spill Preparedness and Response Register. Tracking buoys deployed from vessels or aircraft, as directed by the OIM or IMT. Tracking buoy online tracking tool activated by IMT.
Satellite imagery analysis	Sourced via OSRL, AMOSC and/or AMSA.	Images available in the IMT within 48 hours.	IMT via the INPEX Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register.

4.5 Secondary response measures and relevant arrangements (resources and equipment)

4.5.1 Shoreline clean-up

The IMT shall consider all Operational Monitoring and Evaluation data to determine potential or actual shoreline contact and potential impacts. The INPEX IMT will need to consider, in consultation with WA/NT Control Agency, the practicalities, likely success and risks associated with a shoreline clean-up operation, compared with allowing stranded oil to naturally weather.

If a shoreline clean-up response is required at a Commonwealth shoreline (e.g. Ashmore Reef, Cartier Island), the activation will occur in consultation with AMSA and DAWE.

More detailed planning regarding a shoreline clean-up are available in the Browse Island Oil Spill IMG (X060-AH-GLN-60015). This document also provides guidance on response at any remote shoreline.

There are several logistical options available to conduct shoreline clean-up at Browse Island or other remote shoreline locations.

If weather/sea state conditions are benign, a fully vessel-based logistical solution may be practicable. This would involve the use of an accommodation support vessel (ASV) as the FOB, and tenders/landing barges to move people and equipment between the FOB and the shoreline.

If weather conditions or other factors preclude the use of small landing craft, light utility helicopters, launched from an ASV helideck would be required.

Crew changes could occur via vessel or crew change helicopter, depending on the situation.

A shoreline clean-up would most likely involve the mobilisation of personnel and manual cleaning equipment such as rakes and shovels, to remove the oil from the shoreline. Oily contaminated waste would be stored in impermeable bulka bags or other similar small impermeable waste collection containers. The oily waste containers would then most likely be backloaded to the ASV, either using a landing barge or slung underneath a light utility helicopter. The waste would then transport to shore for appropriate disposal.

Large mechanical equipment such as graders would not be appropriate for remote shoreline clean-up (risk of secondary contamination and general difficulty in mobilising this equipment). However, smaller machines such as rubber tracked bob-cats could be used to help transport collected oily waste and other response equipment around the shoreline.

There are significant logistical constraints and HSE risks with flying personnel in light utility helicopters to remote offshore locations or operating out of small vessels at remote offshore locations. Also, there is the potential to disturb wildlife populations on small islands by landing large numbers of response personnel. Therefore, the number of shoreline response personnel working in remote locations at any one time will be agreed in consultation with the WA/NT Control Agency but is likely to be limited to between 20 and 30 people at any one location.

In a typical shoreline response, a worker is expected to clean between 0.5 to 1.0 m^3 of oily waste per day. Given the hot climates of the Browse Basin, a lower estimate of 0.5 m^3 of oily waste, per person, per day would be appropriate.

Depending on the duration of the operations, this may require the establishment of a one or two week on/off roster system, drawing on trained personnel from AMOSC, and other labour hire sources, until the response is terminated.

A decontamination staging post would be established at the clean-up location to enable decontamination of equipment and personnel before demobilisation at the end of each day. Ultimately, all contaminated equipment and personal protective equipment (PPE) would be back-loaded from the location to the mainland for cleaning or appropriate disposal.

During any shoreline clean-up, a daily progress report will be provided by the response team to the IMT Leader regarding the effectiveness of the activity. The report shall include, as a minimum:

- date(s), time(s) and location(s) of shoreline clean-up activities
- the volume of oily waste generated and disposed of
- the overall effectiveness of shoreline clean-up activities (including photographic evidence, where possible).

Shoreline clean-up operations are often considered in three stages; Stage 1 - bulk oil is removed from the shore to prevent remobilisation; Stage 2 - removal of stranded oil and oiled shoreline material which is often the most protracted part of shoreline clean-up, and; Stage 3 - final clean-up of light contamination and removal of stains, if required. Depending upon the nature of the contamination, progression through each of these stages may not be required, depending on the termination criteria set by the IMT.

Termination criteria outline when continuing clean-up activities may be detrimental to recovery as well as costly (Ecosystem Management and Associates 2008). Termination of response will be determined by the IMT in collaboration with relevant stakeholders and will consider factors including the following:

- the safety of responders
- the current effectiveness of the response
- deteriorating weather conditions (including wind, visibility and sea conditions).

AMSA present guidelines for agreed environmental values and acceptable levels of clean which are useful in guiding the IMT. AMSA (2015) note that the response for shorelines should be terminated when remaining residues are not going to inhibit potential recovery through toxic or smothering effects. Also, ITOPF (2002) suggest the use of three questions to determine when termination of the response should occur:

1) Is the remaining oil likely to damage environmentally sensitive resources?
2) Does it interfere with the aesthetic appeal and amenity use of the shoreline?
3) Is this oil detrimental to economic resources or disrupting economic activities?

If the answers to the questions are no, then there is no rationale to continue shoreline clean up. Ecosystem Management and Associates (2008) suggest that activities can conclude on exposed rocky shores when the shoreline no longer generates sheens that affect sensitive wildlife.

The final decision on whether to activate and terminate a shoreline clean-up response will remain with the WA/NT Control Agency for the WA/NT shorelines. If a shoreline clean-up response is required at a Commonwealth shoreline (e.g. Ashmore Reef, Cartier Island), the response termination will occur in consultation with AMSA and DAWE.

Arrangements and capabilities

The arrangements and capabilities as described in the subsections above are summarised in Table 4-2.

Table 4-2: Arrangement and capabilities – Shoreline clean-up

Technique	Resource capability and availability	Implementation time	Activation
Shoreline clean-up personnel	Under the WA DoT State Hazard Plan – Marine Environmental Emergency the relevant Control Agency (WA DoT or INPEX for Commonwealth lands) will provide the On Scene Commander / Division Commander. WA DoT/NT DENR (as Control Agency) may choose to mobilise their own SCAT assessment and initial shoreline clean-up personnel. Additional trained shoreline response personnel would be available through AMOSC Core Group. • Additional personnel, who would receive on the job training would be sourced from: • INPEX environmental service providers • INPEX general offshore labour hire contracts	24 hours to mobilise personnel to Broome/Darwin to board vessels and/or helicopters.	IMT via the Emergency Contacts Directory (PER-2153095942).
Shoreline clean-up equipment	WA DoT SCAT/first-strike shoreline clean-up stockpiles are located in Karratha, Fremantle and Albany. Shoreline clean-up equipment can be mobilised from the Broome or Darwin stockpiles. Additional shoreline clean-up equipment can be mobilised through AMOSC/AMSA Tier 2/3 stockpiles, or it can be purchased/hired from retail outlets in Broome/Darwin.	24 hours to mobilise shoreline response equipment from the warehouse to a support vessel alongside in Broome/Darwin Port. 24 hours to mobilise a WA DoT SCAT/shoreline response kit from Karratha to a vessel alongside Broome.	IMT via Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register (PER-2153236568).
Helicopters	Crew transfer helicopters (for personnel transfer to designated landing zones only, not to remote shoreline beaches).	INPEX routine crew-change helicopters always available.	IMT via the Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register (PER-2153236568).
	Utility helicopters suitable for landing on remote shorelines are available via INPEX aviation call-off arrangements.	Commence mobilisation activities in Broome within 7 days.	
Vessels	Smaller support vessel assets <40 m in length.	Complete mobilisation and depart Broome/Darwin wharf within 24 hours.	IMT via the Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register (PER-2153236568).
	Larger platform support vessels / accommodation support vessels.	Complete mobilisation and depart Broome/Darwin wharf within 48 hours.	

4.5.2 Pre-contact and post-contact oiled wildlife response

The INPEX IMT shall consult AMOSC for advice regarding any wildlife response activities, as well as consult the DAWE (as the Jurisdictional Authority for wildlife in Commonwealth waters), for any risks from the spill to MNES (including oiled wildlife). In the event that wildlife is oiled on islands which are not WA/NT State/Territory lands (e.g. Ashmore Reef, Cartier Island) the Commonwealth may delegate oiled wildlife management responsibilities to the WA Department of Biodiversity, Conservation and Attractions (WA DBCA).

The INPEX IMT shall also consult, via WA DoT, a WA DBCA 'oiled wildlife adviser' to provide support to for any wildlife response activities, including obtaining permits to conduct an OWR in WA State waters and/or Commonwealth waters, as stated above. OWRs along the WA shoreline areas are managed under the West Kimberley Region Oiled Wildlife Response Plan (DPaW and AMOSC 2015).

The INPEX IMT shall also consult, via NT DIPL, a NT PaWC 'oiled wildlife adviser' to provide support for any wildlife response activities, including obtaining permits to conduct a wildlife response in NT waters. OWRs along the NT shoreline areas are managed under the NT OSCP and the NT Oiled Wildlife Response Plan (AMOSC 2019).

Detailed shoreline sectors and oiled wildlife response priorities are defined in the NT OWRP (AMOSC 2019) and the West Kimberley Region Oiled Wildlife Response Plan (DPaW and AMOSC 2015). These plans should be utilised during the planning and execution of any wildlife response along the Kimberley/NT coastline.

More detailed planning regarding a remote shoreline wildlife response is also available in the Browse Island Oil Spill IMG (X060-AH-GLN-60015). This document also provides guidance on response at any remote shoreline location.

AMOSC maintains an 'oiled wildlife response capability register' on behalf of industry to support OWRs. The AMOSC register maintains currency of potential resources, such as:

- equipment and the locations of stockpiles
- response personnel (including global OWR specialists such as Sea Alarm)
- training/exercise materials
- aid (national and international).

WA DBCA and AMOSC have collaboratively developed an OWR model (shown in Figure 4-1) that is based on a small number of OWR adviser(s) who receive specific training at an IMT level to manage an OWR. At a site-management level this is further broken into 'OWR Field Management' who are moderately trained to supervise field response, such as the WA DBCA oiled wildlife advisors and the AMOSC OWR team.

The Oiled Wildlife Rehabilitators Network (fauna care/rehabilitation volunteers, vets, zoo personnel, etc.) is a group of more than 100 Western Australian personnel who have been trained in physical oiled wildlife capture, cleaning, rehabilitation and using the dedicated OWR containers maintained by AMOSC and WA DoT. The Oiled Wildlife Rehabilitators Network personnel are available on a volunteer basis. The list of current personnel is maintained and activated by the WA DBCA. Oiled Wildlife Rehabilitators Network personnel from the Kimberley region could potentially be utilised to support OWR in the NT.

Philip Island Nature Park (Victoria) have over 100 personnel also trained in OWR. These personnel are available, under a 'best endeavours' MoU agreement with AMOSC.

'General Field Responders' are personnel who receive basic 'just-in-time training' to carry out tasks as directed by personnel with higher levels of OWR training. INPEX maintain service agreements with various environmental service providers and general labour hire companies who can provide personnel to assist as general field responders, who would receive on-the-job training to assist with wildlife response activities.

The OWR Division Coordinator (within the IMT) may engage with qualified veterinarian specialists to provide in-field expertise and technical support to the OWR Coordinator.

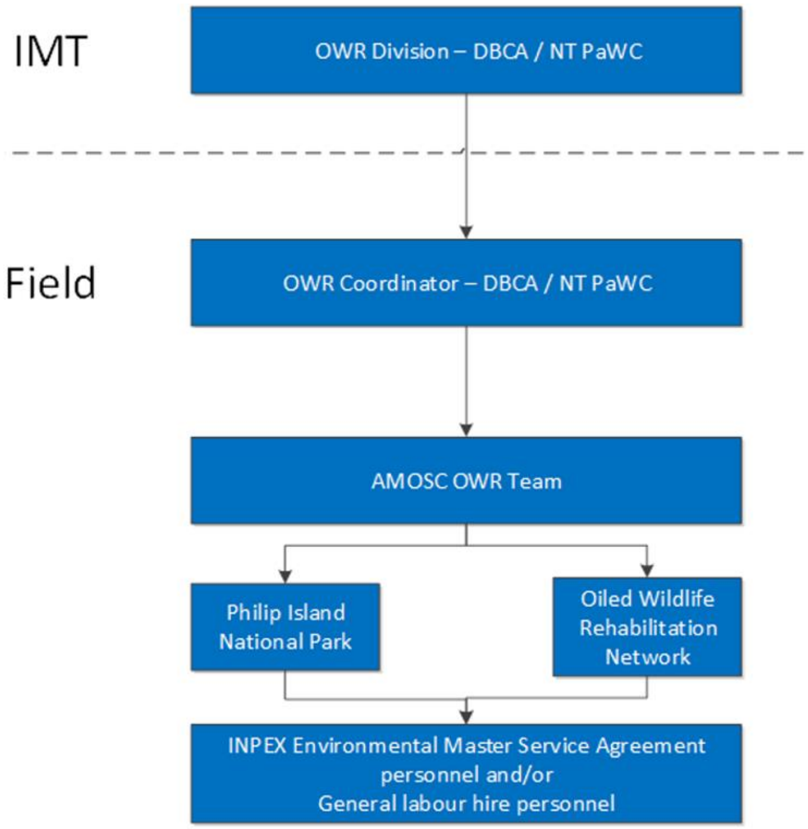

Figure 4-1: Oiled Wildlife Response Division model

There are significant logistical constraints and HSE risks with flying personnel in light utility helicopters to remote offshore locations or operating out of small vessels at remote offshore locations. Also, there is the potential to disturb wildlife populations on small islands by landing large numbers of response personnel. Therefore, the number of oiled wildlife responders working in remote locations at any one time will be agreed in consultation with the WA DBCA/NT PaWC oiled wildlife adviser but is likely to be limited to between 20 and 30 people at any one location. Depending on the duration of the operations, this may require the establishment of a one or two week on/off roster system, drawing on trained personnel from AMOSC, Oiled Wildlife Rehabilitators Network, WA DBCA and WA DoT (as discussed above), until the response is terminated.

WA DBCA (previously DPaW) (DPaW pers. comm. 2016)[1] indicates that shore-based response priorities would generally consider the following fauna:

- Priority 1: birds endangered, threatened or protected by treaty
- Priority 2: common birds
- Priority 3: adult nesting female turtles (wipe down only)
- Priority 4: turtle hatchlings (potential translocation).

Response priorities at the time will be finalised in consultation with the WA DBCA/NT PaWC 'oiled wildlife adviser'.

Under specific circumstances, pre-contact wildlife response could potentially be used to prevent or reduce the impacts of a spill on populations of seabirds and turtles. It is most suitable when used on wildlife affected by persistent oily slicks; however, it may also be considered for residuals from Group I or Group II spills. Operational Monitoring and Evaluation of the spill would provide data regarding spill trajectory and potential wildlife that may be affected by the spill.

Wildlife hazing can be an effective control measure when deployed across limited geographical areas and against specific populations, where the surface oil resulting from a spill is largely contained. Hazing could potentially be used to deter marine fauna, seabirds and shorebirds from entering a spill area. It is not an effective measure against volatile spills which rapidly evaporate, nor does it have particular application against dissolved or dispersed oils.

Techniques include:

- vessel traffic that generates underwater noise and motion
- vessel air horns (where available) to create above-water noise
- vessel fire hoses that direct streams of water in front of whales and other fauna.

Oiled wildlife capture at sea is also theoretically possible; however, it would present significant challenges. The capture and relocation of turtle nests/eggs prior to oil arrival or following oil arrival onshore to prevent oiling of emerging hatchlings could be achieved using translocation and release. Onshore incubation and release of hatchlings at alternative locations away from the oil spill is possible, as noted in the Gulf of Mexico oil spill where personnel successfully relocated and incubated approximately 25,000 turtle eggs and successfully released approximately 15,000 turtle hatchlings (which is roughly the same proportion as natural hatchling success) (Gaskill 2010).

Helicopter transport is preferred over vessel transport due to the latter being more likely to disturb egg orientation. An option that is easier, cheaper and less logistically challenging than nest relocation is using drift fencing above high tide line to fence off potential nesting areas, then monitoring fences (particularly at dawn, following night-time hatching events) to capture and relocate hatchlings out of oiled areas.

Under specific circumstances, post-contact OWR (wildlife capture, cleaning and rehabilitation) could potentially be used to prevent or reduce the impacts of a spill on populations of seabirds and potentially other marine megafauna. It is most suitable when used on wildlife affected by persistent oily slicks, however it may also be considered for residuals from Group I and II spills.

[1] Personal communication, Mr Brad Daws, Department of Parks and Wildlife, Oil Spill Response Wildlife Management Course, Fremantle, pers. comm. 24-26 May 2016

In scenarios where an onshore treatment or rehabilitation facility cannot be located close enough to the site of wildlife collection to be acceptable in terms of wildlife welfare (such as the case at Browse Island and many other WA/NT coastline locations) an ‘on-water’ facility would need to be established. Details of how to activate this are contained in the Browse Island Oil Spill IMG (X060-AH-GLN-60015).

According to DPaW and AMOSC 2015, an ideal ‘on-water’ OWR centre would:

- accommodate a minimum of 30 oiled wildlife responders
- have suitable deck space to house at least one 20 metre OWR sea container and air-conditioned holding containers
- have an ability to safely load/unload wildlife to and from adjacent vessels (i.e. through rescue hatches or by using a loading crane)
- be able to facilitate washdown of animals and have the ability to store oily waste or have an oil-in-water separator and holding tanks for waste oil.

Following a pre or post-contact OWR activity, a report will be provided by the response team to the IMT Leader regarding the effectiveness of the activity. The report shall include, as a minimum:

- date(s), time(s) and location(s) of wildlife capture and release activities
- statistics of daily and total number of wildlife capture, cleaning, rehabilitation, per species
- the overall effectiveness of wildlife response activities (including photographic evidence, where possible).

The final decision on whether to terminate a shoreline wildlife response will remain with the WA DoT/NT DIPL, as the Control Agency for the WA/NT shorelines. If a shoreline wildlife response is required in Commonwealth waters or shoreline (e.g. Ashmore Reef, Cartier Island, the response termination will occur in consultation with AMSA and DAWE.

Termination of response will be determined by the IMT in collaboration with relevant stakeholders and will consider factors including the following:

- the safety of responders
- the current effectiveness of the response
- deteriorating weather conditions (including wind, visibility, sea conditions)
- habitats are deemed clear from risk of oiling
- lack of presence of oiled wildlife remaining in the affected area; or the numbers of affected wildlife being captured fall towards the agreed threshold for ceasing operations
- stabilisation and transportation of all captured wildlife has taken place
- collection and removal of carcasses has occurred.

The Western Australian Oiled Wildlife Response Plan (DPaW and AMOSC 2014) notes that options to assist the IMT make a decision on response termination include setting an agreed threshold for ceasing operations, as well as thresholds for scaling back rescue operations.

The final decision on whether to terminate a shoreline wildlife response will remain with the WA DoT/NT DIPL, as the Control Agency for the WA/NT shorelines. If a shoreline wildlife response is required at a Commonwealth shoreline (e.g. Ashmore Reef or Cartier Island), the response termination will occur in consultation will occur with AMSA and DAWE.

Arrangements and capabilities

The arrangements and capabilities as described in the subsections above are summarised in Table 4-3.

Table 4-3: Arrangements and capabilities – Pre-contact and post-contact oiled wildlife response

Technique	Resource capability and availability	Implementation time	Activation

Oiled wildlife response personnel	Under the WA DoT State Hazard Plan – Marine Environmental Emergency, the relevant Control Agency (WA DoT, or INPEX for Commonwealth waters/lands) will provide the On Scene Commander / Division Commander.
	WA DBCA will provide the in-field Oiled Wildlife Coordinator, and potentially additional wildlife response personnel (via WA DoT, under the West Australian Oiled Wildlife Response Plan, West Kimberley Region Oiled Wildlife Response Plan).
	Approximately 20–30 trained OWR personnel would be available through the following sources:
	• AMOSC Oiled Wildlife Response Team
	• WA DBCA/NT PaWC OWR personnel
	• Oiled Wildlife Rehabilitators Network
	• Philip Island Nature Park
	• Additional personnel, who would receive on the job training would be sourced from:
	  o AMOSC core-group
	  o INPEX environmental service providers
	  o INPEX general offshore labour hire contracts.
		24 hours to mobilise personnel to Broome/Darwin, to board vessels and/or helicopters.	IMT via the INPEX Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register (PER-2153236568).

Oiled wildlife response kit	Section 3 of the West Kimberley Oiled Wildlife Response Plan identifies a large number of OWR kits, including those located in Broome, Exmouth and Dampier. AMOSC maintains an 'oiled wildlife response capability register' on behalf of industry to support an OWR.	The AMOSC Broome OWR kit is available to mobile to a vessel in Broome Port within 24 hours.	IMT via the INPEX Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register (PER-2153236568).
Helicopters	Crew transfer helicopters (for personnel transfer to designated landing zones only, not to remote shoreline beaches).	INPEX routine crew-change helicopters always available.	IMT via the INPEX Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register (PER-2153236568).
	Utility helicopters suitable for landing on remote shorelines.	Commence mobilisation activities in Broome within 7 days.	
Vessels	Smaller support vessel assets < 40 m in length.	Complete mobilisation and depart Broome/Darwin wharf within 24 hours.	IMT via the INPEX Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register (PER-2153236568).
	Larger platform support vessels / accommodation support vessels.	Complete mobilisation and depart Broome/Darwin wharf within 48 hours.	

4.5.3 Protect and deflect/contain and recover

The INPEX IMT shall consider all operational monitoring and evaluation data to determine potential effectiveness of other protect and deflect/contain and recover activities.

The INPEX IMT will need to consider, in consultation with AMOSC and AMSA, the practicalities, likely success and risks associated with at sea contain and recover operation.

The INPEX IMT will need to consider, in consultation with AMOSC and the WA/NT Control Agency, the practicalities, likely success and risks associated with a shoreline protect and deflect operation.

Various stockpiles of oil spill response equipment, including containment booms, skimmers etc are located around Australia.

An AMOSC Level 1 stockpile is immediately available for mobilisation. Additional stockpiles of equipment can be accessed through INPEX's membership with AMOSC. A summary of equipment stockpiles, their custodian and locations are presented in Table 4-4.

Table 4-4: Protect and deflect/contain and recover equipment stockpiles

Level	Custodian	Location
Level 1	Kimberly Port Authority	Broome
Level 2/3	AMOSC	Exmouth/Fremantle/Geelong
	WA DoT	Fremantle
	AMSA	Darwin
Level 3	OSRL	Singapore

A contain and recover operation at sea would require the use of at least one or generally two support vessels, to conduct J-booming or other containment techniques. Skimmers or other collection devices would be used to recover spilled oil. Storage of liquid oily waste would generally be in the inboard storage tanks of the support vessel, or on specially mobilised storage tanks on the decks of vessels.

Shoreline protect and deflect activities, such as at Browse Island or other exposed shoreline locations, would be logistically challenging due to the general exposure to unfavourable sea conditions, large tidal range and shallow coral reef (generally protect and deflect/contain and recover is limited to sheltered waters, not exposed reef/beach environments). Only under exceptionally calm sea-states and appropriate tides would it be safe to conduct vessel activities to carry-out an effective protect and deflect/contain and recover operation at Browse Island.

A small utility helicopter could be utilised to transport personnel and protect and deflect/contain and recover equipment between the island and nearby support vessels or facility. Slinging of equipment from nearby support vessel may be required for heavier equipment, and also for the back-loading of waste.

The INPEX fleet of crew transfer helicopters can transfer personnel to the CPF and FPSO. Personnel can then transfer onto a support vessel, if required, or fly directly from the CPF or FPSO to Browse Island via a small utility helicopter.

The landing facility on Browse Island is a small concrete pad, unsuitable for the INPEX fleet of crew transfer helicopters (as described in the EP). Therefore, only a small utility helicopter would be suitable to provide logistical access to the island.

Waste management will be a key consideration for protect and deflect/contain and recover operations. A waste management plan would be developed in consultation with AMOSC and WA DoT, prior to commencement of the activity.

A decontamination staging post would be established on the shoreline (e.g. Browse Island), to enable decontamination of equipment and personnel before demobilisation from the island following a shoreline protect and deflect activity. Ultimately, all contaminated equipment and PPE would be back-loaded from the island via helicopter (or small vessel if the sea conditions were exceptionally calm), and onto support vessels which would return to the mainland for cleaning and/or appropriate disposal.

During/following protect and deflect/contain and recover activities, a report will be provided by the response team to the IMT Leader regarding the effectiveness of the activity. The report should include, as a minimum:

- date(s), time(s) and location(s) of the activities
- the volume of oily waste collected/generated and disposed of
- the overall effectiveness of the protect and deflect/contain and recover activities (including photographic evidence, where possible).

Arrangements and capabilities

The arrangements and capabilities as described in the subsections above are summarised in Table 4-5.

Table 4-5: Arrangements and capabilities – protect and deflect/contain and recover

Technique	Resource capability and availability	Minimum implementation time	Activation
Protect and deflect/contain and recover personnel	Under the WA DoT State Hazard Plan – Marine Environmental Emergency the relevant Control Agency (WA DoT or INPEX for Commonwealth lands) will provide the On Scene Commander / Division Commander. WA DoT/NT DENR (as Control Agency) may choose to mobilise their own shoreline protect and deflect personnel. AMOSC core group personnel, who can lead/manage a protect and deflect/contain and recover activity are available via the INPEX membership of AMOSC. WA DoT would provide strategic advice to INPEX IMT for any protect and deflect activities at WA shorelines. Under the WA DoT State Emergency Management Plan For Marine Oil Pollution (WestPlan MOP; WA DoT 2015), additional personnel to assist with protect and deflect activities may also be provided, if requested by the INPEX IMT. INPEX has the ability to contract additional general field responders under short-term labour hire contracts. Vessel deck crews are also available to support the activities.	24 hours to mobilise personnel to Broome to board vessels and/or helicopters ready to deploy to protect and deflect/contain and recover locations.	IMT via the Emergency Contacts Directory and the Oil Spill Equipment Tracking Register
Protect and deflect/contain and recover equipment	Protect and deflect/contain and recover equipment can be mobilised from the Broome/Darwin stockpiles to the wharfs. Additional equipment is located at various ports, as listed in Table 4-4. This equipment is accessible through AMOSC.	24 hours to mobilise protect and deflect/contain and recover equipment from the warehouse to a support vessel alongside in Broome/Darwin Port.	IMT via Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register (PER-2153236568).
Helicopters	Crew transfer helicopters (for personnel transfer to designated landing zones only, not to remote shoreline beaches).	INPEX routine crew-change helicopters always available.	IMT via Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register (PER-2153236568).
	Utility helicopters suitable for landing on remote shorelines are available via INPEX aviation call-off arrangements.	Commence mobilisation activities in Broome within 7 days.	
Vessels	Smaller support vessel assets <40 m in length.	Complete mobilisation and depart Broome/Darwin wharf within 24 hours.	IMT via Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register (PER-2153236568).
	Larger platform support vessels / accommodation support vessels.	Complete mobilisation and depart Broome/Darwin wharf within 48 hours.	

4.5.4 Vessel and aerial dispersant application

Dispersant can only be used to treat Group IV oil spills (HFO).

Dispersant **is not to be used** on Group II (diesel) spills.

During spill scenarios where INPEX is the control agency, the IMT can approve dispersant use.

During spill scenarios where AMSA or WA DoT/NT DIPL is the control agency, AMSA or the WA/NT Control Agency may direct INPEX to undertake dispersant response activities.

Depending on sea-state, atmospheric conditions, weathering and emulsification of Group IV spills (HFO), the 'window of opportunity' for effective dispersant application is generally limited – from a few hours, to a few days (ITOPF 2013). If a spill is ongoing, i.e. leaking from a vessel over several days, the window of opportunity for dispersant application may be extended.

Vessel-based dispersant application could be arranged during this window of opportunity for spills within approximately 100 km of the Ichthys facility in WA-50-L.

Depending on the weather conditions and duration of the spill, the FWAD capability from Batchelor could be available within the window of opportunity for spills within 510 km (280 nm) of Mungalalu Truscott Airport or Lombardina Airport. However, it would take at least 24 hours to mobilise all aircraft, personnel and equipment to the selected airport, as required by the *Fixed-Wing Aerial Dispersant Capability Joint Standard Operating Procedures (SOP) Version 1.2* (AMSA 2015).

Dispersant stockpile, vessels and personnel

A stockpile of 16 m^3 of Slickgone NS dispersant and a portable AFEDO dispersant spray system (to be mobilised to available support vessels) is maintained in WA-50-L on the FPSO.

The INPEX operated platform supply vessels (PSVs) and the offtake support vessel (OSV) are also equipped with dispersant spray equipment.

Personnel trained in vessel-based dispersant application are present on the PSVs/OSV and FPSO.

Training requirements in relation to dispersant use are presented in Table 8.12 of the EP.

The INPEX *Oil Spill and Dispersant Visual Observation Guide* is available with the dispersant stockpile and mobile spray system in WA-50-L, and onboard all PSVs and the OSV.

The INPEX *Oil Spill and Dispersant Visual Observation Guide* will be used by vessel-based dispersant application teams, to instruct them on how to monitor colour changes to oil once dispersant has been applied and assess the dispersant effectiveness. It also provides instructions to take photographs or video footage and provides reporting protocols to the IMT.

In the event of a spill amenable to dispersant, upon authorisation from the IMT Leader, the dispersant application team, using the INPEX *Oil Spill and Dispersant Visual Observation Guide* will make the final decision on whether to proceed with vessel-based application of dispersant.

Aviation support during vessel-based dispersant application

Although not mandatory, for vessel-based dispersant application to be most effective, it is desirable to use spotter aircraft to guide and coordinate spraying vessels. The crew of the spotter aircraft should be able to identify the heavier concentrations of oil, or the slicks posing the greatest threat to the environment. They need to have good communication with the vessels spraying the dispersant in order to guide them to the target. Spotter aircraft can also assist with judging the accuracy and effectiveness of the dispersant application (ITOPF 2013).

An additional observer should be mobilised in the aviation support (spotter) aircraft to monitor and report on the effectiveness of the dispersant application, using the INPEX *Oil Spill and Dispersant Visual Observation Guide.*

Aviation support is to be arranged via the INPEX IMT.

Fixed-wing aerial dispersant (FWAD) – dispersant stockpiles, aircraft and personnel

AMOSC maintain a contract (on behalf of the oil and gas industry) with AMSA for FWAD capability for spills in Commonwealth waters.

The AMSA FWAD capability will be made available to INPEX (via call-out through AMOSC) for oil spills where INPEX is the control agency.

All requirements of the *Fixed-Wing Aerial Dispersant Capability Joint Standard Operating Procedures (SOP) Version 1.2* (AMSA 2015) are required to be met in order to implement a FWAD response.

Under the joint SOP, AMSA is required to authorise the FWAD Operations Plan (Annex A of the joint SOP), which will ensure all relevant operational and safety factors have been taken into consideration, before implementing the FWAD response.

Nominated airfield

Lombardina and Mungalalu Truscott Airport are the most likely base from which to launch the FWAD response for a spill in the Ichthys Field. These are the largest all-weather airports in the north Kimberley with sealed runways and the necessary lighting for night operations.

There is road access to these airport; however, it may be restricted during the wet season.

Dispersant application aircraft

Aerotech First Response (AFR) is the nominated contractor who provides the FWAD aircraft fleet, on behalf of AMSA/AMOSC. AFR maintain six FWAD primary aircraft around Australia, the closest of which is at Batchelor Airfield in the Northern Territory. Another is located at Learmonth Airport (Exmouth) in WA.

Primary aircraft are available 24 hours a day, seven days a week (subject to visual flight rules) and will be 'wheels up' (mobilised) within 4 hours of activation.

AFR maintain twelve secondary FWAD aircraft, available if required to replace a primary aircraft in the event of a breakdown, or in the extreme circumstance that additional aircraft are required during an incident.

AMSA (2015) joint SOP, Attachment B (Aircraft Operational Capabilities) provides the following information regarding the Batchelor FWAD primary aircraft capabilities:

- endurance – 240 minutes (4 hours)
- air speed – 290 km/hr (160 knots)
- maximum range – 1165 km (640 nm) operating range – 510 km (280 nm)
- maximum dispersant capacity – 3 m^3

- maximum dispersant capacity at 200 nm – 3 m^3

Relevant distances and timings for the Batchelor FWAD primary aircraft are presented in Table 4-6.

Table 4-6: FWAD primary aircraft distances and timings

From	To	Distance (km)	Distance (nm)	Flight time (hours) at 160 knots
Batchelor Airport (NT)	Mungalalu Truscott Airport (WA)	515	282	1 h, 45 min
Mungalalu Truscott Airport (WA)	Browse Island	306	168	1 h
Mungalalu Truscott Airport (WA)	Ichthys field management area	327	180	1 h, 5 min
Batchelor Airport (NT)	Lombardina Airport (WA)	955	524	3 h, 30 min
Learmonth Airport (WA)	Lombardina Airport (WA)	1106	607	4 h, 5 min,
Lombardina Airport (WA)	Browse Island	271	148	55 min
Lombardina Airport (WA)	Ichthys Field management area	275	151	55 min

Air attack aircraft

An 'air attack' aircraft is required to provide a bird's-eye view of any oil slick. The air attack supervisor will coordinate and direct the dispersant application by the FWAD primary aircraft.

The provision of an air attack aircraft is the responsibility of the control agency. Therefore, INPEX must provide one in the event of a spill. It can be either a fixed-wing aircraft or a helicopter. AMSA will not authorise the FWAD Operations Plan (joint SOP, Annex A) without an available air attack aircraft with an air attack supervisor onboard who is trained and appointed by the Australian government.

Search and rescue platform

A suitable search and rescue platform must be available before any FWAD response. It can be an aircraft or vessel on standby near the proposed location of dispersant application.

AMSA will not authorise the FWAD Operations Plan (joint SOP, Annex A) without a suitable and available search and rescue platform.

FWAD personnel

Joint SOP (AMSA 2015) Section 6.3 provides the typical organisation chart required for FWAD activities.

Key personnel required to mobilise to the airport include:

- Airbase manager (typically AMSA personnel)
- AMSA liaison
- Air attack supervisor (trained and appointed by the Australian government)
- Air attack support (typically AMSA personnel)
- Dispersant coordinator (typically AMSA personnel)
- AFR Pty Ltd. liaison
- Loading crew (typically AFR personnel)
- FWAD primary aircraft pilots (provided by ARF).

The majority of the personnel required to fill the organisation chart will be mobilised from various locations around Australia by AMSA/AMOSC/AFR.

A combination of commercial flights, and possibly charter flights, will be necessary to mobilise these personnel to the airport within 24 hours.

AMSA will not authorise the FWAD Operations Plan (joint SOP, Annex A) without the relevant personnel available to support the FWAD response.

Dispersant stockpiles

Dispersant stockpiles closest to Lombardina and Mungalalu Truscott Airports are in Darwin, Broome and Exmouth. They can be mobilised to the airport by air or road. Dispersant stockpile information is maintained in the INPEX *Oil Spill Equipment Register.*

Table 4-7 presents the dispersant stockpile information, relevant at the time of preparation of this OPEP.

Table 4-7: Dispersant stockpiles

Location	Dispersant stockpile and owner
Mungalalu Truscott Airport	5 m^3 - Jadestone Energy (accessible via AMOSC)
Darwin	10 m^3 Slickgone EW – AMSA 9 m^3 Ardrox 6120 – AMSA 9 m^3 Slickgone LTSW – AMSA
Broome	15 m^3 Ardrox 6120 – INPEX (Broome supplementary stockpile until Dec 2017)
Exmouth	75 m^3 Slickgone NS – AMOSC

FWAD AMSA/AMOSC responsibilities

During a FWAD response, AMSA/AMOSC will be responsible for the following (AMSA 2015):

- activating the FWAD capability in consultation with relevant parties
- identifying a nominated airfield in consultation with the AFR (presumably Lombardina or Mungalalu Truscott Airport)
- coordinating the following equipment, personnel and resources:
  - all equipment required to set up the airbase
  - dispersant operation coordinator (single point of contact to AFR)
  - AMSA liaison officer to the INPEX IMT
  - air attack supervisor
  - search and rescue platform (vessel or helicopter)
  - dispersant monitoring capability (highly desirable)
  - airbase manager
- ensuring that AFR is included in the distribution of incident information.

FWAD INPEX responsibilities

INPEX responsibilities (where INPEX is the control agency) during FWAD activities, as per AMSA (2015), include:

- establishing and maintaining incident control (via the INPEX IMT), including FWAD through the dispersant operation coordinator and using the FWAD operations plan – the INPEX Incident Controller (IMT Leader) is responsible for approving the FWAD operations plan (as part of an IAP)
- assisting with meeting the operational requirements of the FWAD capability
- developing a FWAD operations plan
- providing an air attack aircraft (fixed-wing, or helicopter)
- providing a search and rescue platform (aircraft or nearby vessel on standby).

A simultaneous operations (SIMOPS) communication plan or air operations plan will need to be developed between all aircraft involved in the oil spill response (e.g. FWAD, air attack supervisor and other surveillance or search and rescue operations).

Acceptable dispersant application zone

As discussed in Section 8 of the EP, there is the potential for negative impacts to shallow, subtidal environmental values and sensitivities associated with the application of dispersant. Shallow subtidal biota could be negatively impacted due to increased bioavailability and toxicity of dispersed oils. AMSA (2010) identified that surface-applied dispersant will likely only penetrate to depths shallower than –25 m at lowest astronomical tide (LAT).

RPS APASA 2014 conducted a wide range of modelling of dispersant applications on a 1000 m^3 Group IV spill at various locations along the GEP route. Based on the outcomes of this indicative modelling, 20 km has been determined as a suitable buffer to reduce the risk to ALARP of submerged values and sensitivities being exposed to entrained/dispersed oil above 500 parts per billion (ppb).

The INPEX stakeholder consultation with WA DoT has confirmed that the application of dispersant on a Group IV spill to protect the values and sensitivities of WA shorelines, such as seabirds and turtles (at Browse Island), will be considered on the situation’s merits and this response action should be supported by an Operational SIMA.

Therefore, the ‘Acceptable Dispersant Application Zone’ has been defined in the following manner to denote locations where dispersant application can be undertaken:

- Dispersant use is permitted at any location >20 km from the −30 m LAT contour of any shoal, bank or reef which is wholly submerged at high tide (e.g. Echuca Shoal).
- Dispersant use is permitted for any spills (or dispersed spill) that has the potential to reach WA state waters, if there is a positive outcome for dispersant use based on the Operational SIMA, and WA DoT has been informed regarding the Operational SIMA. The IMT has authorisation for dispersant use.

Dispersant application will only be considered for Level 2 and Level 3, Group IV spills.

Dispersant use shall only be authorised if the IMT Leader is satisfied a 'Yes' has been recorded for ALL of the conditions within Table 4-8.

A map demonstrating the Acceptable Dispersant Application Zone is provided in Figure 4-2.

Dispersant effectiveness monitoring

The INPEX *Oil Spill and Dispersant Visual Observation Guide* will be used by trained personnel during dispersant application. This includes relevant factors (ITOPF 2013) to be considered during dispersant application including:

- spill appearance
  - dispersant should only be applied to thick, fresh oil and target the thickest part of the slick
  - dispersant should not be applied to emulsified oil
  - dispersant should not be applied to thin sheens (silver/rainbow sheens).
- weather conditions
  - Beaufort scale sea states between 2 and 7 are suitable, with conditions between 3 and 6 being optimal, for dispersant application (i.e. Beaufort sea states between 3 and 6 are optimal dispersant application conditions; however, monitoring of effectiveness will ultimately determine continued dispersant application.
- visual monitoring of dispersant effectiveness
  - dispersant effectiveness should be undertaken continuously during application
  - dispersant application should be terminated immediately if the response is deemed no longer effective
  - changes in surface oil appearance should be noticeable shortly after dispersant application
  - no change in the appearance, or no reduction in oil coverage, indicate ineffective dispersant application
  - a milky white plume in the water indicates ineffective dispersant application.

Table 4-8: IMT dispersant application decision matrix

Operational conditions (ALARP considerations)	**Decision (Y/N)**	**Comments**	**IMT Leader Sign-off**
Dispersant application capable vessels/ aircraft are not required for higher priority emergency response activities (PEARS principle)			
Confirm Group IV oil to be dispersed. No dispersant application on Group I (condensate) or, Group II (MGO/diesel) spills.			
Operational SIMA – positive outcome recorded			
For FWAD, AMSA developed and are satisfied with the 'Fixed-Wing Dispersant Operations Plan'.			
Spill where dispersant to be applied is located within the 'Acceptable Dispersant Application Zone'; • Dispersant use is permitted at any location >20 km from the –30 m LAT contour of any shoal, bank or reef which is wholly submerged at high tide (e.g. Echuca Shoal). • Dispersant use is also permitted, including in areas <-30 m LAT and <20km from an intertidal habitat, (but not within State waters) where the Operational NEBA indicates a positive outcome for dispersant use to protect MNES (e.g. turtle nesting/ seabird breeding), and the relevant DoT has been notified regarding the Operational SIMA positive outcome.			

Operational conditions (ALARP considerations)	Decision (Y/N)	Comments	IMT Leader Sign-off
• Dispersant use within state/territory waters is only permitted under instruction from the relevant DoT Incident Commander.			
The following in-field conditions are suitable for dispersant application: • Beaufort scale sea states between 2 and 7 (with sea states between 3 and 6 being optimal) • Daytime and good visibility.			

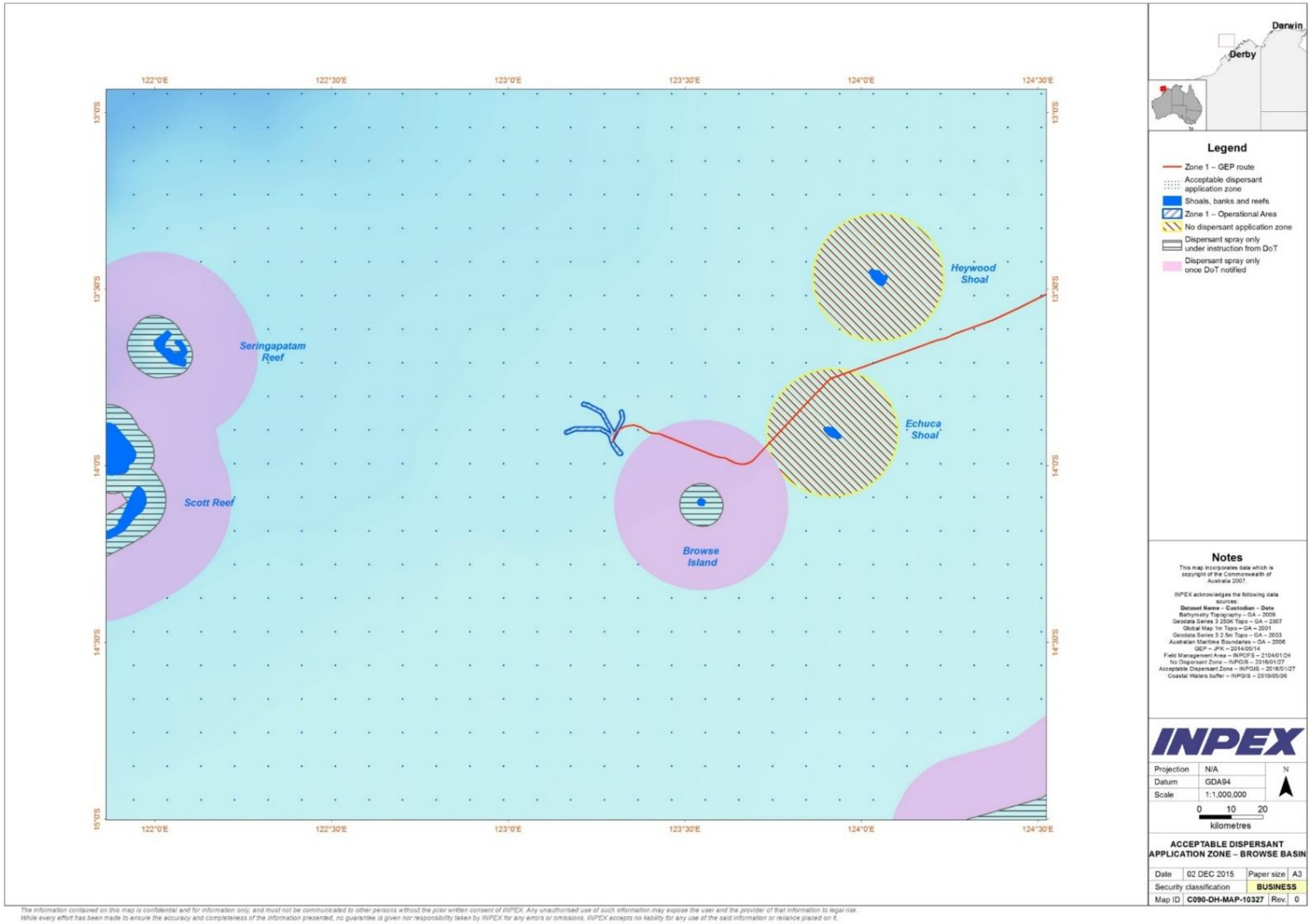

Figure 4-2: Acceptable dispersant application zone

During FWAD activities, an additional observer should be mobilised in the air attack aircraft to monitor and report on the effectiveness of the dispersant application. If an additional observer is not available, this reporting can be facilitated through the air attack supervisor.

During vessel-based dispersant application, the vessel team will monitor and report on the effectiveness of the dispersant application.

In accordance with the INPEX *Oil Spill and Dispersant Visual Observation Guide*, following dispersant application, a report will be provided by the aircraft/vessel observer to the IMT Leader regarding dispersant application. The report will include, as a minimum:

- date(s) and time(s) of dispersant application transects
- locations and track plots of dispersant application transects
- the volume of dispersant used per dispersant application transect
- the effectiveness of the dispersant application (including photographic evidence, where possible).

Arrangements and capabilities

The arrangements and capabilities as described in the subsections above are summarised in Table 4-9.

Table 4-9: Arrangements and capabilities –vessel and aerial-based dispersant application

Technique	Resource capability and availability	Minimum implementation time	Activation
Mainland dispersant stockpiles	A Jadestone Energy owned stockpile (5 m^3) is located at Mungalalu Truscott Airport (accessible via request through AMOSC / AMOS-Plan). AMOSC/AMSA stockpiles that can be rapidly mobilised by air or road to the FWAD airbase are located in Darwin, Broome and Exmouth (refer Table 4-7).	Stockpiles can be relocated via road or air to Lombardina or Mungalalu Truscott Airport within 24 hours.	IMT Leader to request access of dispersant stockpiles through AMOSC.
Aerial-based dispersant application	Nominated airbases would likely be Lombardina or Mungalalu Truscott Airport. The FWAD capability would be requested to be activated through AMOSC. AFR would provide the FWAD spray aircraft. FWAD personnel would be obtained through AMOSC, AMSA and AFR. An air attack aircraft (preferably helicopter) will be provided by INPEX. A SAR platform (vessel/SAR helicopter) will be provided by INPEX.	24 hours required to mobilise dispersant stockpiles, FWAD aircraft, SAR platform and personnel required under the JSOP to a nominated airfield.	IMT Leader to activate FWAD capability through AMOSC. IMT Leader to authorise dispersant spraying, in accordance with decision matrix (Refer Table 4-8).
Vessel-based dispersant application	FPSO maintains 16 m^3 dispersant, an AFEDO spray system and dispersant trained personnel. These can be mobilised onto any available support vessel. INPEX OSV/PSVs maintain dispersant spray systems and dispersant trained personnel. The FPSO can provide the 16 m^3 dispersant to these vessels. Shell Prelude FLNG support tugs are equipped with dispersant, spray systems and dispersant trained personnel. This capability can be requested/accessed through AMOSC/AMOS-Plan. AMOSC/AMSA stockpiles that can be rapidly mobilised by air or road to Broome wharf to resupply vessels are located in Darwin, Broome and Exmouth (refer Table 4-7)	5 hours to mobilise a vessel dispersant capability in WA-50-L.	IMT Leader to authorise vessel-based dispersant spraying, in accordance with decision matrix (Refer Table 4-8).

4.6 Waste management

Waste will be managed in accordance with the INPEX Waste Management Standard (0000-AH-STD-60047), MARPOL 73/78 Annex V – Garbage, relevant Commonwealth and State/Territory regulations regarding disposal of waste generated as a result of spill-response strategies.

On-site transportation and storage of waste

As soon as the details of a spill become evident, a Waste Management Plan, developed in consultation with AMOSC and the relevant control agency shall be developed, to ensure the ongoing supply and backload of appropriate waste management equipment.

Based on the maximum credible spill scenarios modelled, oily waste volumes generated through a shoreline clean-up could be up to 2,500 m^3. Waste storage on remote shorelines and support vessels can be manage with small, easily transportable waste receptacles.

Table 4-10 outlines the waste storage, disposal and treatment options available for the various oily waste streams.

All waste stored or transferred will be fully documented, including details of exact volume and nature of the waste, date and time, receiver of the waste and destination of the waste, in accordance with vessel Garbage Management Plans and the onshore licenced waste contractor's waste tracking process.

Table 4-10: Waste storage, disposal and treatment options for hydrocarbon-contaminated waste.

Waste category	On-site storage option	Transport and disposal options	Location of waste management capabilities	End destination
Solid wastes, including oily residue (e.g. waxy residual diesel and HFO; oiled organic materials such as sand and seagrass).	Impermeable bulka bags Lined skips Oil drums 1 m^3 IBCs Industrial waste bags	Oily waste containers will be back-loaded by tender or light utility helicopter to the support vessel for temporary storage offshore, prior to transport to shore. The waste would then transport to shore for appropriate disposal: • recovery and recycling • bioremediation • land farming • incineration • landfill	Onboard vessels INPEX Broome Drilling Logistic Base INPEX Darwin Offshore Logistics Base	Licensed waste contractor – Broome and/or Darwin.
Solid wastes, including oiled man-made materials (e.g. PPE, booms and sorbent pads).	Impermeable bulka bags Lined skips Oil drums 1 m^3 IBCs Industrial waste bags	Oily waste containers will be back-loaded by tender or light utility helicopter to the support vessel for temporary storage offshore, prior to transport to shore. The waste would then transport to shore for appropriate disposal: • recovery and recycling • incineration • landfill		
Liquid wastes, including diesel, HFO and oily water.	Oil drums 1 m^3 IBCs Slops tanks on vessels	Oily waste containers will be back-loaded by tender or light utility helicopter to the support vessel for temporary storage offshore, prior to transport to shore. The waste would then transport to shore for appropriate disposal: • recovery and recycling • incineration Alternatively, a support vessel may use its MARPOL compliant oily water treatment system to treat and dispose of oily water offshore.		
Biological oiled waste (e.g. euthanised oiled wildlife).	Impermeable bulka bags Oil drums 1 m^3 IBCs Industrial waste bags	Oily waste containers will be back-loaded by tender or light utility helicopter to the support vessel for temporary storage offshore, prior to transport to shore. The waste would then transport to shore for appropriate disposal: • incineration • landfill		

Arrangements and capabilities

The arrangements and capabilities as described in the subsections above are summarised in Table 4-11.

Table 4-11: Arrangements and capabilities – Waste management

Technique	Resource capability and availability	Implementation time	Activation
Waste receptacles	MARPOL compliant vessel oily water storage/treatment systems.	Already onboard vessel.	IMT via the INPEX Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register (PER-2153236568).
	Impermeable bulka bags Lined skips Oil drums Industrial waste bags 1 m^3 IBCs Oil barges Flexible bladders	Available from licenced waste contractor, to be delivered to Broome supply base within 24 hours.	
Waste disposal	Undertaken by a licensed waste contractor in Broome and/or Darwin. Waste disposal includes: • recovery and recycling • bioremediation • land farming • incineration • landfill • water treatment and discharge.	N/A.	IMT via the INPEX Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register (PER-2153236568).
Helicopters	Utility helicopters suitable for landing on remote shorelines.	Within 7 days.	IMT via the INPEX Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register (PER-2153236568).
Vessels	Smaller support vessel assets < 40 m in length.	Commence mobilisation in Broome/Darwin within 24 hours.	IMT via the INPEX Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register (PER-2153236568).
	Larger platform support vessels / accommodation support vessels.	Commence mobilisation in Broome/Darwin within 48 hours.	

4.7 Operational and scientific monitoring

In 2011, an Operational and Scientific Monitoring Program (OSMP) was developed by the Environment Group Browse Basin (of which INPEX is a member). The program encompasses a number of individual Operational Monitoring (OM) and Scientific Monitoring (SM) programs to guide a spill response, assess potential environmental impacts and inform any remediation activities. The OSMP described in this OPEP has been reviewed and refined for the emergency conditions described in Section 8 of the EP. The OSMP is presented in Appendix A, with a division of the OM and SM programs, as follows:

- Operational monitoring is to commence as soon as a spill occurs and aims to characterise the nature and scale of the spill for the duration of the spill. Monitoring is designed to collect information on the predicted spread of the oil and the locations it may impact and, in turn, the OM informs and supports a secondary oil spill response, such as wildlife hazing, as well as the scientific monitoring.
- Scientific monitoring is the investigation component which assesses the overall impact and recovery of the ecosystems which have been exposed to hydrocarbons and response activities, as informed by the OM program.

The OM and SM programs are summarised in sections 4.7.1 and 4.7.2 with further program-specific details, including objectives and triggers for activating and terminating each OM and SM, provided in Appendix A.

Each OM/SM will be tailored, activated and terminated as appropriate to the characteristics, nature and scale of the spill under the supervision of the INPEX IMT Leader, in consultation with:

- the INPEX IMT environmental adviser
- AMOSC
- environmental service providers
- AMSA (for vessel-based spills)
- environmental science coordinators (WA DoT) for spills entering WA waters.

INPEX will maintain a contract with an environmental service provider (ESP) to allow the timely implementation of the OM/SM programs following notification of a Level 2 or Level 3 spill. Details of the ESPs Operational and Scientific Monitoring programs will be maintained in the ESPs Project Execution Plan.

This contract ensures the timely activation of field surveys and delivery of results from survey activities/studies. Results arising from OSMP will be technically reviewed by subject matter experts as determined by the ESPs project manager and technical lead prior to submission to the INPEX environment team.

The monitoring programs will be designed to be repeatable so that in the event of a Level 2 or Level 3 spill there is continuity throughout all monitoring phases to detect potential impacts and subsequent recovery. This will include the use of before–after, control–impact (BACI) design or gradient design monitoring programs for impact detection, as appropriate. However, it is important to note that the actual OSMP design will be dependent on the outcomes and any recommendation from baseline monitoring; receptors potentially to be impacted and the nature and scale of the spill. Further details on baseline information are provided in Section 4 of the EP.

While AMSA is responsible for monitoring in instances where AMSA is the Control Agency (i.e. vessel-based spills), INPEX will provide support to AMSA in accordance with the MoU between AMSA and INPEX (2013).

The person responsible for activating and terminating the OSMP is the INPEX IMT Leader (in consultation with those personnel listed above), as shown in Figure 4-3. Consultation with relevant regulatory authorities, regarding progress and outcomes of the OSMP, will occur as part of ongoing notifications and reporting during a Level 2 or Level 3 spill.

All scientific report outputs associated with this OSMP will undergo timely peer review by appropriate subject matter experts; for example, those from contracted environmental service providers.

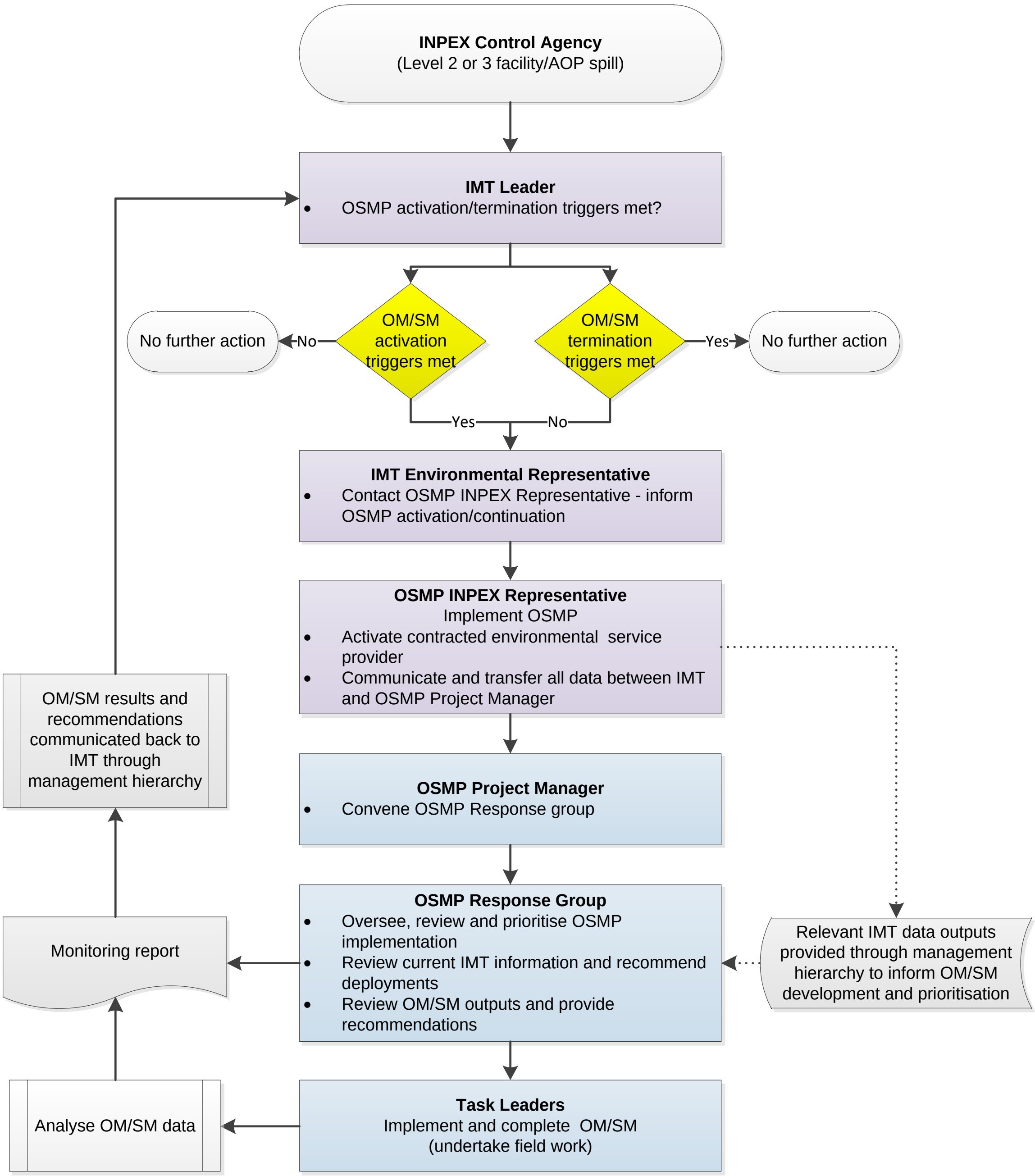

Figure 4-3: OM and SM activation, termination and communication flowchart

4.7.1 Operational monitoring

The focus of the OM program is to assist the IMT to maintain situational awareness by providing information regarding the nature and scale of a spill, and the values and sensitivities at risk.

Information from the OM program also drives the response strategy with regards to triggering and monitoring the effectiveness of secondary response measures, such as wildlife hazing (if required). The data outputs will also be used to trigger the longer-term SM programs (as required).

A summary of the OM programs is provided in Table 4-12. In summary, OM03 and OM01 will be supported by OM04 and OM06. OM04 and OM06 require analysis of water and sediment quality (e.g. laboratory analysis of samples, calibrated field instruments) and will be completed as soon as it is practical to mobilise vessels to the area (nominally seven days). Surface slicks tracked or modelled as part of OM03 and OM01 respectively, may provide an initial indication of the location of any entrained or dissolved hydrocarbons. This will then drive the desktop review of key areas and environmental sensitives at risk from the spill (OM05). Additional details are provided in Appendix A.

Table 4-12: Summary of operational monitoring programs

OM #	Monitoring program	Monitoring method(s)	Data output
OM01	Oil Spill Trajectory Modelling	Forecast and hindcast modelling.	Forecast and hindcast modelling of movement and weathering of oil. This enables the identification of values and sensitivities that may be impacted and drives the response strategy with regards to any secondary response measures and scientific monitoring that may be implemented.
OM03	Oil Spill Surveillance and Reconnaissance	Vessel and aerial surveillance, satellite imagery and satellite tracking buoys.	Assess the colour, consistency, distribution and locations of the surface slicks. Identify values and sensitivities likely to be impacted by the spill. This assists in validation of the model.
OM04	Operational Monitoring of Oil Properties, Behaviour and Weathering at Sea	Vessel-based water sampling.	Assess hydrocarbon physical and chemical properties, as well as the spatial and temporal extent. This assists in validation of the model and identifies any scientific monitoring that may be implemented.

OM #	Monitoring program	Monitoring method(s)	Data output
OM05	Pre-emptive Desktop Assessment of Sensitive Resources	Desktop analysis of baseline data.	Detailed analysis of values and sensitivities that may be impacted. Identifies any secondary response measures and scientific monitoring that may be implemented.
OM06	Assessment of the Presence and Quantity of Petroleum Hydrocarbons in Water and Sediments	Vessel-based water and sediment sampling.	Assess hydrocarbon physical and chemical properties, as well as the spatial and temporal extent in water and sediment. This assists in validation of the model and identifies any scientific monitoring that may be implemented.

4.7.2 Scientific monitoring

The SM program does not directly inform spill response operations directed by the INPEX IMT. It does, however, assess the overall impact and subsequent recovery of the identified values and sensitivities to hydrocarbon exposure and oil spill response activities.

SM will only be undertaken in the event of a Level 2 or Level 3 spill and where the information obtained through the OM program indicates values and sensitivities are predicted to be impacted or have been impacted.

SM will be consistent with the nature and scale of the spill and sufficient to inform any remediation activities, where appropriate. It may begin before the termination of similar OM activities. Details on the SM program are provided in Appendix A.

As discussed in Section 8 of the EP, any wind driven entrained components of a Group II surface spill, including dispersed oils, will remain within the top 30 m (with the vast majority in the top 10 m) of the water column. Therefore, for all surface spills, SM relating to water quality (SM05), sediment quality (SM06) and intertidal and benthic environments (SM07 and SM08) will only be activated where OM indicates potential impacts to areas shallower than –30 m LAT.

All Level 2 and Level 3 spills have the potential to impact planktonic communities. Therefore, SM09 has been included.

A surface diesel or HFO spill could potentially impact marine megafauna such as cetaceans, dugongs, turtles, whale sharks and marine avifauna. Therefore, SM10 and SM11 have been included in order to monitor for potential impacts and recovery of MNES within Biologically Important Areas (BIAs) or other identified populations.

As commercial, recreational and traditional fishing all occur within the PEZ, SM12 has been included to understand potential impacts to this sensitivity.

IN the event of an HFO spill, where chemical dispersant is applied, monitoring of residual dispersant concentrations in the water column, to validate impact predictions provided in Section 8 of the EP, will be implemented via activation of SM04.

Note that limited information is presented in Appendix A with respect to timings for implementation of the SM program. Unlike the OM program, in order to implement an effective SM program, thorough planning is required to ensure the correct data is collected with respect to confirming potential lasting impacts from a spill. This relies on data outputs generated from the OM program and therefore the planning stage may take additional time. Mobilisation times for the SM program will be as soon as practicable given the context of the area and mobilisation will generally commence within 7 days of receipt of notification.

4.7.3 Baseline data to support the OSMP

A range of data has been used to establish the environmental baseline in the Browse Basin as described in Section 4 of the EP. This includes information collected during various environmental surveys completed by INPEX (2006-2009) and the Applied Research Program (ARP) partnership between Shell, INPEX and the Australian Institute of Marine Science (AIMS) (2014–2018). The focus of the ARP was to collect baseline data to inform understanding of the extent, severity and persistence of impacts in the unlikely event that a significant spill occurs during the activity.

In addition to INPEX-collected data, INPEX is also a member of the Industry-Government Environmental Metadata (I-GEM) project. The pilot I-GEM project was completed in 2014 and contains accessible metadata from industry, research institutes and government organisations Australia-wide, which were uploaded to the Australian Ocean Data Network (AODN) portal. Metadata searches can be conducted via the AODN portal and the standalone I-GEM website which contain data sets from the Abrolhos Islands to the Timor Sea, out to the extent of Australia’s exclusive economic zone.

Published monitoring reports from the Montara spill augment this data both spatially and temporally. Further to this, extensive multi-year monitoring programs have been undertaken by other operators (e.g. Woodside and Shell) in the Browse Basin, which also augment the INPEX data, spatially and temporally, for physical and biological aspects of the environment.

Research institutes and organisations such as AIMS, the Western Australian Museum and Monash University have also conducted long-term monitoring programs in the Browse Basin. This data further increases the environmental understanding of the region. INPEX has also formalised an agreement with WA DBCA which confirms WA DBCA will supply environmental data (including Western Australian Marine Science Institution data (C075-PAW-IPX-LE-00001)) to INPEX Australia in the event of an incident or oil spill in the nearshore/coastal waters of the region.

Information collected from these surveys, as well as the ARP program, provide a substantial baseline on the marine flora, fauna and habitats which may be referenced in the event of a Level 2 or Level 3 spill event. The current states of knowledge for receptors in the Browse region relevant to this OPEP are described in Section 4 of the EP.

4.8 Health and safety

Health and safety considerations will be incorporated into any spill response.

INPEX health and safety objectives are to:

- adhere to the INPEX PEARS philosophy as detailed in the INPEX Emergency and Crisis Management Standard (Doc. No. PER-0000-AH-STD-60051)
- provide a safe working environment and prevent workplace incidents by managing risks to ALARP
- eliminate, or minimise all environment and community risks to ALARP and ensure any impacts are neither serious nor long-lasting
- ensure the security of INPEX personnel, assets and information.

The IMT should develop a Safety Management Plan utilising the National Plan Guidance on Marine Oil Spill Response Health and Safety document (AMSA 2018).

Contractors are responsible for the development of site-specific risk assessments before undertaking any activities.

The safety of personnel is the primary concern in a spill incident. An individual risk assessment, such as a job hazard analysis (JHA), will always be conducted by a response contactor or other appointed or responsible personnel, such as the HSE manager or supervisor.

If the response is conducted by a Control Agency other than INPEX (i.e. AMSA), that agency is expected to adhere to stringent safety procedures as outlined in their respective oil spill response plans (i.e. the NatPlan).

Table 4-13 provides examples of hazards and risks that may be encountered during a response to a spill.

Table 4-13: Examples of health and safety risks from spill response

Hazards	Risks	Prevention and mitigation considerations
Inadequately trained personnel carrying out the response	Lack of appropriate training	Prior to any response being implemented, a HSE Plan must be prepared, and will identify induction/on-the-job training requirements, and associated JHAs etc. All personnel must complete the induction/on-the-job training and sign onto the JHA prior to commencing work. Appropriately qualified personnel, such as AMOSC core-group members, will be appointed as field response team leaders, and will provide on-the-job supervision and training (as required) to other response team members.
Flammability	Fire and explosion	Firefighting capacity of INPEX-contracted vessels and their tenders as per flag state requirements and INPEX standards.
		Permit to work (PTW) system and JHAs applied to all activities.

Hazards	Risks	Prevention and mitigation considerations
Toxicity of hydrocarbon	Inhalation, ingestion or contact with skin or eyes leading to dermal irritation or illness	Air quality monitoring equipment, to protect the health of oil spill responder personnel, is available as part of the Broome Supplementary Stockpile.
		PPE including respiratory protection, coveralls, gloves, glasses, boots and barrier gels, to be provided to all personnel working on the response.
		Clean-up area provided for responders to decontaminate and remove soiled clothing. Ample quantity of clean PPE available.
Manual handling	Manual handling injuries	Use of cranes, or large teams of trained personnel, to lift response materials as required.
Slips, trips and falls	General injury	Hydrocarbon waste and used absorption equipment will have dedicated waste receptacles. Additional supply of absorption material to be located at access and egress points from vessels and/or in and out of offices, to mitigate the additional risk of slipping on oily surfaces, and to minimise the spread of hydrocarbons.
		Designated and separate, clean and contaminated work areas and movement routes in all work areas.
Working over water	Drowning	Mandatory use of lifejackets when working over water and independent sentry posted to monitor activity. "Man overboard" procedures clearly defined and included in personnel inductions and ongoing training. PTW from vessel master to be in place for personnel working over water.
Dangerous marine fauna	Bites, stings and other injury from marine fauna	No personnel are permitted in the water. Sentry in place whenever personnel are working over the water and to watch for fauna. All work will be done under a PTW from a response contractor. Any personnel retrieving equipment or wildlife from the water will be alert to marine animals.

Hazards	Risks	Prevention and mitigation considerations
		All personnel working to retrieve equipment or wildlife from the water will be equipped with gloves and protective clothing, and all retrieved equipment will be washed to remove any marine life.
Working from helicopters	Helicopter downed	As a minimum, any helicopter working for an INPEX response must meet the INPEX minimum aviation standards. Any personnel working from a helicopter over water must have a completed Tropical Basic Offshore Safety Induction and Emergency Training (TBOSIET) certificate or equivalent.
Excessive working hours	Fatigue	Personnel will work under the applicable working-hour limitations. As a minimum, the INPEX fitness-for-work standard will be used as a template for all INPEX employees. There will be monitoring of fatigue and personnel fitness by work supervisors. A roster will be established to allow change-out of personnel as required, depending on the nature and duration of the spill response.
Weather	Dehydration, heatstroke	The INPEX fitness-for-work standard and the fatigue guidelines will be used as minimum requirements.
Quarantine	Human communicable diseases	Browse Island and other locations within the traditional fishing MoU box have the potential for contact between spill response personnel and Indonesian fishermen. Communicable diseases, such as tuberculosis can be transmitted from human to human. Inductions need to communicate that no contact with Indonesian fishermen is permitted, and appropriate controls will be implemented to mitigate this risk.
Unexploded Ordnance (Cartier Island)	Vessel damage / fatality	Cartier Island and the surrounding marine area within a 10 km radius was a Defence Practice Area up to 2011. Although the site is no longer an active weapons range there is a SUBSTANTIAL RISK that UXO remains in the area.

Hazards	Risks	Prevention and mitigation considerations
		Due to the risk posed by UXO, landing on Cartier Island or anchoring anywhere within the Cartier Island Commonwealth Marine Reserve is strictly prohibited without express, prior written approval. If anchoring is unavoidable due to an emergency (e.g. extreme weather conditions), great care should be taken to ensure anchoring is on sand and that anchors do not drag. Any metal objects or suspicious objects found in the reserve should not be touched or disturbed and reported immediately to the police and the Parks Australia Work Health and Safety Advisor on (02) 6274 2369 or parks.healthandsafety@environment.gov.au

The Browse Island Oil Spill IMG (X060-AH-GLN-60015) contains completed HAZID reports for helicopter, vessel and shoreline response activities. These HAZID reports should be used to generate HSE plans and associated JHAs for shoreline response activities.

5 INPEX forms and guidance

Table 5-1 has been copied from the Oil Spill Forms Register (PER-2153332031).

The table provides rapid access for IMT personnel to forms needed during an oil pollution emergency event. Not all of the forms on this table are relevant to the spill event described in the EP. Please use the most recent version of the controlled copy of the Oil Spill Forms Register (PER-2153332031) during an emergency response.

Table 5-1: Oil Spill Response Forms

Form type	Form title	Purpose	Reporting timeframe	Applicable for oil spills in				Document reference (Coreworx, DMS or URL)
				Darwin Harbour	NT	WA	Cwlth Waters	
Notify & Report	NT Oil spill notification report (POLREP) - as per NT OSCP	Notify the following external parties of an oil spill in NT waters: • Darwin Port Corporation (DPC) for spills inside Darwin Port limits • NT Department of Infrastructure, Planning and Logistics (NT DIPL) – Marine Safety Branch for spills inside Territory waters (but outside Darwin Port limits) • NT Environment Protection Authority (NT EPA) for spills inside Territory waters and/or Darwin Port limits (NOTE: The NT POLREP is a modified version of AMSA's Marine Pollution Report (POLREP). (IMT Environment to obtain copy).	< 2hrs	✓	✓			C020-AG-FRM-0008
	NT Incident update report (SITREP) – as per NT OSCP	Notify the following external parties of an oil spill in NT waters: DPC for spills inside Darwin Port limits NT DIPL – Marine Safety Branch for spills inside Territory waters (but outside Darwin Port limits) NT EPA for spills inside Territory waters and/or Darwin Port limits (NOTE: The NT SITREP is a modified version of AMSA's Marine Pollution Situation Report (SITREP) available at www.amsa.gov.au) (IMT Environment to obtain copy).	Daily Or as situation changes significantly	✓	✓			C020-AG-FRM-0010
	AMSA harmful substances report (POLREP)	Facility OIM / Vessel master to report marine pollution incidents in Commonwealth waters to AMSA. (IMT Environment to obtain copy).	< 2hrs				✓	C075-AH-FRM-10009
	WA Department of Transport - POLREP	Facility OIM / Vessel master to report marine pollution incidents, which **may** threaten WA waters / lands to WA DoT. (IMT Environment to obtain copies of POLREP/SITREP).	Immediately			✓		https://www.transport.wa.gov.au/mediaFiles/marine/MAC-F-PollutionReport.pdf https://www.transport.wa.gov.au/mediaFiles/marine/MAC-F-SituationReport.pdf

Form type	Form title	Purpose	Reporting timeframe	Applicable for oil spills in				Document reference (Coreworx, DMS or URL)
				Darwin Harbour	NT	WA	Cwlth Waters	
	WA Department of Transport - SITREP							
	WA Department of Water and Environment Regulation (DWER) - Online Pollution Report	Pollution onto WA land (i.e. oil contacting WA shoreline) is to be reported online. (IMT Environment to complete).	< 12 hrs			✓		http://www.der.wa.gov.au/your-environment/reporting-pollution/report-pollution-form
	Offshore occurrence report form (Western Australian Department of Mines & Petroleum (DMP))	Report to DMP for marine incidents within the 3 nautical mile limit (WA State waters) by INPEX IMT Leader. This includes reporting oil spill incidents that originated in commonwealth or NT waters, but moved into WA State waters. (IMT Environment to complete).	< 3 days			✓		DEV-CEX-FM-0002
	Report of a known or suspected contaminated site (*Contaminated Sites Act 2003 (WA)*)	Report to WA DWER of a contaminated site on land, shoreline or seabed within WA State waters (within 3 nm). (IMT Environment to complete).	< 21 days			✓		DEV-CEX-FM-0001
	NOPSEMA incident report form (FM0831)	Report to NOPSEMA offshore incidents in accordance with relevant OPEP (typically this is only required for Level 2 or 3 spills). (INPEX IMT Leader to issue report) NOTE: NOPSEMA must be verbally notified within 2 hours after becoming aware of the incident	< 3 days				✓	C075-AH-FRM-10007
Log	Emergency incident log	Record the specific activities undertaken by personnel during an oil spill response (Individual form optional for IMT Carbon copy incident log books also available)	Ongoing during emergency	✓	✓	✓	✓	C020-AG-FRM-0005

Form type	Form title	Purpose	Reporting timeframe	Applicable for oil spills in				Document reference (Coreworx, DMS or URL)
				Darwin Harbour	NT	WA	Cwlth Waters	
	Telephone call record	Record all phone calls, both incoming and outgoing, particularly those to and from government agencies, external support agencies, employees' families, etc. (Individual form optional for IMT Carbon copy incident log books also available)	Ongoing during emergency	✓	✓	✓	✓	C020-AG-FRM-0007
	Dispersant Activity Log	To be completed by vessel master (for dispersant applied by vessel) or by an aerial observer (for dispersant applied by aircraft) (Field personnel to prepare)	Ongoing during emergency	✓	✓	✓	✓	C075-AH-LOG-10000
Situational Awareness	Oil Spill Observation and Visual Dispersant Guide for Aircraft and Vessels	Provide guidance to vessel and aircraft operators on how to identify oil spills; record their location; estimate the oil thickness, quantity of oil and area affected; look for colour changes to oil once dispersant has been applied and assess effectiveness; instructions to take photos or video footage; and reporting protocols. (Field personnel to prepare)	Ongoing during emergency	✓	✓	✓	✓	0000-AH-GLN-60054
	Shoreline clean-up and assessment technique (SCAT)	Assess the state of the shoreline or commonwealth shoals (i.e. Carter Island, Ashmore Reef) should a spill make contact (or if there is a significant threat of a spill making contact) (Field personnel to prepare).	Prior to shoreline contact (i.e. <12-24 hrs) Ongoing until termination	✓	✓	✓	✓	C020-AG-FRM-0012
Modelling	RPS Search & Rescue request form	Search & request form to activate RPS to conduct trajectory modelling under Contract # 800767 (IMT Environment to request)	Info only	NA	NA	NA	NA	C075-AH-FRM-10001
	RPS Oil Spill Modelling Response Procedures and Interpret Subsequent Results	Procedure: How to Activate RPS Oil Spill Modelling Response Procedures and Interpret Subsequent Results (info only)	Info only	NA	NA	NA	NA	PER-2153332031

Form type	Form title	Purpose	Reporting timeframe	Applicable for oil spills in				Document reference (Coreworx, DMS or URL)
				Darwin Harbour	NT	WA	Cwlth Waters	
	RPS oil spill trajectory modelling request form	Modelling request form to activate RPS to conduct oil spill trajectory modelling under Contract # 800767 (IMT Environment to request)	< 2 hrs	✓	✓	✓	✓	C020-AG-FRM-0015
	RPS oil spill trajectory model update form	Update of oil-spill trajectory to RPS (IMT Environmental to request)	Daily	✓	✓	✓	✓	PER-2153332031
	RPS Gas or Vapour Plume Modelling request form	Modelling request form to activate RPS to conduct gas and vapour modelling under Contract # 800767 (IMT HS Officer to request)	< 2 hrs	✓	✓	✓	✓	C075-AH-FRM-10003
	RPS Chemical Spill Trajectory Modelling Request Form	Modelling request form to activate RPS to conduct chemical spill trajectory modelling under Contract # 800767 (IMT Environmental to request)	< 2 hrs	✓	✓	✓	✓	C075-AH-FRM-10004
AMOSC/OSRL	AMOSC mobilisation and authorisation form	In order to mobilise AMOSC, a service contract must be completed by the IMT Leader to identify AMOSC requirements for equipment, consumables, personnel, advice and estimated duration. (IMT Leader to sign)	> Level 2 incident	✓	✓	✓	✓	NA
	OSRL notification form	To notify Oil Spill Response Limited of an incident that may requires support under the terms of the Agreement (ORSL #129). (IMT Environmental to request)	> Level 2 incident	✓	✓	✓	✓	C075-AH-FRM-10005
	OSRL mobilisation form	To authorise activation of Oil Spill Response Limited and its resources in connection with an incident under the terms of the Agreement (ORSL #129). (IMT Environmental to request)	> Level 2 incident	✓	✓	✓	✓	C075-AH-FRM-10006

Form type	Form title	Purpose	Reporting timeframe	Applicable for oil spills in				Document reference (Coreworx, DMS or URL)
				Darwin Harbour	NT	WA	Cwlth Waters	
Wildlife Permit	Permit to interfere with EPBC listed species	General permit application for interfering with threatened species and ecological communities, migratory species, whales and dolphins and listed marine species. (IMT Environmental to prepare)	As required	NA	NA	NA	✓	C075-AH-FRM-10010
	Wildlife Status and Situation Report	To record situation of wildlife found, whether they are alive (or dead) and if they have been (or are planned to be) cleaned and/or released. (IMT Environmental to prepare)	As required			✓	✓	Appendix J of C075-AH-REP-10086 (WA Oiled Wildlife Response Plan)
	Wildlife Rescue & Release Form	This form is to accompany any live oiled wildlife from the time it is rescued until it is released or euthanized. The form should record each time an animal is cleaned, transported etc and any general observations (of improvement, decline) made during its rehabilitation. (IMT Environmental to prepare)	As required, per oiled wildlife			✓	✓	Appendix J of C075-AH-REP-10086 (WA Oiled Wildlife Response Plan)
	Fauna Admission Form (Vet to complete)	This form is to be used to when admitting the oiled wildlife to a veterinary clinic. (Vet to prepare)	As required, per oiled wildlife admitted to vet			✓	✓	Appendix J of C075-AH-REP-10086 (WA Oiled Wildlife Response Plan)
WA DoT Cross Jurisdiction Spill	IMT Handover Checklist (cross jurisdictional arrangements)	For use by IPX IMT-Leader, to check handover of relevant incident information to WA DoT IMT-Leader, when INPEX spill moved into WA Waters				✓		PER-2153261255
	IMT Functions and Lead IMT Designations (cross jurisdictional arrangements)	For use by IPX IMT-Leader, and WA DoT IMT-Leader, to define each IMT 'lead' roles, when INPEX spill moved into WA State waters and a cross jurisdictional spill response is underway.				✓		PER-2153261254

6 References

AMOSC–see Australian Marine Oil Spill Centre.

AMSA—see Australian Maritime Safety Authority.

AMSA and INPEX—see Australian Maritime Safety Authority and INPEX Operations Australia Pty. Ltd.

ANZG—see Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand.

APASA—see Asia-Pacific Applied Science Associates.

Asia-Pacific Applied Science Associates (APASA). 2014a. *INPEX Ichthys Gap Analysis EP – OSC14.* J0312, Rev 0. Report prepared by RPS Asia-Pacific Applied Science Associates, Perth, for INPEX Browse, Ltd., Perth, Western Australia.

Asia-Pacific Applied Science Associates (APASA). 2014b. *INPEX Ichthys Gap Analysis EP – OSC31.* J0312, Rev 0. Report prepared by RPS Asia-Pacific Applied Science Associates, Perth, for INPEX Browse, Ltd., Perth, Western Australia.

Australian and New Zealand Guidelines for Fresh and Marine Water Quality. 2018. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Accessed online 01/02/2020 at www.waterquality.gov.au/anz-guidelines

Australian Marine Oil Spill Centre. 2019. *Northern Territory Oiled Wildlife Response Plan*. Australian Marine Oil Spill Centre, Geelong, Victoria.

Australian Maritime Safety Authority. 2010. Montara Well Release Monitoring Study S7.2 Oil Fate and Effects Assessment Modelling of Chemical Dispersant Operation. Prepared for: PTTEP Australasia. 4th October 2010

Australian Maritime Safety Authority. 2018. *National Plan Guidance on: Marine Oil Spill Response Health and Safety.* Reference NP-GUI-026. Australian Maritime Safety Authority, Canberra, Australian Capital Territory.

Australian Maritime Safety Authority. 2019. National plan for maritime environmental emergencies. Australian Maritime Safety Authority, Canberra, ACT. Viewed online on 03 March 2020 at https://www.amsa.gov.au/sites/default/files/amsa-496-national-plan.pdf.

Australian Maritime Safety Authority. 2015. *Fixed Wing Aerial Dispersant Capability Joint Standard Operating Procedures*. Version 1.2. Australian Maritime Safety Authority, Canberra, Australian Capital Territory.

Australian Maritime Safety Authority and INPEX Operations Australia Pty. Ltd. 2013. Memorandum of Understanding between the Australian Maritime Safety Authority and INPEX Operations Australia Pty. Ltd. (ABN 48 150 217 262) on support for oil spill preparedness and response. INPEX document number C091-IPX-ARA-ME-00001. Document prepared and signed by the Australian Maritime Safety Authority and INPEX Operations Australia Pty. Ltd., Perth, Western Australia.

Commonwealth Scientific and Industry Research Organisation. 2016. *Oil spill monitoring handbook*. CSIRO Publishing, Clayton South, Victoria.

Department of the Environment and Energy. 2017. *Recovery plan for marine turtles in Australia, Commonwealth of Australia 2017*. Department of Environment and Energy, Canberra, ACT.

Department of Parks and Wildlife and Australian Marine Oil Spill Centre. 2014. *Western Australian Oiled Wildlife Response Plan*. Department of Parks and Wildlife, Perth, Western Australia.

Department of Parks and Wildlife and Australian Marine Oil Spill Centre. 2015. *West Kimberley Region Oiled Wildlife Response Plan*. Version 1.1. Department of Parks and Wildlife, Perth, Western Australia, and Australian Marine Oil Spill Centre, Canberra, ACT.

DPaW—see Department of Parks and Wildlife.

DPaW and AMOSC–see Department of Parks and Wildlife and Australian Marine Oil Spill Centre.

Ecosystem Management and Associates. 2008. Criteria for evaluating oil spill planning and response operations. A report to IUCN, The World Conservation Union. Report 07-02. Lusby, Maryland.

Fingas. 2012. *The Basics of Oil Spill Cleanup* – Third Edition. CRC Press.

French-McCay, D. 2009. *State-of-the-art and research needs for oil spill impact assessment modelling*. pp. 601–653 in Proceedings of the 32nd AMOP Technical Seminar on Environmental Contamination and Response, Emergencies Science Division, Environment Canada, Ottawa, ON, Canada.

Gaskill, M. 2010. Turtle rescue plan succeeds. Nature. Viewed online on 03 March 2020 at https://www.nature.com/news/2010/101008/full/news.2010.528.html

Gyuris E. 1993. *The rate of predation by fishes on hatchlings of the green turtle* (Chelonia mydas). Zoology Department, James Cook University of North Queensland, Townsville, Australia.

ITOPF—see International Tanker Owners Pollution Federation Limited

International Tanker Owners Pollution Federation Limited. 2002. *Termination of shoreline cleanup – A technical perspective.* International Tanker Owners Pollution Federation Limited, London, United Kingdom.

International Tanker Owners Pollution Federation Limited. 2011. *Clean-up of oil from shorelines*. Technical Information Paper 7. International Tanker Owners Pollution Federation Limited, London, United Kingdom.

International Tanker Owners Pollution Federation Limited (ITOPF). 2013. Technical Information Paper (TIP) 04: *Use of Dispersants to Treat Oil Spills*. London. UK.

International Tanker Owners Pollution Federation Limited (ITOPF). 2013. Technical Information Paper (TIP) 04: *Use of Dispersants to Treat Oil Spills*. London. UK.

International Petroleum Industry Environmental Conservation Association. 2015a. A guide to oiled shoreline clean-up techniques. IPIECA-IOGP Good Practice Guide Series, Oil Spill Response Joint Industry Project. IOGP report 521. International Petroleum Industry Conservation Association, London, United Kingdom.

International Petroleum Industry Environmental Conservation Association. 2015b. At sea containment and recovery. IPIECA-IOGP Good Practice Guide Series, Oil Spill Response Joint Industry Project. IOGP report 522. International Petroleum Industry Conservation Association, London, United Kingdom.

International Petroleum Industry Environmental Conservation Association. 2015c. Dispersants: surface application. IPIECA-IOGP Good Practice Guide Series, Oil Spill Response Joint Industry Project. IOGP report 532. International Petroleum Industry Conservation Association, London, United Kingdom.

International Petroleum Industry Environmental Conservation Association. 2017. Key principles for the protection, care and rehabilitation of oiled wildlife. IPIECA-IOGP Good Practice Guide Series, Oil Spill Response Joint Industry Project (OSR-JIP). IOGP report 583. International Petroleum Industry Conservation Association, London, United Kingdom.

Ohlendorf, H.M., Risebrough R.W. and Vermeer, K. 1978. *Exposure of Marine Birds to Environmental Pollutants,* Report 9. U.S. Fish and Wildlife Service. Patuxent Wildlife Research Centre. Washington.

Pilcher N.J., and Enderby. S. 2001. Effects of prolonged retention in hatcheries of green turtle (Chelonia mydas) hatchling swimming speed and survival. *Journal of Herpetology*. 35(4): 633–638.

RPS APASA. 2014. INPEX – Ichthys GEP Vessel Spills – Dispersant Application Modelling Study. Job Ref# J0293. Report prepared by RPS APASA for INPEX Operations Australia, Perth, Western Australia.

Samuels, W.B. and Lanfear K.J. 1982. Simulations of seabird damage and recovery from oil spills in the northern gulf of Alaska. *Journal of Environmental Management,* 15: 169–182.

Seip, K.L., Sandersen, E., Mehlum, F. and Ryssdel, J. 1991. Damages to seabirds from oil spills: comparing simulation results and vulnerability indexes*. Ecological Modelling*, 53: 39–59.

Sell, D., Conway, L., Clark, T., Picken, G.B., Baker, J.M., Dunnet, G.M. 1995. Scientific criteria to optimize oil spill cleanup. *International Oil Spill Conference Proceedings* 1:595-610.

WA DoT—see Western Australian Department of Transport.

Waples, K. Field, S. Kendrick, A. Johnston, A. and Twomey, L. 2019. *Strategic Integrated Marine Science for the Kimberley Region: Kimberley Marine Research Program Synthesis Report 2012 – 2018.* Prepared by the Western Australian Marine Science Institution, Perth Western Australia.

Warne, M.S., Batley, G.E., van Dam, R.A., Chapman, J.C., Fox, D.R., Hickey, C.W. and Stauber, J.L. 2018. *Revised Method for Deriving Australian and New Zealand Water Quality Guideline Values for Toxicants – update of 2015 version*. Australian and New Zealand Governments and Australian State and Territory Governments, Canberra, ACT.

Western Australian Department of Transport. 2018. *State Hazard Plan Maritime Environmental Emergencies*. Prepared by Western Australian Department of Transport, Perth, for the State Emergency Management Committee, Perth, Western Australia.

APPENDIX A: OPERATIONAL AND SCIENTIFIC MONITORING PROGRAM

The decision-making process for termination of the OM and SM is undertaken by the INPEX IMT Leader, in consultation with AMOSC and the designated ESP. In addition, relevant jurisdictional agencies, including AMSA, WA DoT and WA DBCA (via WA DoT), as relevant to the nature and scale of the spill, will be consulted.

The termination decision-making process includes the following steps:

- Step 1: Review the data collected by the OM and SM against the OM and SM objectives.
- Step 2: Evaluate whether the OM and SM objectives have been achieved and provide the evaluation to the INPEX IMT Leader.
- Step 3: Reach agreement with the INPEX IMT Leader that the termination criteria have been satisfied.
- Step 4: Sign-off for termination of the OM and SM by the INPEX IMT Leader.

Code	Title	Aim of the plan	Key objectives	Activation triggers	Termination criteria	Mobilisation time	Service provider
OM01	Oil Spill Trajectory Modelling	To use computer-based forecasting methods to predict oil-spill movement and guide the management and execution of oil spill response strategies to maximise the protection of environmental and other resources at risk.	Provide forecasting of the movement and weathering of spilled oil (and oil with dispersant applied, where applicable). Assist in identifying values and sensitivities that are at risk of contamination.	All Level 2 and Level 3 spills	The oil discharge has ceased and spill modelling outputs (as verified by OM03, OM04 and OM06, where applicable) show no additional values and sensitivities are at risk of oil spill contact.	<2 hours	Oil spill modelling provider (Refer to Table 5-1).
OM03	Oil Spill Surveillance and Reconnaissance	To provide regular, ongoing oil spill surveillance in the event of a spill (aerial, vessel, satellite imagery, oil spill tracking buoys), as appropriate. Identify key breeding/ aggregation/ foraging areas for wildlife groups that may be at risk from the oil spill.	To assess the colour, consistency, distribution and locations of the surface slick. To identify values and sensitivities likely to be impacted by the spill.	All Level 2 and Level 3 spills	Upon completion of the oil spill response operations (Refer to Section 4.5) AND Spill surveillance indicates (and is supported by OM01 outputs) no additional values and sensitivities are at risk of oil spill contact.	<48 hours	Aircraft providers Vessel providers AMOSC/OSRL satellite imagery provider INPEX oil spill tracking buoys.
OM04	Operational Monitoring of Oil Properties, Behaviour and Weathering at Sea	To provide in-field information on the properties, behaviour, extent and weathering of the spilled oil.	Establish the case-specific situation for the released oil, including: • surface and subsurface extent • density • viscosity • wax and asphaltene content • water content (as water-in-oil emulsion)	All Level 2 and Level 3 spills	Monitoring of the evolution of the oil properties indicates that the released oil has undergone weathering to reach a steady weathered state*.	Preparation to deploy field personnel and equipment will commence on notification from INPEX that this OM has been triggered. Deployment of field personnel and equipment into the field within 7 days of receipt of notification.	Environmental service provider under contract for duration of activities. NATA laboratory for sample analysis.

Code	Title	Aim of the plan	Key objectives	Activation triggers	Termination criteria	Mobilisation time	Service provider
			• proportion of residual hydrocarbons over time • proportion of volatile hydrocarbons • proportion of soluble hydrocarbons. Monitor the evolution of these oil properties through time and assess the rate of their reduction or increase.		*Steady weathered state is defined as <10% change in percentage of mass for weathering processes for 3 consecutive days (measured weathering rates compared with weathering curves for the spilled product, generated through the US National Oceanic and Atmospheric Administration (NOAA) oil spill weathering model ADIOS).		
OM05	Pre-emptive Desktop Assessment of Sensitive Resources	To undertake a rapid desktop assessment of the broad character and ecological integrity of sensitive receptors at risk of impact from a moving oil slick.	Undertake a desktop assessment, to obtain all relevant information in relation to the values and sensitivities that may be affected by the spill. Note: Values and sensitivities for OM05 are defined as those described in Section 4 of the EP, including islands, reefs, shoals and banks, and areas of conservation significance, and BIAs associated with MNES.	All Level 2 and Level 3 spills.	Completion of the desktop assessment of values and sensitivities that were identified by Operational Monitoring (OM01, OM03, OM04 and OM06) as being potentially impacted or contacted by the oil spill.	24 hours	Environmental service provider under contract for duration of activities.
OM06	Assessment of the Presence and Quantity of Petroleum Hydrocarbons in Water and Sediments	To provide a rapid assessment of the presence, type, quantity and character of hydrocarbons in the water and marine sediments to assess the extent of the impact and verify impact predictions for other monitoring plans.	Detect the presence of oil and oil-derived (petrogenic) hydrocarbons in the water column and marine sediments. Determine, if possible, the source of these (i.e. the slick or some other sources). Determine the spatial and temporal distribution of the hydrocarbons. Distinguish between petrogenic and non-petrogenic (natural background) hydrocarbons that are present. Determine the concentrations of the hydrocarbons. Benchmark the level of individual hydrocarbons against trigger levels of concern for aquatic life and human health.	All Level 2 and Level 3 spills	Upon completion of the oil spill response OR Rapid assessment of the hydrocarbons in water and marine sediments has been completed and the operational monitoring has been superseded by relevant SM programs.	Preparation to deploy field personnel and equipment will commence on notification from INPEX that this OM has been triggered. Deployment of field personnel and equipment into the field within 7 days of receipt of notification.	Environmental service provider under contract for duration of activities.

Code	Title	Aim of the plan	Key objectives	Activation triggers	Termination criteria	Mobilisation time	Service provider
SM02	Detailed Characterisation of the Oil Properties and Ecotoxicological Assessment	To provide a toxicological assessment of the spilled oils. To assess the risks posed by short-term exposure (acute effects) or longer term exposure (chronic effects), or both, to potentially impacted values and sensitivities.	Determine the chemical characteristics of the spilled oil throughout a spill response and the character of residual oils as they continue to weather, post-response. Determine the potential adverse effects on values and sensitivities of exposure to fresh, weathered and chemically dispersed oil, based on the chemical and physical character of the oil.	Other scientific monitoring programs are triggered that require information on the ecotoxicity of hydrocarbons in the water column and sediments (SM07, SM08, SM10, SM11 and SM12).	Laboratory results have defined the chemical characteristics of fresh and weathered oil (which has reached a steady weathered state, as defined in OM04); AND Results have provided contextual information for the potential adverse effects on values and sensitivities exposed to be quantified.	Laboratory testing only; using water and sediment samples collected from OM04, SM05 and SM06.	Environmental service provider under contract for duration of activities.
SM04	Impact of Dispersant Operations	To determine and quantify the impacts of dispersant operations on values and sensitivities.	Monitor the initial and longer term spatial and temporal distribution, concentration, and breakdown (fate) of dispersed oil to determine the potential acute and chronic exposures of values and sensitivities to dispersed oil.	When any chemical dispersants are applied to an oil spill.	Monitoring results have determined the spatial and temporal distribution, persistence and fate of dispersed oil and indicate no further shoreline, intertidal or shallow subtidal receptors will be contacted; AND Monitoring results have quantified the potential acute and chronic exposures of values and sensitivities to dispersed oil.	Preparation to deploy field personnel and equipment will commence on notification from INPEX that the SM has been triggered. Deployment of field personnel and equipment into the field within 7 days of receipt of notification.	Environmental service provider under contract for duration of activities.

Code	Title	Aim of the plan	Key objectives	Activation triggers	Termination criteria	Mobilisation time	Service provider
SM05	Monitoring for Hydrocarbons in Marine Waters	To quantify presence and extent, as well as the longer term weathering, persistence and toxicity of hydrocarbon compounds in marine waters, and to assess and verify predicted impacts on values and sensitivities for other SM.	Quantify the temporal and spatial distribution and concentration of hydrocarbon compounds in marine waters in relation to background or reference levels, e.g. ANZG (2018) Determine the sources of any identified hydrocarbons in the water column, e.g. natural, pyrogenic, or petrogenic spill sources. Provide samples to enable toxicity of the hydrocarbon compounds in marine waters to be assessed under SM02.	All Level 2 and Level 3 spills from subsea production system OR For surface spills, OM indicates oil contact within 2 km of a shallow, subtidal (–30 m LAT or above) or intertidal location or BIAs associated with MNES; OR Other Scientific Monitoring programs (SM07, SM08, SM09, SM10, SM11 and SM12) are triggered that require information on the presence, extent and toxicity or persistence of hydrocarbons in the water column.	Monitoring results have confirmed the temporal and spatial distribution, concentration and source of hydrocarbons in the water column; AND OM indicates no further values and sensitivities are likely to be contacted; AND Monitoring results have determined petrogenic hydrocarbon concentrations in marine waters are consistent with background or reference levels e.g. ANZG (2018); AND Water samples have been provided for SM02.	Preparation to deploy field personnel and equipment will commence on notification from INPEX that the SM has been triggered. Mobilisation of field personnel and equipment within 7 days of receipt of notification.	Environmental service provider under contract for duration of activities.
SM06	Monitoring for Hydrocarbons in Subtidal and Intertidal Sediments	To understand the behaviour, persistence and fate of hydrocarbons in sediments to provide data to assist in assessing and verifying predicted impacts on key habitats and sensitive receptors.	Determine the distribution (spatial and temporal extent) of oil in shallow, subtidal and intertidal sediments in relation to background or reference levels, e.g. ANZG (2018) Determine the sources of any identified hydrocarbons in sediment, e.g. natural, pyrogenic or petrogenic spill sources. Provide samples to enable toxicity of the hydrocarbon compounds in marine sediments to be assessed under SM02.	All Level 2 and Level 3 spills from subsea production system; OR For surface spills, OM indicates oil contact within 2 km of a shallow, subtidal (–30 m LAT or above) or intertidal location; OR Other Scientific Monitoring programs (SM07, SM08, SM12) are triggered that require information on the presence, extent and toxicity or persistence of hydrocarbons in benthic sediments.	Monitoring results have confirmed the temporal and spatial distribution, concentration and source of hydrocarbons in the sediments; AND OM indicates no further values and sensitivities are likely to be contacted; AND Monitoring results have determined petrogenic hydrocarbon concentrations in sediments are consistent with background or reference levels e.g. ANZG (2018); AND Sediment samples have been provided for SM02.	Preparation to deploy field personnel and equipment will commence on notification from INPEX that the SM has been triggered. Mobilisation of field personnel and equipment within 7 days of receipt of notification.	Environmental service provider under contract for duration of activities.

Code	Title	Aim of the plan	Key objectives	Activation triggers	Termination criteria	Mobilisation time	Service provider
SM07	Monitoring of Shoreline and Intertidal Benthos to Determine Impacts of Oil Spill and Recovery	To determine and monitor the potential impact of a hydrocarbon spill or response activities and recovery of intertidal benthos and associated organisms.	Collect quantitative data on intertidal habitats and organisms that are at risk from, or have been exposed to, oil and/or dispersant and activities. Detect and quantify lethal or sublethal impacts of the spill on intertidal habitats and organisms and monitor recovery to baseline or reference levels.	OM indicates oil contact within 2 km of an intertidal location where sensitive organisms are known to occur.	Impacts to shoreline and intertidal benthos have been quantified and monitoring results indicate no further shoreline and intertidal coastal habitats and organisms are at risk from, or have been exposed to, oil and/or dispersant; AND Impacted intertidal benthos indicators have returned to baseline or reference levels.	Preparation to deploy field personnel and equipment will commence on notification from INPEX that the SM has been triggered. Mobilisation of field personnel and equipment within 7 days of receipt of notification.	Environmental service provider under contract for duration of activities.
SM08	Monitoring of Subtidal Marine Benthos to Determine Impacts of Oil Spill and Recovery	To determine and monitor the potential impact of a hydrocarbon spill or response activities and recovery of shallow, subtidal benthos and associated organisms.	Collect quantitative data on shallow subtidal habitats and organisms that are at risk from, or have been exposed to, oil and/or dispersant and activities. Detect and quantify lethal or sublethal impacts of the spill on intertidal habitats and organisms and monitor recovery to baseline or reference levels.	All Level 2 and Level 3 spills from subsea production system; OR For surface spills, OM indicates oil contact within 2 km of a shallow, subtidal (–30 m LAT or above) location where sensitive organisms are known to occur.	Impacts to shallow, subtidal benthos have been quantified and monitoring results indicate no further shallow subtidal benthos and organisms are at risk from, or have been exposed to, oil and/or dispersant; AND Impacted subtidal benthos indicators have returned to baseline or reference levels.	Preparation to deploy field personnel and equipment will commence on notification from INPEX that the SM has been triggered. Mobilisation of field personnel and equipment within 7 days of receipt of notification.	Environmental Service Provider under contract for duration of activities.
SM09	Determine Impacts of Oil Spill on Plankton Populations and Recovery	To investigate the possible scale of impacts to plankton and the degree to which hydrocarbons may accumulate in populations as a result of a spill event.	Quantify plankton in the vicinity of a spill and at reference sites in the wider region. Determine if there are oil-derived hydrocarbons in plankton. Evaluate the potential for impacts to plankton by the oil spill or response activities. If possible, detect and quantify lethal and, where appropriate, sublethal effects to plankton.	There is a plankton community in the spill vicinity (identified during the course of remote sensing undertaken in OM03) that is likely to support the regionally important natural or commercial resources in the area, or is an important source of recruitment for plankton communities; AND The nature (composition) and magnitude of the spill (volume, area of impact, components, etc.) are sufficient to present a significant risk of exposure and lethal impacts to plankton communities (identified in OM03); OR Use of dispersants in proximity to plankton communities identified above; OR	Plankton communities in the vicinity the spill and at reference sites in the wider region have been quantified. Oil-derived hydrocarbon presence in plankton has been determined. Impacts to plankton by the oil spill or response activities have been evaluated. Lethal and sublethal effects to plankton have been quantified.	Preparation to deploy field personnel and equipment will commence on notification from INPEX that the SM has been triggered. Mobilisation of field personnel and equipment within 7 days of receipt of notification.	Environmental Service Provider under contract for duration of activities.

Code	Title	Aim of the plan	Key objectives	Activation triggers	Termination criteria	Mobilisation time	Service provider
				A mass spawning event has taken place or is likely to occur within the area of impact.			
SM10	Determine Impact of Oil Spill on Seabirds and Shorebird Populations and Recovery	To assess potential impacts on seabird and shorebird populations within the marine avifauna BIAs, or populations identified by OM01 and/or OM03, which may have been affected by the oil spill or response activities.	Quantify and assess potential impacts to seabirds and coastal bird populations (in particular known breeding colonies) by the spill, and associated response activities, including abundance, mortality, sublethal effects, sickness and oiling. Determine whether oil or response activities were the cause of observed impacts. Monitor the recovery of key behaviour and breeding activities of seabirds and coastal bird populations over time, with regard to reference or baseline levels. Provide information to feed into any restoration or remediation activities that need to be implemented for marine avifauna.	OM indicates oil contact within 2 km of an intertidal location or within a marine avifauna BIA; OR Likely spill contact with any other identified marine avifauna population.	Monitoring results have quantified the lethal or sublethal impacts to seabirds and shorebirds as a result of the oil spill and indicate no new populations are at risk from, or have been exposed to, oil or response activities; AND Key seabird and shorebird behaviour and breeding activities or habitat have been measured and are comparable to baseline or reference levels.	Preparation to deploy field personnel and equipment will commence on notification from INPEX that the SM has been triggered. Mobilisation of field personnel and equipment within 7 days of receipt of notification.	Environmental Service Provider under contract for duration of activities.
SM11	Determine Impact of Oil Spill on Non-Avian Marine Megafauna and Recovery	To assess potential impacts on non-avian marine megafauna within their relevant BIAs, or populations identified by OM01 and/or OM03, which may have been affected by the oil spill or response activities.	Quantify and assess impacts of the spill and associated response activities on non-avian marine megafauna, including abundance, mortality, sublethal effects, sickness and oiling. Determine whether oil or response activities were the cause of observed impacts. Monitor the recovery of key behaviour and breeding activities of non-avian marine megafauna over time, with regard to baseline or reference levels. Provide information to feed into any restoration or remediation activities that need to be implemented for non-avian marine megafauna.	OM indicates oil contact within 2 km of an intertidal location or within a non-avian marine megafauna BIA; OR Likely spill contact with any other identified non-avian marine megafauna population.	Monitoring results have quantified the lethal or sublethal impacts to non-avian marine megafauna to the oil spill and indicate no new populations are at risk from, or have been exposed to, oil or response activities; AND Key non-avian marine megafauna behaviour and breeding activities or habitat have been measured and are comparable to baseline or reference levels.	Preparation to deploy field personnel and equipment will commence on notification from INPEX that the SM has been triggered. Mobilisation of field personnel and equipment within 7 days of receipt of notification.	Environmental Service Provider under contract for duration of activities.

Code	Title	Aim of the plan	Key objectives	Activation triggers	Termination criteria	Mobilisation time	Service provider
SM12	Determination of the Impact of the Oil Spill on Commercial, Traditional and Recreational Fisheries	To monitor potential impacts of the oil spill and response activities on commercial, traditional and recreational fisheries and subsequent recovery.	Determine the potential impacts of the oil spill and response activities on commercial, traditional and recreational fisheries and follow their recovery in relation to baseline or reference levels. Evaluate the type and severity of physiological or biochemical changes (as measured by biomarkers of fish health) in commercial, traditional and recreational fisheries species affected by the spill, including the identification of potential reproductive impairment. Determine whether oil or response activities were the cause of observed impacts.	For surface spills, OM indicates oil contact within 2 km of a shallow, subtidal (–30 m LAT or above) or intertidal location; OR For Level 2 and Level 3 spills from the subsea production system; AND OM predicts contact is possible to commercial, traditional or recreational fisheries species; OR Advice has been provided to government to restrict, ban or close a fishery. SM12 will commence to provide data for government to enable decisions to be made on when a fishery can be reopened; OR Declarations of intent by commercial fisheries or government agencies to seek compensation for alleged or possible damage.	Monitoring results have quantified the physiological or biochemical changes and sublethal impacts of the oil spill and clean-up methods on, commercial, traditional and recreational fisheries; AND Contamination in the edible portion or in the stomach/intestinal contents attributable to the spill is no longer detected; OR No differences are detected in commercial, traditional or recreational fisheries from reference levels; OR The physiological and biochemical parameters in the studied species have returned to baseline levels.	Preparation to deploy field personnel and equipment will commence on notification from INPEX that the SM has been triggered. Mobilisation of field personnel and equipment within 7 days of receipt of notification.	Environmental Service Provider under contract for duration of activities.

APPENDIX B: INPEX INCIDENT ACTION PLAN TEMPLATE (PER-2153316130)

INPEX – Incident Action Plan				
IAP Sequence #		IAP Issue Date / Time		
Incident Name		Operational Period		
	From		to	
IAP Developer - *Planning Function Lead*		IAP Approver - *IMT Leader*		
Mission Statement	*Responsible: IMT Leader*			

Situation	*Responsible: IMT Leader/Operations* *Information from: Incident Status Board*
Incident Level:	
Incident Location	
Status:	*Is incident contained, escalating, under control*
Incident Commenced	*Time /Date*
Incident Commander Contact Details:	
Brief Description of Incident	
Actions Completed	
Current Situation	
Actions Underway	
Predicted Situation *(at end of operational period)*	

Safety Message / Risks	*Responsible: H&S Advisor*
Key message to prevent further injury or hazard exposure for responders plus key risk areas over the operational period	

	Ref	**People**	*Ref*	**Environment**	*Ref*	**Assets**	*Ref*	**Reputation**	*Ref*	**Sustainability**
Incident Objectives	*PO 1*		*EO 1*		*AO 1*		*RO 1*		*SO 1*	
	PO 2		*EO 2*		*AO 2*		*RO 2*		*SO 2*	
	P0 3		*EO 3*		*AO 3*		*RO 3*		*SO 3*	
	PO 4		*EO 4*		*AO 4*		*RO 4*		*SO 4*	
Strategies	*PO1*		*EO 1*		*AO 1*		*RO 1*		*SO 1*	
							RO 2		*SO 2*	
			EO 2		*AO 2*					
	PO2									
	PO3									

Tasks		IMT Function responsible		IMT Function responsible		IMT Function responsible		IMT Function responsible		IMT Function responsible

Resources	*Responsible:* *Logistics Function*	*Information from:* *Resources Summary Board*
A summary of resources required and being used during Operational period ETD and ETA are to be included.		
Medical Plan	*Responsible:* *HR Function*	*Information from:* *Medical Planning Board*
A summary of casualties, medevacs and medical facilities		
Communications Plan	*Responsible:* *IMT Leader (EA&JV Function can assist if activated by P-CMT Leader)*	*Information from:* *Stakeholder Management Board*
A summary of key stakeholder deadlines and planned engagements or updates required during Operational Period		
Key Timings	*Responsible:* *IMT Leader/Planning*	
A summary of key timings within this Operational Period such as next IMT Update Briefing, Shift Change, etc.		
Administration	*Responsible:* *All*	
Additional specialist functions activated to support incident management. *A summary of administrative arrangements such as feeding, accommodation, security, travel etc.*		

Appendix E
Strategic Spill Impact Assessment

X060-AH-LIS-60032 Spill Impact Mitigation Assessment Surface Diesel Release

Location	N/W WA and NT Waters	Spill Scenario	<500m³ Marine Diesel Instantaneous Surface Release

Resource Compartment (including values dependent on the resource compartment)	SIMA Stage 2: Predict Outcomes – Potential Relative Impact – No Intervention (natural weathering)		SIMA Stage 3: Balance Trade-Offs - Impact Modification Factors – Prediction of the effectiveness and impact modification potential of the response options: Contain and Recover		Protect and Deflect		Shoreline Clean-up		Chemical Dispersant (near spill location)		Pre-Contact Wildlife Response (Hazing & Translocation)		Post Contact Wildlife Response		In-situ Burn (near spill location)	Operational monitoring and evaluation
		A	B1	A x B1	B2	A x B2	B3	A x B3	B4	A x B4	B5	A x B5	B6	A x B6		
Subtidal Benthic Communities															In-situ is not considered to be safe, effective or feasible.	Operational monitoring and evaluation is implemented under all oil spill scenarios
Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging within this habitat)	Moderate	3	1	3	0	0	0	0	-1	-3	0	0	0	0		
Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)	None / Insignificant	1	0	0	0	0	0	0	0	0	0	0	0	0		
Deep-sea unconsolidated muds and sands	None / Insignificant	1	0	0	0	0	0	0	0	0	0	0	0	0		
Intertidal seabed																
Intertidal Coral Reef	Moderate	3	1	3	-2	-6	-1	-3	-1	-3	0	0	0	0		
Mangrove/Mudflats/Samphires	Minor	2	1	2	-1	-2	-1	-2	-1	-2	0	0	0	0		
Sandy Beach	Minor	2	1	2	1	2	1	2	-1	-2	0	0	0	0		
Rocky Shoreline	Minor	2	1	2	1	2	1	2	-1	-2	0	0	0	0		
Macro-Algae and Seagrass	Minor	2	1	2	1	2	-1	-2	-1	-2	0	0	0	0		
Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)	Moderate	3	1	3	1	3	1	3	-1	-3	1	3	1	3		
Water column																
Lower water column (below photic zone)	None / Insignificant	1	0	0	0	0	0	0	0	0	0	0	0	0		
Upper water column (in photic zone, including plankton and EPBC foraging in the photic zone)	Minor	2	1	2	0	0	0	0	-1	-2	0	0	0	0		
Water surface, including foraging areas for EPBC listed species	Moderate	3	1	3	0	0	0	0	-1	-3	0	0	1	3		
Air	Minor	2	0	0	0	0	0	0	0	0	0	0	0	0		
Socio-economic																
Commercial demersal fisheries	None / Insignificant	1	0	0	0	0	0	0	0	0	0	0	0	0		
Shallow commercial fisheries (including aquaculture)	None / Insignificant	1	1	1	0	0	1	1	-1	-1	0	0	0	0		
Recreational fisheries	None / Insignificant	1	1	1	0	0	1	1	-1	-1	0	0	0	0		
Cultural heritage																
Aboriginal heritage (cultural practices, sites and fishing / foraging)	None / Insignificant	1	0	0	0	0	1	1	0	0	0	0	0	0		
Indonesian traditional fishing	None / Insignificant	1	1	1	0	0	1	1	-1	-1	0	0	0	0		
Total Impact Mitigation Score				25		1		4		-25		3		6	-	-
Carried to ALARP evaluation yes/no				Yes		Yes		Yes		No		Yes		Yes	No	Yes

Resource Compartment (including values dependent on the resource compartment)	No Intervention (natural weathering)		Justification for Potential Relative Impact Score
		A	
Subtidal Benthic Communities			
Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging within this habitat)	Moderate	3	Subtidal benthic primary producer habitat (BPPH) may be exposed to entrained/dissolved diesel above impact thresholds from a vessel collision in the Browse Basin. The effect of the toxic fractions of entrained/dissolved oil on intertidal coral includes partial mortality of colonies, reduced growth rates, bleaching, reduced photosynthesis, interruption of chemical communication necessary for mass spawning, premature explosion of larvae, decreased growth rates, decreased lipid content, decreased survival of larvae, decreased gonadal development, negative impacts to coral settlement, increased susceptibility to algae colonisation, epidemic diseases, localised tissue rupture, reduced reef resilience and mortality (Hayes et al 1992; Peters et al 1997; Negri & Heyward 2000; Shigenaka 2001; CSIRO 2016). WA DoT (2018) note that coral is sensitive to dissolved hydrocarbons as it causes toxicity at a cellular level. Corals accumulate oil from the water column (Pie et al 2015) making it biologically available to EPBC species foraging in this habitat. Seagrass and macroalgae may be subject to lethal or sublethal toxic effects, including mortality, reduced growth rates and impacts to seagrass flowering. BPPH is collectively considered to be an important resource as it supports a high biomass of fish, cetaceans and seabirds, including foraging EPBC species (DEWHA 2008). Several studies have indicated rapid recovery rates for seagrass and macroalgae may occur even in cases of heavy oil contamination (Connell et al, 1981; Burns et al. 1993; Dean et al. 1998; Runcie & Riddle 2006), but coral is sensitive to oil (and dispersants), making recovery from spills potentially slow (Guzman et al 1994). RPS (2019) modelling of a 250m3 MGO spill confirmed that at no point would dissolved oil exceed the 500 ppb impact threshold, limiting the potential for toxic effects from an MGO spill. Therefore, the consequence to benthic primary producer habitat is considered to be Moderate.
Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)	None / Insignificant	1	No impact from surface spill of diesel below 25m (RPS 2019).
Deep-sea unconsolidated muds and sands	None / Insignificant	1	No impact from surface spill of diesel below 25m (RPS 2019).
Intertidal seabed			
Intertidal Coral Reef	Moderate	3	Intertidal coral reefs could be impacted by surface fresh, weathered, entrained and dissolved diesel from a vessel collision in the Browse Basin. RPS (2019) modelling of a 250m3 MGO spill confirmed that at no point would dissolved oil exceed the 500 ppb impact threshold, limiting the potential for toxic effects from an MGO spill. The effect of diesel on intertidal coral is unlikely to result in significant smothering as diesel is expected to be weathered and in the form of waxy flakes/residues when it arrives in intertidal coral areas. In this form, toxicity is less than fresh diesel (Woodside 2014). The effect of the toxic fractions of entrained/dissolved oil on intertidal coral include partial mortality of colonies, reduced growth rates, bleaching, reduced photosynthesis, interruption of chemical communication necessary for mass spawning, premature explosion of larvae, decreased growth rates, decreased lipid content, decreased survival of larvae, decreased gonadal development, negative impacts to coral settlement, increased susceptibility to algae colonisation, epidemic diseases, localised tissue rupture, reduced reef resilience and mortality (Hayes et al 1992; Peters et al 1997; Negri & Heyward 2000; Shigenaka 2001; CSIRO 2016). WA DoT (2018) note that coral is sensitive to dissolved hydrocarbons as it causes toxicity at a cellular level. Coral reefs are found in isolated locations within the Browse Basin and are considered to be significant benthic primary producers that play a key role in the ecosystem and have an iconic status in the environment (WA DoT 2018). They are considered of high importance to EPBC species that aggregate, nest, roost and forage in the area, hence isolated populations could potentially be exposed in the event of a spill. As spills disperse, intertidal communities are expected to recover (Dean et al. 1998), though the rate of recovery of coral reefs depends on the level or intensity of the disturbance, with recovery rates ranging from 1 or 2 years, to decades (Fucik et al. 1984, French McCay 2009). Impact on the receptor is considered to be Moderate.
Mangrove/Mudflats/Samphires	Minor	2	Mangrove, mudflats and samphire communities may be exposed to entrained/dissolved diesel above impact thresholds from a vessel collision in the Browse Basin. RPS (2019) modelling of a 250m3 MGO spill confirmed that at no point would dissolved oil exceed the 500 ppb impact threshold, limiting the potential for toxic effects from an MGO spill. Given that mangrove habitats are remote from permit areas, fresh or weathered diesel (both surface and entrained) are unlikely to reach this receptor. The potential effects of entrained and dissolved oil include defoliation and mortality of mangroves (Burns et al. 1993; Duke et al. 2000). Entrained and dissolved oil exposure is only likely to occur at isolated locations amongst a very large and generally contiguous population. The recovery of mangroves from shoreline oil accumulation can be a slow process, due to the long-term persistence of oil trapped in anoxic sediments and subsequent release into the water column (Burns et al. 1993). Any impacts to benthic habitats are expected to be localised and of short to medium term. The potential consequence is considered to be Minor.
Sandy Beach	Minor	2	Sandy beaches could be impacted by surface fresh, weathered, entrained and dissolved diesel from a vessel collision in the Browse Basin. RPS (2019) modelling of a 250m3 MGO spill confirmed that at no point would dissolved oil exceed the 500 ppb impact threshold, limiting the potential for toxic effects from an MGO spill. The effect of gradual accumulation of oil on the receptor could lead to harm including the increased prevalence of tumours in species (CSIRO 2016). Sandy beaches are the dominant shoreline habitat on offshore islands in the Browse Basin and are considered significant habitat for turtles and seabird nesting. Organisms such as polychaete worms, bivalves and crustaceans generally inhabit sandy beaches but the mobile nature of the sands generally limits diversity. These species provide a valuable food source for resident and migratory sea and shorebirds (DEC/MPRA 2005). Law et al (2011) note that when grain size is between 2 and 64 mm, beaches are not considered especially sensitive to oil spills as they are regularly cleaned by wave action and oil is generally not retained. Offshore island beaches of the Browse Basin are generally coarse grained, due to high wave energy. WA DoT (2018) assessed Kimberley sandy beaches and concluded that they are moderately ecologically sensitive and are moderately difficult to rehabilitate from an oil spill. The potential consequence is considered to be Minor.
Rocky Shoreline	Minor	2	Rocky shorelines could be impacted by surface fresh, weathered, entrained and dissolved diesel from a vessel collision in the Browse Basin. RPS (2019) modelling of a 250m3 MGO spill confirmed that at no point would dissolved oil exceed the 500 ppb impact threshold, limiting the potential for toxic effects from an MGO spill. This receptor is typically characterised as being a high wind and wave energy environment (CSIRO 2016). Diesel from a spill has the potential to coat the substrate or become stranded by receding tides – but incoming tides also have the potential to remove deposited diesel (Law et al 2011). CSIRO (2016) note that rocky shorelines are not considered sensitive environments, and IPIECA (2017) state that rocky shorelines generally have a diverse and productive intertidal community which are considered resilient to oil spills and short-term oil persistence. WA DoT (2018) note that rocky shorelines are the least susceptible of shoreline types to long term impacts from a spill of both floating and dissolved oil. As such, this receptor is not expected to have issues relating to recovery from an oil spill. The potential consequence for rocky shorelines is considered to be Minor.

Macro-Algae and Seagrass	Minor	2	Macroalgae and seagrass may be exposed to entrained and dissolved diesel above impact thresholds from a vessel collision in the Browse Basin. RPS (2019) modelling of a 250m3 MGO spill confirmed that at no point would dissolved oil exceed the 500 ppb impact threshold, limiting the potential for toxic effects from an MGO spill. This receptor is unlikely to come into contact with significant amounts of fresh floating surface hydrocarbons, but could potentially be exposed to weathered waxy flakes and residues. WA DoT (2018) note that dissolved oil causes more impacts to algae than floating oil, as it results in cellular level poisoning. The effect of subjecting seagrass and macroalgae to lethal or sublethal toxic effects of oil can result in mortality, reduced growth rates and impacts to seagrass flowering. Several studies have indicated rapid recovery rates may occur even in cases of heavy oil contamination (Connell et al, 1981; Burns et al. 1993; Dean et al. 1998; Runcie & Riddle 2006). Taylor and Rasheed (2011) reported that seagrass meadows were not significantly affected by an oil spill when compared to a non-impacted reference seagrass meadow. Macroalgae support diverse small invertebrates that are the principal food source for a number of inshore fish (WA DoT 2018). Seagrasses provide energy and nutrients for detrital grazing food webs (WA DoT 2018), act as a refuge for fish and invertebrates, and provide a food source for EPBC species such as dugongs and green turtles (DEC 2007). Therefore, the potential consequence is considered to be Minor.
Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)	Moderate	3	Intertidal habitat may be exposed to fresh, weathered, entrained and dissolved diesel above impact thresholds from a vessel collision in the Browse Basin. RPS (2019) modelling of a 250m3 MGO spill confirmed that at no point would dissolved oil exceed the 500 ppb impact threshold, limiting the potential for toxic effects from an MGO spill. The effect of diesel on this receptor can result in mortality or harm to benthic primary producers and organisms such as EPBC species that rely on these species for food, or rely on the habitat for nesting and roosting. IPIECA (2014) note that dehydration, gastrointestinal problems and anaemia are commonly found in oiled animals, causing potential long-term effects on reproductive success. They further note that the toxic effects of ingested oil generally impacts the liver, whilst volatile fumes damage lungs resulting in debilitating effects (IPIECA 2014). Oiled aquatic EPBC fauna can further suffer hypothermia, irritations, burns, respiratory problems and loss of waterproofing, leading to them moving onto land (i.e. away from their food source) where they have further difficulty thermoregulating and feeding (IPIECA 2017). Specifically, marine reptiles, including turtles and crocodiles can be exposed to hydrocarbons externally in intertidal areas through direct contact; or internally, by ingesting oil, consuming prey containing oil, or inhaling volatile compounds (Milton et al. 2003). Turtle hatchlings may be particularly vulnerable to toxicity and smothering, as they emerge from nests and make their way over the intertidal area to the water (AMSA 2015; Milton et al. 2003). Birds coated in hydrocarbons can suffer damage to external tissues including skin and eyes, as well as internal tissue irritation in their lungs and stomachs (AMSA 2015; WA DoT 2018). Toxic effects may also result where the product is ingested, either through birds' attempts to preen their feathers (Jenssen 1994; Matcott et al. 2019) or ingested as weathered waxy flakes/residues present on shorelines. There is the potential for short to medium term impacts; however, the overall population viability for any protected species would not be threatened from a vessel collision spill. The cumulative potential consequence is considered to be Moderate.
Water column			
Lower water column (below photic zone)	None / Insignificant	1	No impact from surface spill of diesel below 25m (RPS 2019).
Upper water column (in photic zone, including plankton and EPBC foraging in the photic zone)	Minor	2	The upper water column may be exposed to entrained and dissolved diesel above impact thresholds from a vessel collision in the Browse Basin. RPS (2019) modelling of a 250m3 MGO spill confirmed that at no point would dissolved oil exceed the 500 ppb impact threshold, limiting the potential for toxic effects from an MGO spill. The effect of entrained and dissolved oil on this receptor include chronic impacts to juvenile fish, larvae and planktonic organisms due to their sensitivity during these life stages, with the worst impacts predicted to occur in smaller species (WA DoT 2018). Whale sharks are filter feeders and are expected to be highly vulnerable to entrained hydrocarbons (Campagna et al 2011) with potential effects including damage to the liver and lining of the stomach and intestines, as well as toxic effects on embryos (Lee 2011). Marine mammals, marine reptiles and marine avifauna could also be impacted through entrained and dissolved hydrocarbon exposure, primarily through ingestion during foraging activities (AMSA 1998). The upper water column is considered to be very important habitat for EPBC species as a large number of BIAs for marine fauna are present in the Browse Basin. It is expected that the upper water column will recover quickly as a vessel collision spill is unlikely to cause significant or cumulative impacts. The consequence is considered to be Minor.
Water surface, including foraging areas for EPBC listed species	Moderate	3	The water surface may be exposed to fresh and weathered surface diesel above impact thresholds from a vessel collision in the Browse Basin. Fresh diesel and weathered waxy flakes/residues can impact marine mammals surfacing, as they are vulnerable to oil exposure. Blue whales and humpback whales (baleen whales), that filter-feed near the surface, could potentially ingest diesel. Spilled hydrocarbons may also foul the fibres of baleen whales impairing food gathering efficiency or fouling prey with hydrocarbons (AMSA 2015). Turtles can be exposed to hydrocarbons if they surface within the spill, resulting in direct contact with the skin, eyes, and other membranes, as well as the inhalation of vapours or ingestion (Milton et al. 2003). Floating oil is considered to impact reptiles more than entrained/dissolved oil because reptiles hold their breath underwater and are unlikely to directly ingest dissolved oil (WA DoT 2018). Other aspects of turtle behaviour, including a lack of avoidance behaviour, indiscriminate feeding in convergence zones, and large, pre dive inhalations, make them vulnerable to spilled oil (AMSA 2015). Hatchlings spend more time on the surface than older turtles, thus increasing the potential for contact with oil slicks (Milton et al. 2003). Aquatic migratory birds are among the most vulnerable and visible species to be affected by surface oil, with oil impacts frequently leading to long-term physiological changes potentially resulting in lower reproductive rates or survival rates (Fingas 2012). The probability of lethal effects is dependent on factors such as timing, location, oceanographic and weather patterns, and the movements of species that forage, feed, nest and inhabit that area (IPIECA 2014), the amount of time spent on the water surface as well as any oil avoidance behaviour (French-McCay 2009). Direct contact with surface hydrocarbons may break down the ability of plumage to maintain body heat, resulting in direct and indirect impacts such as hypothermia, dehydration, drowning and starvation (AMSA 2015; Matcott et al, 2019; Jenssen 1994; IPIECA 2014; ITOPF 2011). Birds resting at the sea surface or surface plunging can be impacted by oil resulting in damage to external tissues, including skin and eyes, and internal tissue irritation in lungs and stomachs (Clark 1984; WA DoT 2018). Toxic effects may also result where hydrocarbons are ingested, as birds attempt to preen their feathers (Jenssen 1994; Matcott et al. 2019). The water surface is considered an important receptor where EPBC listed species forage. It is expected to recover from oil impacts with time, and it is unlikely that there will be cumulative impacts through bioaccumulation up the food chain. The consequence is considered to be Moderate.
Air	Minor	2	Air may be exposed to fresh surface diesel above impact thresholds from a vessel collision in the Browse Basin. Surface oil may lead to high local concentrations of atmospheric volatiles that have the potential to cause harmful impacts to species such as cetaceans if inhaled. Turtles could also be affected by harmful vapours during pre-dive inhalations (Milton et al. 2003). The receptor is not considered to be sensitive, thus is expected to recover in a very short period of time, as the evaporated hydrocarbons are rapidly dispersed by the wind, and evaporation rapidly reduce with time as oil weathers and entrains. Only a very localised area, immediately above the freshest parts of the oil slick would be impacted by evaporating hydrocarbons. The potential consequence is considered to be Minor.

Socio-economic			
Commercial demersal fisheries	None / Insignificant	1	No impact to fish stocks deeper 25 metres (RPS 2019). Commercial demersal fisheries may be exposed to surface, weathered, entrained and dissolved diesel above impact thresholds from a vessel collision in the Browse Basin. RPS (2019) modelling of a 250m3 MGO spill confirmed that at no point would dissolved oil exceed the 500 ppb impact threshold, limiting the potential for toxic effects from an MGO spill. The effect of diesel on this receptor includes the ability to cause economic loss (through indirect loss of stock and perceived tainting of stock by oil) (WA DoT 2018), impede access to fishing areas from the implementation of an exclusion zone during a spill response; impact seafood quality and employment; plus negatively impact lines and nets (ITOPF 2011). The economic impact from an oil spill is dependent on the species being cultured, as species have different recovery rates. WA DoT (2018) note that dissolved oil will impact finfish, taking 6-8 years for fisheries to recover (due to the time it takes for hatchlings to reach maturity) (WA DoT 2018). This receptor is considered to be important, however a vessel collision spill is unlikely to cause significant impacts to demersal fisheries due to the shallow and localised entrained oil affected area. The real and perceived consequence is considered to be Insignificant.
Shallow commercial fisheries (including aquaculture)	None / Insignificant	1	Shallow commercial fisheries including aquaculture (shallower than 25m, (RPS 2019)) may be exposed to surface, weathered, entrained and dissolved diesel above impact thresholds from a vessel collision in the Browse Basin. RPS (2019) modelling of a 250m3 MGO spill confirmed that at no point would dissolved oil exceed the 500 ppb impact threshold, limiting the potential for toxic effects from an MGO spill. The effect of diesel on this receptor includes the ability to cause economic loss (through indirect loss of stock and perceived tainting of stock by oil) (WA DoT 2018), impede access to fishing areas from the implementation of an exclusion zone during a spill response; impact seafood quality and employment; plus negatively impact lines and nets (ITOPF 2011). The economic impact from an oil spill is dependent on the stock being cultured, as species have different recovery rates. DoT (2018) note that dissolved oil will have the greatest impact, with oyster farms potentially taking 3-4 years to recover from a spill (DoF 2013), whilst finfish farms could take 6-8 years to recover due to the time it takes for hatchlings to reach maturity. WA DoT (2018) note that the pearling industry relies almost exclusively on sourcing pearl oysters from Eighty Mile Beach (south of Broome) and an area off the Lacepede Islands. There is also other aquaculture in the region including trochus and barramundi (Fletcher et al 2017). WA DoT (2018) note that some wild stocks aquaculture species such as mussels are impacted more by dissolved oil than floating oil due to being filter feeders. This receptor is considered to be important however a vessel collision spill in the Browse Basin unlikely to cause any significant impacts to shallow commercial fisheries (including aquaculture) due to the limited and localised surface and shallow entrained oil and remoteness of the shallow commercial fishing areas and aquaculture to potential release locations. Therefore, the real and perceived consequence is considered to be Insignificant.
Recreational fisheries	None / Insignificant	1	Recreational fisheries (shallower than 25m, RPS 2019)) may be exposed to surface, weathered, entrained and dissolved diesel above impact thresholds from a vessel collision in the Browse Basin. RPS (2019) modelling of a 250m3 MGO spill confirmed that at no point would dissolved oil exceed the 500 ppb impact threshold, limiting the potential for toxic effects from an MGO spill. The effects of diesel on this receptor includes negatively impacting nets and lines (ITOPF 2011), impeding access to fishing areas from the implementation of an exclusion zone during a spill response and impacting seafood quality and quantity. Recreational fishing is generally concentrated around readily accessible coastal settlements along the Kimberley and NT coastlines (such as Broome, Wyndham and Darwin) and there is little recreational fishing around the offshore Browse Basin due to the distance from land, lack of features of interest and deep waters. Offshore islands, coral reef systems and continental shelf waters of the Browse Basin however are increasingly being targeted by fishing based charter vessels (Fletcher and Santoro 2014) with extended fishing charters operating during certain times of the year. This receptor is considered to be important, however a vessel collision spill is unlikely to cause significant impacts to recreational fisheries due to the limited and localised surface and shallow entrained oil affected area and very limited recreational fishing in the offshore Browse Basin. The real and perceived consequence is considered to be Insignificant.
Cultural heritage			
Aboriginal heritage (cultural practices, sites and fishing / foraging)	None / Insignificant	1	Aboriginal heritage including special places, cultural landscapes, practices and fishing/foraging along the Kimberley and NT coastline are unlikely to be impacted by surface and weathered diesel above impact thresholds from a vessel collision in the Browse Basin. The effect of surface weathered diesel on this receptor includes physically degrading a site, disrupting the harvesting of fish, and area closures could displace Aboriginal people and have implications on cultural identity, health and wellbeing. The receptor is important however is generally remote from any potential vessel collision locations, limiting the scale of imact, and the recovery is expected to be short to medium term. Therefore, consequence is considered to be Insignificant.
Indonesian traditional fishing	None / Insignificant	1	Indonesian traditional fishing areas shallower than 25m (RPS 2019) may be exposed to fresh, weathered surface oil and entrained/dissolved diesel above impact thresholds from a vessel collision in the Browse Basin. RPS (2019) modelling of a 250m3 MGO spill confirmed that at no point would dissolved oil exceed the 500 ppb impact threshold, limiting the potential for toxic effects from an MGO spill. Indonesian traditional fishing occurs within the MoU box which covers Scott Reef and surrounds, Seringapatam Reef, Browse Island, Ashmore Reef, Cartier Island and various banks and shoals. The effect of diesel on these receptor could include reduction and contamination of target species such as sea cucumbers (bêche-de-mer), trochus (top shell snail), reef fish. Exclusion zones during the spill response may also affect access to fishing locations, even if the target species are not affected by diesel. This receptor is considered to be important however a vessel collision spill is unlikely to cause significant impacts to Indonesian traditional fishing due to the limited and localised surface and shallow entrained oil affected area. The real and perceived consequence is considered to be Insignificant.

Containment and Recovery

Overall statement of likelihood of success of Contain and Recovery (C&R):

Aim: This strategy aims to collect oil from the ocean surface using booms and skimmers, generally at or near the release location, where oil concentrations are highest. Floating booms are used to corral and concentrate spilled floating oil into a surface thickness that will allow for mechanical removal (i.e. pumping oil into temporary storage) by devices such as skimmers (IPIECA 2015).

Type of slick: Surface oil is in the form of Group II floating slicks which have a low viscosity and rapidly spread into a thin sheen. Surface oil concentrations will be approximately 10 g/m^2 (~0.01mm, which equates to Bonn code 1/2) up to approximately 160 km from the spill site and weathered oil concentrations reduce down to below 1 g/m^2 up to approximately 300 km from the spill site.

Likely success/effectiveness against slick: O'Brien (2002) notes that spreading of oil is the main obstacle to a successful at sea contain and recovery response, with this type of oil tending to spread so thinly and quickly that skimmers are unable to efficiently skim and recover meaningful quantities. Generally oil needs to be >100 g/m^2 (>0.1mm, which equates to Bonn code 4/5) to feasibly corral oil with a boom and achieve any significant level of oil recovery with skimmers (O'Brien 2002), as booms have limited effect against thin oil films and no effect against a subsurface plume (ITOPF 2011). The initial, gravity-dominated release and spreading is generally complete within minutes to hours after a release (O'Brien 2002)). In the context of the Browse Basin, with high sea surface and air temperatures in all seasons, the spreading of any diesel spill would be very rapid. Diesel spilled from a vessel collision would therefore remain at a thickness of >100g/m^2 for only a very brief period of time, before evaporation and spread effects generating very thin surface slicks, making C&R inefficient and impractical (IPIECA 2017). Where there is any significant diesel slick, flammable/toxic vapours will also be present, and will likely exceed safe exposure thresholds, further reducing response efficiency (as vessels will not be permitted to operate in areas where explosive limits or VOC exposure thresholds are exceeded). Due to the very thin surface slicks, very low rates of recovery would be expected. Note that IPIECA (2015) state that efficiency of contain and recover operations (for any oil type) can vary widely due to operational, environmental and logistical constraints, but usually it is limited to recovering approximately only 5-20% of the initial spilled volume. Contain and recovery is therefore unlikely to be an effective response strategy, with limited chance of any significant surface slick recovery from a Group II spill.

Resource Compartment (including values dependent on the resource compartment)	Impact Modification Score		Justification for Impact Modification Score
		B	
Subtidal Benthic Communities			
Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)	Minor mitigation of impact	1	C&R may result in a minor reduction in localised surface oil which may have a minor positive outcome in reducing future entrained oil in the upper water column including submerged BBPH.
Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)	No or insignificant alteration of impact	0	C&R occurs on the surface and has no impact on entrained oil affecting deep sea features.
Deep-sea unconsolidated muds and sands	No or insignificant alteration of impact	0	C&R occurs on the surface and has no impact on entrained oil affecting deep sea unconsolidated muds and sands.
Intertidal seabed			
Intertidal Coral Reef	Minor mitigation of impact	1	C&R may result in a minor reduction on oil on surface, resulting in very minor reduction in surface and entrained oil reaching intertidal zones.
Mangrove/Mudflats/Samphires	Minor mitigation of impact	1	
Sandy Beach	Minor mitigation of impact	1	
Rocky Shoreline	Minor mitigation of impact	1	
Macro-Algae and Seagrass	Minor mitigation of impact	1	
Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)	Minor mitigation of impact	1	
Water column			
Lower water column (below photic zone)	No or insignificant alteration of impact	0	C&R occurs on the surface and has no impact on entrained oil affecting fully submerged benthic primary producer habitat.
Upper water column (in photic zone)	Minor mitigation of impact	1	C&R may result in a minor reduction in localised surface oil which may have a minor positive outcome in reducing future entrained oil in the upper water column.
Water surface	Minor mitigation of impact	1	C&R may result in a minor reduction in localised surface oil.
Air	No or insignificant alteration of impact	0	Due to the rapid evaporation of diesel and low expected recovery rates of surface oil, C&R activities would not result in any significant change to local atmospheric VOC concentrations.

Socio-economic			
Commercial demersal fisheries	No or insignificant alteration of impact	0	C&R may result in a minor reduction in localised surface oil which may have a minor positive outcome on entrained oil, resulting in no change to oil exposure to demersal fish communities.
Shallow commercial fisheries (including aquaculture)	Minor mitigation of impact	1	C&R may result in a minor reduction in localised surface oil which may have a minor positive outcome in reducing future entrained oil in the upper water column including shallow commercial and recreational fisheries.
Recreational fisheries	Minor mitigation of impact	1	C&R may result in a minor reduction in localised surface oil which may have a minor positive outcome in reducing future entrained oil in the upper water column including shallow commercial and recreational fisheries.
Cultural heritage			
Aboriginal heritage (cultural practices, sites and fishing / foraging)	No or insignificant alteration of impact	0	C&R may result in a minor reduction in localised surface oil which may have a minor positive outcome in reducing future entrained oil in the upper water column. However, due to distance to aboriginal cultural heritage receptors, the impact mitigation potential is considered to be insignificant.
Traditional Indonesian fishing	Minor mitigation of impact	1	C&R may result in a minor reduction in localised surface oil which may have a minor positive outcome in reducing future entrained oil in the upper water column including shallow traditional fishing habitats.

Protect and Deflect

Overall statement of likelihood of success of Protect and Deflect (P&D):

Aim: This strategy aims to use physical barriers to exclude or restrict the spill contacting specific sensitive receptors or to deflect the spill from these locations; typically onto less sensitive areas.

Type of slick: Surface oil reaching remote shorelines will be in the form of thin floating slicks of weathered diesel which could accumulate over time. Weathered oil would be in the form of waxy flakes and residues which are generally considered to be of lower toxicity than fresh oil (Woodside 2014).

Likely success/effectiveness against slick: Booms could be used to protect and deflect surface spills away from sensitive habitats, but they have limited effect against thin Group II oil films and no effect against subsurface entrained plumes (ITOPF 2011). Generally oil needs to be >100 g/m^2 (>0.1mm, which equates to Bonn Code 4/5) to feasibly corral oil with a boom (O'Brien 2002), as would be required for a P&D response. However diesel on the ocean surface from a vessel collision is unlikely to have slicks >100 g/m^2. Even in a scenario where the best equipment is available, shoreline protect and deflect activities at Browse Island or other exposed remote shoreline locations, would be technically challenging due to the general exposure to unfavourable sea conditions, large tidal range and shallow coral reefs. Generally protect and deflect is limited to sheltered waters, not exposed reef/beach environments. Only under exceptionally calm sea-states and appropriate tides would it be safe to conduct vessel activities to carry-out an effective protect and deflect operation at remote shorelines. MetOcean conditions required for this technique to be successful include <1 m sea-state and low surface currents - but these are frequently exceeded at remote offshore locations in the Browse Basin region. In addition, given the size of the offshore island shorelines (e.g. Browse Island, one of the smallest offshore islands, has an intertidal zone 3km in diameter, 7km in circumference), a substantial number of booms would be needed to be deployed to protect the shorelines, or deflect oil into a collection point on a beach. Anchoring of booms would most likely result in additional damage to the subtidal and intertidal environment (coral reef) surrounding most offshore islands, due to anchor chain drag. Booms themselves would also drag around on the coral intertidal reef during periods of lower tides, potentially resulting in significant physical damage to the benthos of the reef platform and also result in damage to booms. Booms could potentially be held in place by vessels however due to widths of shorelines requiring protection this would most likely require an unfeasibly large number of vessels, and at low tide this isn't practicable in intertidal zones. Most offshore island shorelines would be expected to 'self clean' any accumulated Group II oil due to the lack of adhesiveness, the coarse substrate, the high wave energy and high tidal regime (Fingas 2012), further reducing the impact mitigation potential of protect and deflect at these locations. As a result of the above mentioned factors, protect and deflect would be unlikely to result in any significant deflection or recovery of Group II diesel at remote intertidal/shoreline habitats.

Resource Compartment (including values dependent on the resource compartment)	Impact Modification Score		Justification for Impact Modification Score
		B	
Subtidal Benthic Communities			
Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)	No or insignificant alteration of impact	0	P&D occurs on the surface at a shoreline location and will have insignificant impact on entrained oil affecting subtidal benthic primary producer habitat.
Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)	No or insignificant alteration of impact	0	P&D occurs on the surface at a shoreline location and has insignificant impact on entrained oil affecting deep sea features.
Deep-sea unconsolidated muds and sands	No or insignificant alteration of impact	0	P&D occurs on the surface at a shoreline location and has insignificant impact on entrained oil affecting deep sea unconsolidated muds and sands.
Intertidal seabed			
Intertidal Coral Reef	Moderate additional impact	-2	P&D may result in a minor reduction of thin slicks of weathered diesel reaching intertidal receptors. However, anchoring extensive boom arrays would most likely result in physical damage to subtidal and intertidal coral reefs.
Mangrove/Mudflats/Samphires	Minor additional impact	-1	P&D may result in a minor reduction of thin slicks of weathered diesel reaching intertidal receptors. However, due to the extensive scale of mangrove communities along the mainland and islands of the Kimberley and NT coastline, the ability to successfully achieve a benefit from P&D is extremely limited. Anchors/anchor chains also have the potential to damage mangrove aerial root structures and disturb other fragile low-energy shorelines.
Sandy Beach	Minor mitigation of impact	1	P&D may result in a minor reduction of thin slicks of weathered diesel reaching intertidal receptors. A correctly executed shoreline clean-up may result in a positive outcome compared to natural weathering.

Rocky Shoreline	Minor mitigation of impact	1	P&D may result in a minor reduction of thin slicks of weathered diesel reaching intertidal receptors. A correctly executed clean-up on a rocky shoreline may result in a positive outcome compared to natural weathering.
Macro-Algae and Seagrass	Minor mitigation of impact	1	P&D may result in a minor reduction of thin slicks of weathered diesel reaching intertidal receptors. However, anchoring extensive boom arrays would most likely result in physical damage to subtidal and intertidal coral reefs.
Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)	Minor mitigation of impact	1	P&D may result in a minor reduction of thin slicks of weathered diesel reaching intertidal receptors. A correctly executed clean-up on a sandy beach or rocky shoreline may result in a positive outcome, including protected species such as marine avifauna and turtles who utilise these habitats.
Water column			
Lower water column (below photic zone)	No or insignificant alteration of impact	0	P&D does not reduce the amount of entrained oil affecting the lower water column.
Upper water column (in photic zone)	No or insignificant alteration of impact	0	P&D does not reduce the amount of entrained oil affecting the upper water column.
Water surface	No or insignificant alteration of impact	0	P&D would only occur near shorelines and would not result in any significant reduction to the volume of oil on the water surface.
Air	No or insignificant alteration of impact	0	P&D would only occur at shorelines remote form the spill release location. The weathered slick will not have any significant volatile components remaining, and therefore P&D would have no effect on local atmospheric conditions.
Socio-economic			
Commercial demersal fisheries	No or insignificant alteration of impact	0	P&D would result in insignificant reduction in entrained oil, resulting in no change to oil exposure to commercial demersal fisheries.
Shallow commercial fisheries (including aquaculture)	No or insignificant alteration of impact	0	P&D would result in insignificant reduction in oil on surface or entrained oil, resulting in no change to oil exposure to shallow commercial fisheries including aquaculture sites.
Recreational fisheries	No or insignificant alteration of impact	0	P&D would result in insignificant reduction in oil on surface or entrained oil, resulting in no change to oil exposure to fish communities, thus no change to recreational fishing.
Cultural heritage			
Aboriginal heritage (cultural practices, sites and fishing / foraging)	No or insignificant alteration of impact	0	P&D would result in insignificant reduction in oil on surface and entrained oil, resulting in no change to impacts on Aboriginal heritage.
Traditional Indonesian fishing	No or insignificant alteration of impact	0	P&D would result in insignificant reduction in oil on surface and entrained oil, resulting in no change to impacts on Indonesian traditional fishing areas.

Shoreline Clean-Up

Overall statement of likelihood of success of Shoreline Clean-Up:

Aim: Using various physical means to clean up oil from affected shorelines to reduce impacts on sensitive receptors or to avoid any reintroduction of the hydrocarbon to the marine environment. It is often viewed as a three step process, with the first phase involving bulk collection of oil floating against the shoreline or stranded on it; phase two involving in-situ treatment of shoreline substrate and phase three involving removal of any remaining residues (final polish) (IPIECA 2015).

Type of slick: Diesel spilled from a vessel collision in the Browse Basin is expected to have undergone several physical and biological weathering processes, such as photo oxidation and biodegradation by the time it strands on a shoreline. Weathered diesel reaching a remote shoreline will be in the form of thin floating slicks which could accumulate over time. Impacts to ecological receptors from exposure to weathered oil (waxy flakes and residues) are far less than those associated with exposure to fresh oils, which have higher levels of toxicity (Milton et al, 2003; Hoff & Michel 2014; Woodside 2014). Group II oils are relatively non-adhesive and will not form a thick adhesive barrier on a shoreline (Fingas 2012).

Likely success/effectiveness against slick: Shoreline clean-up has been consistently found to not enhance ecological recovery of oiled coastlines (Sell et al 1995) but it may protect other resources in the area, such as birds, marine mammals or subtidal habitats including coral reefs or fish farms (CSIRO 2016). Choosing a particular clean-up technique is dependent on factors such as shoreline type, exposure, sensitivity, amount of oil, persistence of oil, toxicity of oil and rate of natural oil removal (IPIECA 2015). Mechanical cleaning is generally not an appropriate technique for offshore/remote shorelines, and manual techniques involving rakes and shovels would likely be required. The clean-up of Group II spills from a beach or shoreline is likely to be difficult, generating high volumes of waste in comparison to the oil recovered. Browse Island and other similar offshore shorelines would be expected to naturally 'self-clean' any accumulated Group II oils, due to factors such as the lack of adhesiveness of these oil types, the coarse substrate present and the high wave energy and high tidal regime (Fingas 2012). Typically, inaccessible rocky coves are highly exposed and are best left to naturally clean (IPIECA 2015). ITOPF (2011) also note that for a number of sensitive shoreline types, such as mangroves, natural cleaning is the preferred option in order to minimise the damage caused from clean-up activities. Thus shoreline clean-up would be most effective in areas which are expected to receive large amounts of shoreline oil; where chosen activities don't physically break/damage sensitive habitat such as coral or mangroves; and in areas which are not expected to self clean.

Resource Compartment (including values dependent on the resource compartment)	Impact Modification Score		Justification for Impact Modification Score
		B	
Subtidal Benthic Communities			
Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)	No or insignificant alteration of impact	0	Shoreline clean-up will have no impact on entrained oil in benthic primary producer habitat within subtidal areas.
Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)	No or insignificant alteration of impact	0	Shoreline clean-up will have no impact on entrained oil affecting filter feeding communities within subtidal areas.
Deep-sea unconsolidated muds and sands	No or insignificant alteration of impact	0	Shoreline clean-up will have no impact on entrained oil affecting deep-sea unconsolidated muds and sands in subtidal areas.
Intertidal seabed			
Intertidal Coral Reef	Minor additional impact	-1	Shoreline clean-up on an intertidal coral reef would result in physical damage/breaking of coral structures, therefore a net damage to the eco-system.
Mangrove/Mudflats/Samphires	Minor additional impact	-1	Shoreline clean-up within mangrove/low energy ecosystems is likely to result in more physical damage/breaking of mangrove root structures than benefit from any oil removed.
Sandy Beach	Minor mitigation of impact	1	Shoreline clean-up of sandy beaches is a well understood, well documented spill response technique, which can reliably remove thick oil from the eco-system. This is beneficial for species such as turtles who nest on sandy beaches. However, in the case of a condensate spill, the likely oil accumulating on a shoreline remote from the release location is likely to be very thin, and possibly not recoverable. Natural weathering on high energy beaches may be just as effective as attempting to clean-up very thin, non-adhesive slicks.
Rocky Shoreline	Minor mitigation of impact	1	Shoreline clean-up of rocky shorelines is a well understood, well documented spill response technique, which has the ability to remove some oil from the eco-system. However, certain techniques like steam cleaning and high pressure blasting are known to cause more harm than allowing the oil to naturally weather. Therefore, this technique would likely be successful, provided the correct clean-up techniques are chosen.

Macro-Algae and Seagrass	Minor additional impact	-1	Shoreline clean-up within intertidal macro-algae/seagrass ecosystems would likely result in more physical disturbance to plant/root structures than benefit from any oil removed.
Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)	Minor mitigation of impact	1	If it is deemed that the amount of hydrocarbons expected to impact shorelines is large enough that a shoreline clean up will have positive impacts, then the removal of oil from the intertidal zones would likely result in reduction in harm to the benthic primary producers and associated food sources utilised by foraging protected fauna such as seabirds. Also, removal of oil reaching a turtle nesting beach would be of benefit to turtle nesting success. However, due to the type (generally non-toxic and non-adhesive weathered oil), shoreline clean-up of weathered diesel may only have limited positive effect compared to natural weathering. Caution is required, as additional physical damage can occur in sensitive intertidal environments, and the general presence of responders can result in additional disturbance to natural wildlife behaviours and processes, especially seabirds and turtle nesting etc.
Water column			
Lower water column (below photic zone)	No or insignificant alteration of impact	0	Shoreline clean-up will have insignificant impact on entrained oil in the lower water column.
Upper water column (in photic zone)	No or insignificant alteration of impact	0	Shoreline clean-up will have insignificant impact on entrained oil in the upper water column.
Water surface	No or insignificant alteration of impact	0	Shoreline clean-up will have insignificant impact on thin surface slicks on the water surface.
Air	No or insignificant alteration of impact	0	As oil will have significantly weathered by the time it reaches a shoreline, clean-up activities will result in no net change to impacts to air quality.
Socio-economic			
Commercial demersal fisheries	No or insignificant alteration of impact	0	There would be no reduction in entrained oil, resulting in no significant change to fish communities, and thus commercial demersal fisheries.
Shallow commercial fisheries (including aquaculture)	Minor mitigation of impact	1	Reduction in oil remobilising from a shoreline into intertidal habitats may result in less harm to intertidal fish nurseries and foraging habitats. However damage to these ecosystems could occur, through physical damage associated with shoreline clean-up in sensitive intertidal environments.
Recreational fisheries	Minor mitigation of impact	1	Reduction in oil remobilising from a shoreline into intertidal habitats may result in less harm to intertidal fish nurseries and foraging habitats. However damage to these ecosystems could occur, through physical damage associated with shoreline clean-up in sensitive intertidal environments.
Cultural heritage			
Aboriginal heritage (cultural practices, sites and fishing / foraging)	Minor mitigation of impact	1	Shoreline clean-up may reduce oil damage to Aboriginal heritage sites along the Kimberley / NT coastline, however care would be required to ensure important sites are not damaged during the clean-up process.
Traditional Indonesian fishing	Minor mitigation of impact	1	Reduction in oil remobilising from a shoreline into intertidal habitats may result in less harm to intertidal fish nurseries and foraging habitats. However damage to these ecosystems could occur, through physical damage associated with shoreline clean-up in sensitive intertidal environments.

Chemical Dispersant - Surface

Overall statement of likelihood of success of Chemical Dispersant:

Aim: To remove oil from the sea's surface via dispersant spraying from vessels and aircraft, thus reducing the amount of oil reaching birds, mammals and other organisms - as well as coastal habitats, socioeconomic features and shorelines (IPIECA 2015).

Type of slick: Surface oil is in the form of Group II floating slicks which have a low viscosity and rapidly spread into a thin sheen. They will be approximately 10 g/m^2 up to approximately 160 km from the spill site and approximately 1 g/m^2 up to approximately 300 km from the spill site.

Likely success/effectiveness against slick: The National Research Council (2005) notes that the window to use dispersants is early, typically within hours to 2 days of a spill, then after that, weathering makes oil more difficult to disperse (due to increased viscosity). Rapid dispersion of dispersant-treated oil begins at a wind speed of approximately 7 knots with wave heights of 0.2 to 0.3 metres (IPIECA 2015). Conditions where wave energy is too low, oil droplets may resurface after being applied with dispersant due to oil not being effectively dispersed into the water column. Dispersant becomes challenging in high winds and rough seas, where floating oil will be over-washed or temporarily submerged (IPIECA 2015). Whilst dispersants reduce the amount of oil on the surface that can affect wildlife, they also increase the exposure of dispersed oil in the upper water column to other wildlife. It is expected that dispersant will not significantly change the proportion of surface oil which would become entrained as the sea-state changes. Therefore, given surface diesel slicks will rapidly entrain with increasing wind-speed, dispersant will have limited effect when compared with natural entrainment processes.

Generally oil slicks needs to be >100 g/m^2 (>0.1mm, which equates to Bonn code 4/5) to feasibly achieve a successfully dispersant operation. However diesel from a vessel collision on the ocean surface is unlikely to have slicks >100 g/m^2. Where there are any significant diesel slick, flammable/toxic vapours will also be present, and will likely exceed safe exposure thresholds, further reducing response efficiency (as vessels will not be permitted to operate in areas where explosive limits or VOC exposure thresholds are exceeded). Due to the very thin surface slicks, very low rates of successful dispersal would be expected. Therefore, surface dispersant application on a diesel vessel slick would not be an effective response strategy.

Resource Compartment (including values dependent on the resource compartment)	Impact Modification Score		Justification for Impact Modification Score
		B	
Subtidal Benthic Communities			
Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)	Minor additional impact	-1	Chemical dispersant and additional entrained oil would result in negative impacts to shallow water BPPH. However, impacts would be minor, provided dispersant applied at a significant distance from the BPPH.
Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)	No or insignificant alteration of impact	0	Chemical dispersant would result in an insignificant increase in any additional oil reaching deep water locations, regardless of chemical dispersant application on the surface.
Deep-sea unconsolidated muds and sands	No or insignificant alteration of impact	0	
Intertidal seabed			
Intertidal Coral Reef	Minor additional impact	-1	Dispersant is generally considered ineffective at significantly increasing entrainment of thin sheens of marine diesel, compared to natural rates of entrainment. A significant volume of dispersant would need to be applied to result in any change, therefore this would result in negative impacts, due to additional chemicals on the surface and in the shallow water column, which could negatively impact on sensitive shallow/intertidal receptors such as corals, seagrass etc, and the biota who depend on them, including invertebrates, and mega-fauna who forage in these zones.
Mangrove/Mudflats/Samphires	Minor additional impact	-1	
Sandy Beach	Minor additional impact	-1	
Rocky Shoreline	Minor additional impact	-1	
Macro-Algae and Seagrass	Minor additional impact	-1	
Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)	Minor additional impact	-1	

Water column			
Lower water column (below photoic zone)	No or insignificant alteration of impact	0	No oil reaching deep water locations, regardless of dispersant application on surface.
Upper water column (in photic zone)	Minor additional impact	-1	
Water surface	Minor additional impact	-1	Dispersed oil can cause marine organisms inhabiting the upper water column to be briefly exposed to dispersed oil which can potentially have toxic effects. Dispersant is generally considered ineffective at significantly increasing entrainment of thin sheens of marine diesel, compared to natural rates of entrainment. A significant volume of dispersant would need to be applied to result in any change, therefore this would result in negate impacts, due to additional chemicals on the surface and in the shallow water column.
Air	No or insignificant alteration of impact	0	A very slight reduction in VOCs in local atmosphere could occur as a result of dispersant application and additional entrainment. However additional chemical dispersant mist in the local atmosphere would likely offset any reduction in VOCs.
Socio-economic			
Commercial demersal fisheries	No or insignificant alteration of impact	0	No oil reaching deep water locations, including demersal fish habitat, regardless of chemical dispersant application on surface.
Shallow commercial fisheries (including aquaculture)	Minor additional impact	-1	Chemical dispersant and additional entrained oil would result in negative impacts to shallow commercial fisheries.
Recreational fisheries	Minor additional impact	-1	Chemical dispersant and additional entrained oil would result in negative impacts to recreational fisheries.
Cultural heritage			
Aboriginal heritage (cultural practices, sites and fishing / foraging)	No or insignificant alteration of impact	0	As any dispersant application would occur within offshore waters, and as there would likely be significant naturally entrained of a diesel spill due to natural wind effects, surface dispersant application would result in an insignificant change in dispersed/entrained oil reaching traditional Aboriginal areas of the Kimberley and NT coastline.
Traditional Indonesian fishing	Minor additional impact	-1	Chemical dispersant and additional entrained oil could result in negative impacts to shallow water BPPH which support Indonesian traditional fishing target species. However, impacts would be minor, provided dispersant applied at a significant distance from the BPPH.

Pre-Contact Wildlife Response (Hazing and Translocation)

Overall statement of likelihood of success of Pre-contact OWR (hazing and relocation/displacement):

Aim: Hazing involves discouraging animals from entering oiled areas by encouraging them to move into low-risk unoiled areas, in an attempt to prevent them from becoming oiled (IPIECA 2017). Hazing techniques include vessels generating underwater noise and motion, vessel air horns making above-water noise and fire hoses directing streams in front of fauna. Translocation/displacement involves removing wildlife who are at risk of becoming oiled from the spill environment in an attempt to prevent them from becoming oiled (IPIECA 2017). This includes holding animals in captivity until the risk of oiling is over, or relocating them to another area not affected by the oil spill (IPIECA 2017).

Type of slick: Surface oil is in the form of Group II floating slicks which have a low viscosity and rapidly spread into a thin sheen. They will be approximately 10 g/m^2 up to approximately 160 km from the spill site and approximately 1 g/m^2 up to approximately 300 km from the spill site. Group II oils are relatively non-adhesive, and oil reaching shorelines is likely to have undergone weathering and will be in the form of waxy flakes and residues which are generally considered to be of lower toxicity than their unweathered counterparts (Milton et al, 2003; Hoff & Michel 2014; Woodside 2014).

Likely success/effectiveness against slick: Wildlife hazing in the open ocean is inherently unlikely to be effective due to a number of limitations;

1) effectiveness depends upon the deployment of numerous ocean-going vessels (as opposed to smaller vessels which can be used near to the shore);
2) against a spreading plume (i.e. away from the immediate source of the spill), the technique becomes entirely impracticable;
3) there are significant safety issues associated with a spill of diesel and vessel masters will not approach the source of the spill, or fresh areas of slick, while the spill is still ongoing; and
4) without the constraints of a shoreline or other geographical feature, the technique may cause wildlife to move into other areas of the spill area instead of away from it.

Wildlife hazing is most suitable when used near sensitive shoreline habitats against persistent oily slicks, such as IFO, HFO or crude oil spills - but in the case of a Group II vessel collision, oil slicks are thin and not considered particularly adhesive, therefore reducing the likelihood and severity of impacts on wildlife. Additionally, hazing isn't considered an effective measure against volatile spills which rapidly evaporate.

In regard to wildlife translocation, IPIECA (2014) advise that the difficulty of capturing wildlife safely and maintaining their health during relocation should not be underestimated, and that working with live or dead animals has health and safety issues including potential injuries (bites, scratches) or zoonotic diseases. Risks to wildlife are high during pre-emptive capture and the risks of oiling need to be weighed against the risk of injury, death etc. (IPIECA 2014). The translocation of turtles from beaches and islands would likely require the capture of large numbers of hatchlings, followed by translocation to a location far from the slick (to prevent surface oil impacts on released hatchlings). The prolonged retention of hatchlings has been demonstrated to be detrimental to hatchling swimming speed and survival, even in short periods (6 hours) of retention (Pilcher and Enderby 2001). Attempting to capture large numbers (or an entire flock) of healthy seabirds would be very challenging, if not impossible (DPaW 2014), especially at a remote shoreline location (such as Browse or Cartier Island). There is no practicable method to capture healthy seabirds at sea (DPaW 2014). Potential harm to healthy seabirds could occur during the capture process. Any seabirds released would likely fly back to the shoreline from which they originally were captured. Therefore, long term veterinary care (feeding etc.) would be required for any successfully captured birds, until spill weathering or remediation has occurred and it was safe to release the animals. An evaluation would need to be undertaken, to ensure the released animals do not pose a disease risk (human/zoonotic diseases), to the wild population into which they are released.

Resource Compartment (including values dependent on the resource compartment)	Impact Modification Score		Justification for Impact Modification Score
		B	
Subtidal Benthic Communities			
Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Deep-sea unconsolidated muds and sands	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Intertidal seabed			
Intertidal Coral Reef	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Mangrove/Mudflats/Samphires	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Sandy Beach	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Rocky Shoreline	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Macro-Algae and Seagrass	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)	Minor mitigation of impact	1	Wildlife hazing of flocks of seabirds may temporarily prevent oiling of individuals or small proportions of a local/regional populations, however it is not likely effective across a broad geographical area. Even conducting wildlife hazing in the nearshore environment at an isolated location such as Browse Island would be of logistically challenging and potentially not result in any significant impact mitigation. Hazing of seabirds to prevent them landing on an oiled shoreline may temporarily prevent impacts, whilst shoreline clean-up is occurring. Capture and translocation of turtle hatchlings away from the oiled shoreline, and release in the open ocean is potentially feasible. Therefore, undertaking pre-contact oiled wildlife response at a shoreline may reduce the number of protected species of a local population from being oiled.
Water column			
Lower water column (below photic zone)	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Upper water column (in photic zone)	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Water surface	No or insignificant alteration of impact	0	Wildlife hazing and/or translocation of seabirds or other megafauna, such as cetaceans and turtles in the open ocean, using vessel presence, vessel noise or at sea capture is highly unlikely to be successful. It may be possible to temporarily (minutes / hours), prevent a few individuals of a protected species from entering a small geographic area affected by a slick. However, over the longer term duration and geographic area of a well-blowout scenario, there would be no alteration to the level of oiling of wildlife populations using this strategy in the open ocean.
Air	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Socio-economic			
Commercial demersal fisheries	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Shallow commercial fisheries (including aquaculture)	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Recreational fisheries	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Cultural heritage			
Aboriginal heritage (cultural practices, sites and fishing / foraging)	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Traditional Indonesian fishing	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.

Post Contact Oiled Wildlife Response

Overall statement of likelihood of success of Post-contact OWR:

Aim: Post-contact wildlife response involves capturing oiled wildlife - and if necessary, cleaning, rehabilitating and releasing them.

Type of slick: Surface oil is in the form of Group II floating slicks which have a low viscosity and rapidly spread into a thin sheen. They will be approximately 10 g/m^2 up to approximately 160 km from the spill site and approximately 1 g/m^2 up to approximately 300 km from the spill site. Group II oils are relatively non-adhesive, and oil reaching shorelines is likely to have undergone weathering and will be in the form of waxy flakes and residues which are generally considered to be of lower toxicity than fresh oil (Milton et al, 2003; Hoff and Michel 2014; Woodside 2014). Note that Group II hydrocarbons are relatively non-adhesive compared to crude oils, and are generally not considered an oil product that would 'coat' the feathers of birds, requiring a full wildlife cleaning response on a shoreline.

Likely success/effectiveness against slick: Capture, relocation, assessment, cleaning and rehabilitation of oiled wildlife has the ability to increase the survival of individuals. ITOPF (2011) note that there are many cases where oiled turtles have been cleaned successfully and returned to the water. Any seabirds captured, cleaned and released would likely fly back to the shoreline from which they originally were captured. Once oiled, it is generally agreed that birds have a very low survival rate, even when rescue and cleaning is attempted (Bourne et al. 1967; Holmes and Cronshaw 1977; Croxall 1977; Ohlendorf et al. 1978; Chapman, 1981; Ford et al., 1982; Samuels and Lanfear, 1982; Varoujean et al., 1983; Ford, 1985; Evans and Nettleship 1985; Fry 1987; Seip et al. 1991; Anderson et al. 2000). French-McCay (2009) produced mortality estimates of 99% for surface swimmers, 35% for aerial divers and raptors, and 5% for aerial seabirds. Samuels and Lanfear (1982) estimated that 95% of oiled seabirds die. ITOPF (2011) note that penguins and pelicans are often the exception as they are generally more resilient than many other species, however they are not present in the Browse Basin. IPIECA (2014) advise working with live or dead animals has health and safety issues including potential injuries (bites, scratches) or zoonotic diseases. An evaluation would need to be undertaken, to ensure any released animals do not pose a disease risk (human/zoonotic diseases), to the wild population into which they are released.

Resource Compartment (including values dependent on the resource compartment)	Impact Modification Score		Justification for Impact Modification Score
		B	
Subtidal Benthic Communities			
Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Deep-sea unconsolidated muds and sands	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Intertidal seabed			
Intertidal Coral Reef	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Mangrove/Mudflats/Samphires	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Sandy Beach	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Rocky Shoreline	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Macro-Algae and Seagrass	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)	Minor mitigation of impact	1	Post-contact OWR has the ability to increase the likelihood of survival of oil-affected EPBC species (individuals, or small proportion of a local population) in the intertidal/shoreline habitats. However, the seabird species of the Browse Basin are generally not expected to survive the capture, cleaning and rehabilitation process. Capture, cleaning and release of marine turtles would have a greater likelihood of success.
Water column			
Lower water column (below photic zone)	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Upper water column (in photic zone)	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Water surface	Minor mitigation of impact	1	It is possible that some individuals of protected species, which have been oiled and are unable to fly, could be captured in the open ocean and relocated to an oiled wildlife treatment facility. Therefore, whilst there is a very low probability of survival, under the right circumstances a positive environmental outcome, for a limited number of individuals of a protected species could be achieved.
Air	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Socio-economic			
Commercial demersal fisheries	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Shallow commercial fisheries (including aquaculture)	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Recreational fisheries	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Cultural heritage			
Aboriginal heritage (cultural practices, sites and fishing / foraging)	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Traditional Indonesian fishing	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.

In Situ Burn

Overall statement of likelihood of success of In-situ burn (ISB):

Aim: In-site burning rapidly removes the volume of spilled oil's hydrocarbon vapours in place, via combustion or burning (IPIECA 2016). This technique reduces the need to collect, store, transport and dispose recovered oil, plus it can shorten the overall response time (IPIECA 2016).

Type of slick: Surface oil is in the form of Group II floating slicks which have a low viscosity and rapidly spread into a thin sheen. They will be approximately 10 g/m^2 up to approximately 25 km from the spill site and approximately 1 g/m^2 up to approximately 110 km from the spill site.

Likely success/effectiveness against slick: ISB requires wave heights typically below 1 m and wind speeds below 10 knots (IPIECA 2016) which are frequently exceeded at remote offshore locations in the Browse Basin region. Overseas experience shows that burns can be conducted safely, but the most discernible disadvantage is the resulting dark smoke plumes caused by the combustion of oil (IPIECA 2016). Carbon dioxide, soot (PM 2.5), water, polyaromatic hydrocarbons, volatile organic compounds, carbonyls, carbon monoxide, sulphur dioxide and potentially other gases can result from an in-situ burn, which has the potential to affect human and animal health (IPIECA 2016). IPIECA (2016) note that tests and information from previous burns indicate that ISB has little effect on water quality. Burn residue (i.e. burned oil depleted of volatiles and precipitated soot) rarely sinks and smothers benthic species (IPIECA 2016). Plus it is unlikely that Group II burn residue will cause smothering as this generally only occurs for heavier crudes (IPIECA 2016). IPIECA (2016) further note that burn residue is less toxic to aquatic biota than weathered oil.

To implement an effective in-situ burn response, a minimum surface hydrocarbon thickness of 2-5 mm (2000 - 5000 g/m^2) is required to be present. In the case of a vessel collision, the surface slick is not expected to meet the required thickness (i.e. only 10 g/m^2 or 0.1 mm expected thickness in the immediate area of the release). Booms would be required to corral the spill, in an attempt to generate additional oil thickness, but this in turn is expected to exceed the VOC exposure thresholds for the workforce, and also may result in concentrations exceeding the lower explosive limit. Given this, and the lack of suitable booms available for in-situ burns in Australia, implementation of this response in an open ocean, high current environment is not considered to be safe, effective or feasible, especially against the thin sheen and hazardous atmospheric conditions associated with a diesel spill.

Resource Compartment (including values dependent on the resource compartment)	Impact Modification Score		Justification for Impact Modification Score
		B	
Subtidal Benthic Communities			
Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)			
Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)			
Deep-sea unconsolidated muds and sands			
Intertidal seabed			
Intertidal Coral Reef			
Mangrove/Mudflats/Samphires			
Sandy Beach			
Rocky Shoreline			
Macro-Algae and Seagrass			
Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)			
Water column			
Lower water column (below photic zone)			
Upper water column (in photic zone)			
Water surface			
Air			

Socio-economic			
Commercial demersal fisheries			
Shallow commercial fisheries (including aquaculture)			
Recreational fisheries			
Cultural heritage			
Aboriginal heritage (cultural practices, sites and fishing / foraging)			
Traditional Indonesian fishing			

References

Anderson, D. W., Newman, S.H., Kelly, P.R., Herzog, S.K. and Lewis, K.P. 2000. An Experimental Soft-Release of Oil-Spill Rehabilitated American Coots (Fulica americana): I. Lingering Effects on Survival, Condition and Behavior. Environmental Pollution 107: 285–294.

Asia-Pacific Applied Science Associates (APASA). 2012. Basset Deep Well: Quantitative Spill Risk Assessment. J0172 Rev 2. Prepared for INPEX Operations Australia Pty 27/11/2012

Australian Maritime Safety Authority (AMSA). 2015. *The Effects of Maritime Oil Spills on Wildlife including Non-avian Marine Life*. Accessed online 14/11/2018 at <http://www.amsa.gov.au/environment/maritime-environmental-emergencies/national-plan/general-information/oiled-wildlife/marine-life/index.asp>.

Australian Maritime Safety Authority (AMSA). 1998. National Plan (document now superseded): *The effects of maritime oil spills on wildlife including non-avian marine life*. Accessed 16 July 2015 at <https://www.amsa.gov.au/environment/maritime-environmental-emergencies/national-plan/General-Information/oiled-wildlife/marine-life/index.asp>.

Bourne, W.R.P., Parrack J.D. and Potts G.R. 1967. Birds Killed in the Torrey Canyon Disaster. Nature 215: 1123–1125.

Burns, K.A., Garrity, S.D. and Levings, S.C. 1993. How many years before mangrove ecosystems recover from catastrophic oil spills? *Marine Pollution Bulletin.* 26(5):239–248

Campagna, C., Short, F.T., Polidoro, B.A., McManus, R., Collette, B.B., Pilcher, N.J., Mitcheson, Y.S., Stuart, S.N. and Carpenter, K.E. 2011. Gulf of Mexico oil blowout increases risks to globally threatened species. *BioScience* 61:393–397.

Chapman, B.R. 1981. *Effects of the Ixtoc I Oil Spill on Texas Shorebird Populations*. pp. 461–465 in American Petroleum Institute, Proceedings of the 1981 Oil Spill Conference. American Petroleum Institute, Washington, D.C.

Clark, R.B. 1984. Impact of oil pollution on seabirds. Environmental Pollution 33:1–22.

Connell, D.W., Miller, G.J. and Farrington, J.W. 1981. Petroleum hydrocarbons in aquatic ecosystems—behavior and effects of sublethal concentrations: Part 2. *Critical Reviews in Environmental Science and Technology* 11(2):105–162.

Commonwealth Scientific and Industry Research Organisation (CSIRO). 2016. Oil spill monitoring handbook. CSIRO Publishing, Clayton South, Victoria.

Croxall, J.P. 1977. *The Effects of Oil on Seabirds*. Rapport Procès-Verbal Reunion Conseil International pour L'Exploration de la Mer 171: 191–195.

Dean, T.A., Stekoll, M.S., Jewett, S.C., Smith, R.O. and Hose, J.E. 1998. Eelgrass (Zostera marina L.) in Prince William Sound, Alaska: effects of the Exxon Valdez oil spill. Marine Pollution Bulletin 36: 201–210.

DoF. 2013. Pearl Oyster, Webpage managed by the Department of Fisheries Western Australia, accessed December 2017. Last updated 24 April 2013. [http://www.fish.wa.gov.au/Species/Pearl-Oyster/Pages/default.aspx]

Department of Environment and Conservation (DEC). 2007. Management Plan for the Montebello/Barrow Islands Marine Conservation Reserves 2007–2017: Management Plan No. 55. Department of Environment and Conservation, Perth, Western Australia

Department of Environment and Conservation (DEC) and Marine Parks and Reserves Authority (MPRA). 2005. Management Plan for the Ningaloo Marine Park and Muiron Islands Marine Management Area 2005–2015. Department of Environment and Conservation and Marine Parks and Reserves Authority. Perth, Western Australia.

Department of the Environment, Water, Heritage and the Arts (DEWHA). 2008. North Marine Bioregional Plan bioregional profile: a description of the ecosystems, conservation values and uses of the North Marine Region.

Department of Parks and Wildlife (DPaW). 2014. *Western Australian Oiled Wildlife Response Plan (WAOWRP)*. Department of Parks and Wildlife, Perth, WA.

Duke, N., Burns, K,. Swannell, J., Dalhaus, O. and Rupp, R. 2000. Dispersant use and a bioremediation strategy as alternative means of reducing impacts of large oil spills on mangroves: the Gladstone field trials. *Marine Pollution Bulletin*. Vol 41, Issues 7–12:403–412.

Evans, P.G.H. and Nettleship, D.N. 1985. *Conservation of the Atlantic Alcidae*. pp. 427–488 in Nettleship, D.N. and Birkhead, T.R. (eds.). The Atlantic Alcidae. Academic Press, London, UK.

Fingas. 2012. The Basics of Oil Spill Cleanup – Third Edition. CRC Press. Boca Raton, Florida.

Fletcher WJ, Mumme MD and Webster FJ (eds). 2017. Status Reports of the Fisheries and Aquatic Resources of Western Australia 2015/6: The State of the Fisheries. Department of Fisheries, Western Australia.

Fletcher, W.J. and Santoro, K. (eds). 2014. Status reports of the fisheries and aquatic resources of Western Australia 2013/14: The state of the fisheries. Department of Fisheries, Western Australia.

Ford, R.G., Wiens, J.A., Heinemann D. and Hunt G.L. 1982. Modelling the Sensitivity of Colonially Breeding Marine Birds to Oil Spills: Guillemot and Kittiwake Populations on the Pribilof Islands, Bering Sea. *Journal of Applied Ecology* 19:1–31.

Ford, R.G. 1985. *A Risk Analysis Model for Marine Mammals and Seabirds: A Southern California Bight Scenario*. Final Report to U.S. Department of the Interior, Minerals Management Service MMS 85-0104, Pacific OCS Region, Los Angeles, CA.

French-McCay, D.P. 2009. State of the art and research needs for oil spill impact assessment modelling. pp. 601-653, 2009 in Proceedings of the 32nd AMOP Technical Seminar on Environmental Contamination and Response, Emergencies Science Division, Environment Canada, Ottawa, ON, Canada.

Fry, D.M. 1987. *Seabird Oil Toxicity Study*. Report submitted by Nero and Associates, Inc. to Minerals Management Service, U.S. Department of Interior, Washington, D.C., USA.

Fucik, K.W., Bight, T.J. and Goodman K.S. 1984. Measurements of damage, recovery, and rehabilitation of coral reefs exposed to oil. pp. 115–134 in Cairns Jr., J. and Buikema Jr., A.L. (eds.), *Restoration of Habitats Impacted by Oil Spills*, Butterworth Publishers, Boston, MA.

Guzman H.M., Burns K.A., Jackson B.C. 1994. Injury, regeneration and growth of Caribbean reef corals after a major oil spill in Panama. Marine Ecology Progress Series 105, 231–241.

Hayes M., Hoff R., Michel J., Scholz D. and Shigenaka G. 1992. An introduction to Coastal Habitats and Biological Response to an Oil Spill. Report prepared by the Hazardous Materials Response and Assessment Division National Oceanic and Atmospheric Administration.

Hoff, R. and Michel, J. 2014. Oil spills in mangroves: planning and response considerations. US Department of Commerce. National Oceanic and Atmospheric Administration (NOAA), Seattle, Washington.

Holmes, W.N. and Cronshaw, J. 1977. *Biological Effects of Petroleum on Marine Birds*. pp. 359–398 in Malins, D.C. (ed.), Effect of petroleum on arctic and subartic marine environments and organisms. Vol. II: Biological effects. Academic Press, New York, USA.

Hook S.E., Osborn H.L., Spadaro D.A., Simpson S.L. 2014b. Assessing mechanisms of toxicant response in the amphipod Melita plumulosa through transcriptomic profiling. Aquatic Toxicology 146, 247–257. doi:10.1016/j.aquatox.2013.11.001

International Petroleum Industry Environmental Conservation Association (IPIECA). 2014. Wildlife resopnse preparedness. IPIECA-IOGP Good Practice Guide Series, Oil Spill Response Joint Industry Project (OSR-JIP). IOGP Report 516. London, UK.

International Petroleum Industry Environmental Conservation Association (IPIECA). 2015a. A guide to oiled shoreline clean-up techniques. IPIECA-IOGP Good Practice Guide Series, Oil Spill Response Joint Industry Project (OSR-JIP). IOGP report 521. London, UK.

International Petroleum Industry Environmental Conservation Association (IPIECA). 2015b. At-sea containment and recovery. IPIECA-IOGP Good Practice Guide Series, Oil Spill Response Joint Industry Project (OSR-JIP). IOGP report 522. London, UK.

International Petroleum Industry Environmental Conservation Association (IPIECA). 2015c. Dispersants: surface application. IOGP report 532. London, UK.

International Petroleum Industry Environmental Conservation Association (IPIECA). 2017b. Key principles for the protection, care and rehabilitation of oiled wildlife. IPIECA-IOGP Good Practice Guide Series, Oil Spill Response Joint Industry Project (OSR-JIP). IOGP Report 583. London, UK.

International Tanker Owners Pollution Federation (ITOPF). 2011. Effects if Oil Pollution on the Marine Environment - Technical Information Paper. Published by the International Tanker Owners Pollution Federation Limited, London UK.

Jenssen, B.M. 1994. Review article: Effects of oil pollution, chemically treated oil, and cleaning on the thermal balance of birds. *Environmental Pollution*, 86:207–215.

Law R.J., Kirby M.F., Moore J., Barry J., Sapp M., Balaam J. 2011. PREMIAM – pollution response in emergencies marine impact assessment and monitoring: post-incident monitoring guidelines. In Science Series Technical Report No. 146. Cefas, Lowestoft, UK, <www.cefas.defra.gov.uk/premiam>.

Lee, K. 2011. *Toxicity Effects of Chemically Dispersed Crude Oil on Fish*. International Oil Spill Conference Proceedings 2011(1):163.

Matcott, J., Baylis, S., and Clarke, R.H. 2019. The Influence of Petroleum oil films on the feather structure of tropical and temperate seabird species. Marine Pollution Bulletin 138: 135-144.

Milton, S., Lutz, P. and Shigenaka G. 2003. Oil Toxicity and Impacts on Sea Turtles. In Shigenaka, G. (ed.), *Oil and Sea Turtles: Biology, Planning, and Response*. National Oceanic and Atmospheric Administration (NOAA), Seattle, Washington.

Montagna P.A., Baguley J.G., Cooksey C., Hartwell I., Hyde .LJ., Hyland J.L. et al. 2013. Deep-sea benthic footprint of the Deepwater Horizon blowout. PLoS One 8, e70540. doi:10.1371/journal.pone.0070540

Murawski S.A., Hogarth W.T., Peebles EB, Barbeiri E. 2014. Prevalence of external skin lesions and polycyclic aromatic hydrocarbon concentrations in Gulf of Mexico fishes, post Deepwater Horizon. Transactions of the American Fisheries Society 143, 1084–1097.

National Research Council (NRC). 2005. Oil Spill Dispersants: Efficacy and Effects. The National Academies Press. Washington, DC.

Negri, A.P. and Heyward, A.J. 2000 Inhibition of fertilization and larval metamorphosis of the coral *Acropora millepora* (Ehrenberg, 1834) by petroleum products. *Marine Pollution Bulletin* 41(7–12):420–427.

O'Brien, M. 2002. At-sea recovery of heavy oils - A reasonable response strategy? 3rd Forum on High Density Oil Spill response. The International Tanker Owners Pollution Federation Limited (ITOPF). London, UK.

Ohlendorf, H.M., Risebrough R.W. and Vermeer, K. 1978. *Exposure of Marine Birds to Environmental Pollutants*. U.S. Fish and Wildlife Service Wildlife Research Report 9.

Peters E.C., Gassman N.J., Firman J.C., Richmond R.H., Power EA .1997. Ecotoxicology of tropical marine ecosystems. Environmental Toxicology and Chemistry 16, 12–40. doi:10.1002/etc.5620160103

Pie HV, Heyes A, Mitchelmore C.L. 2015. Investigating the use of oil platform marine fouling invertebrates as monitors of oil exposure in the Northern Gulf of Mexico. The Science of the Total Environment 508, 553–565. doi:10.1016/j.scitotenv.2014.11.050

Pilcher N.J., and Enderby. S. 2001. Effects of prolonged retention in hatcheries of green turtle (Chelonia mydas) hatchling swimming speed and survival. Journal of Herpetology. 35(4): 633–638.

RPS. 2018. WA-343-P Quantitative Spill Risk Assessment. West Perth, Western Australia.

RPS. 2019. INPEX Ichthys Phase 2 Development WA-50-L Oil Spill Risk Assessment. MAW0796J. Report prepared by RPS for INPEX Operations Australia, Perth, Western Australia.

Runcie, J.W. and Riddle, M.J. 2006. Diel variability in photosynthesis of marine macroalgae in ice-covered and ice-free environments in East Antarctica. European Journal of Phycology 41(2):223–233.

Samuels, W.B. and Lanfear K.J. 1982. Simulations of seabird damage and recovery from oil spills in the northern gulf of Alaska. Journal of Environmental Management 15: 169–182.

Seip, K.L., Sandersen, E., Mehlum, F. and Ryssdel, J. 1991. Damages to seabirds from oil spills: comparing simulation results and vulnerability indexes. Ecological Modellin, 53: 39–59.

Sell D, Conway L, Clark T, Picken GB, Baker JM, Dunnet GM. 1995 Scientific criteria to optimize oil spill cleanup. International Oil Spill Conference Proceedings 1995(1), 595–610.

Shigenaka, G. 2001. *Toxicity of Oil to Reef Building Corals: A Spill Response Perspective*. National Oceanic and Atmospheric Administration (NOAA) Technical Memorandum, National Ocean Service, Office of Research and Restoration 8, Seattle, USA.

Simberloff, D. 2009. The role of propagule pressure in biological invasions. The Annual Review of Ecology, Evolution, and Systematics 40:81-102.

Taylor H and Rasheed M. 2011. Impacts of a fuel oil spill on seagrass meadows in a subtropical port, Gladstone, Australia – The value of long-term marine habitat monitoring in high risk areas. Marine Pollution Bulletin 63:431-437.

Varoujean, D.H., Baltz, D.M., Allen, B., Power, D., Schroeder, D.A. and Kempner, K.M. 1983. *Seabird-Oil Spill Behavior Study*. Report by Nero and Associates, Inc. to U.S. Department of the Interior, Minerals Management Service, Reston, VA.

WA Department of Transport (WA DoT). 2018. Provision of Western Australian Marine Oil Pollution Risk Assessment - Protection Priorities - Protection Priority Assessment for Zone 1: Kimberley - Draft Report. Perth, Western Australia.

Woodside Energy Ltd. 2014. Browse FLNG Development, Draft Environmental Impact Statement. EPBC 2013/7079. November 2014. Woodside Energy Ltd., Perth, Western Australia.

X060-AH-LIS-60033 - Spill Impact Mitigation Assessment - IFO/HFO Surface Spill

Location	N/W WA and NT Waters	Spill Scenario	Surface Spill 800m^3 IFO/HFO

Resource Compartment (including values dependent on the resource compartment)	SIMA Stage 2: Predict Outcomes – Potential Relative Impact – No Intervention (natural weathering)	A	SIMA Stage 3: Balance Trade-Offs - Impact Modification Factors – Prediction of the effectiveness and impact modification potential of the response options – Contain and Recover B1	A x B1	Protect and Deflect B2	A x B2	Shoreline Clean-up B3	A x B3	Chemical Dispersant (near spill location) B4	A x B4	Pre-Contact Wildlife Response (Hazing & Translocation) B5	A x B5	Post Contact Wildlife Response B6	A x B6	In-situ Burn (near spill location)	Operational monitoring and evaluation
Subtidal Benthic Communities															In-situ is not considered to be safe, effective or feasible.	Operational monitoring and evaluation is implemented under all oil spill scenarios
Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging within this habitat)	None / Insignificant	1	1	1	0	0	0	0	-1	-1	0	0	0	0		
Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)	None / Insignificant	1	0	0	0	0	0	0	0	0	0	0	0	0		
Deep-sea unconsolidated muds and sands	None / Insignificant	1	0	0	0	0	0	0	0	0	0	0	0	0		
Intertidal seabed																
Intertidal Coral Reef	Moderate	3	1	3	-1	-3	-1	-3	-1	-3	0	0	0	0		
Mangrove/Mudflats/Samphires	Minor	2	1	2	2	4	-1	-2	1	2	0	0	0	0		
Sandy Beach	Minor	2	1	2	1	2	2	4	1	2	0	0	0	0		
Rocky Shoreline	Minor	2	1	2	1	2	1	2	1	2	0	0	0	0		
Macro-Algae and Seagrass	Moderate	3	1	3	-1	-3	-1	-3	-1	-3	0	0	0	0		
Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)	Significant	4	1	4	2	8	2	8	2	8	1	4	1	4		
Water column																
Lower water column (below photic zone)	None / Insignificant	1	0	0	0	0	0	0	0	0	0	0	0	0		
Upper water column (in photic zone, including plankton and EPBC foraging in the photic zone)	Minor	2	1	2	0	0	0	0	-1	-2	0	0	0	0		
Water surface, including foraging areas for EPBC listed species	Moderate	3	1	3	0	0	0	0	1	3	0	0	1	3		
Air	None / Insignificant	1	0	0	0	0	0	0	0	0	0	0	0	0		
Socio-economic																
Commercial demersal fisheries	Moderate	3	0	0	0	0	1	3	0	0	0	0	0	0		
Shallow commercial fisheries (including aquaculture)	Moderate	3	1	3	0	0	1	3	-1	-3	0	0	0	0		
Recreational fisheries	Moderate	3	1	3	0	0	1	3	-1	-3	0	0	0	0		
Cultural heritage																
Aboriginal heritage (cultural practices, sites and fishing / foraging)	None / Insignificant	1	0	0	0	0	1	1	0	0	0	0	0	0		
Indonesian traditional fishing	None / Insignificant	1	1	1	0	0	1	1	-1	-1	0	0	0	0		
		Total Impact Mitigation Score		29		10		17		1		4		7	-	-
		Carried to ALARP evaluation yes/no		Yes		Yes		Yes		Yes		Yes		Yes	No	Yes

Resource Compartment (including values dependent on the resource compartment)	No Intervention (natural weathering)		Justification for Potential Relative Impact Score
		A	
Subtidal Benthic Communities			
Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging within this habitat)	None / Insignificant	1	Subtidal benthic primary producer habitat (BPPH) are unlikley to be exposed to entrained/dissolved IFO/HFO above impact thresholds from a vessel collision in the Browse Basin. HFO will result in insignficant entraied/disoolved hdyrocarboson. IFO surface spill may result in exceedances of the 100ppb entrained oil threshold for up to 5km, and generally only in the top 10m of the water column. Therefore, BPPH in the offshore Browse Basin are not expected to be impacted. The consequence to benthic primary producer habitat is considered to be Insignificant.
Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)	None / Insignificant	1	No impact from surface spill of IFO/HFO below 10m (RPS APASA 2014).
Deep-sea unconsolidated muds and sands	None / Insignificant	1	No impact from surface spill of IFO/HFO below 10m (RPS APASA 2014).
Intertidal seabed			
Intertidal Coral Reef	Moderate	3	Intertidal coral reefs could be impacted by surface fresh, weathered/emulsified, but very limited (if any) entrained and dissolved hydrcarbons from an IFO/HFO surface spill in the Browse Basin. The effect of IFO/HFO on intertidal coral is likely to result in significant smothering as IFO/HFO is expected to remain as a persistent, viscous surface spill when it arrives in intertidal coral areas. Physical oiling of coral tissue can cause a decline in metabolic rate and may cause varying degrees of tissue decomposition which can lead to death (Negri & Heyward 2000). The, toxicity of weathered/emulsified IFO/HFO is less than fresh oil. The effect of any residual toxic fractions of the oil on intertidal coral include partial mortality of colonies, reduced growth rates, bleaching, reduced photosynthesis, interruption of chemical communication necessary for mass spawning, premature explosion of larvae, decreased growth rates, decreased lipid content, decreased survival of larvae, decreased gonadal development, negative impacts to coral settlement, increased susceptibility to algae colonisation, epidemic diseases, localised tissue rupture, reduced reef resilience and mortality (Hayes et al 1992; Peters et al 1997; Negri & Heyward 2000; Shigenaka 2001; CSIRO 2016). Coral reefs are found in isolated locations within the Browse Basin and are considered to be significant benthic primary producers that play a key role in the ecosystem and have an iconic status in the environment (WA DoT 2018). They are considered of high importance to EPBC species that aggregate, nest, roost and forage in the area, hence isolated populations could potentially be exposed in the event of a spill. As spills disperse, intertidal communities are expected to recover (Dean et al. 1998), though the rate of recovery of coral reefs depends on the level or intensity of the disturbance, with recovery rates ranging from 1 or 2 years, to decades (Fucik et al. 1984, French McCay 2009). Impact on the receptor is considered to be Moderate.
Mangrove/Mudflats/Samphires	Minor	2	Mangrove, mudflats and samphire communities, which are remote from Permit areas, may be exposed weathered surface slicks, but are unlikely to be exposed to entrained/dissolved hydrocarbons above impact thresholds from a IFO/HFO spill resulting from a vessel collision in the Browse Basin. The potential effects of surface oiling include defoliation and mortality of mangroves (Burns et al. 1993; Duke et al. 2000). Oil exposure is only likely to occur at isolated locations amongst a very large and generally contiguous populations of mangrove communities. The recovery of mangroves from shoreline oil accumulation can be a slow process, due to the long-term persistence of oil trapped in anoxic sediments and subsequent release into the water column (Burns et al. 1993). Any impacts to benthic habitats are expected to be localised and of short to medium term. The potential consequence is considered to be Minor.
Sandy Beach	Minor	2	Sandy beaches may be exposed to fresh and weathered/emulsified IFO/HFO above impact thresholds in the event of a vessel collision in the Browse Basin. The effect of gradual accumulation of oil on the receptor could lead to harm including the increased prevalence of tumours in species (CSIRO 2016). Sandy beaches are the dominant shoreline habitat on offshore islands in the Browse Basin and are considered significant habitat for turtles and seabird nesting. Organisms such as polychaete worms, bivalves and crustaceans generally inhabit sandy beaches but the mobile nature of the sands generally limits diversity. These species provide a valuable food source for resident and migratory sea and shorebirds (DEC/MPRA 2005). Law et al (2011) note that when grain size is between 2 and 64 mm, beaches are not considered especially sensitive to oil spills as they are regularly cleaned by wave action and oil is generally not retained. Offshore island beaches of the Browse Basin are generally coarse grained, due to high wave energy. WA DoT (2018) assessed Kimberley sandy beaches and concluded that they are moderately ecologically sensitive and are moderately difficult to rehabilitate from an oil spill. The potential consequence is considered to be Minor.
Rocky Shoreline	Minor	2	Rocky shorelines may be exposed to to fresh and weathered/emulsified IFO/HFO above impact thresholds in the event of a vessel collision in the Browse Basin. This receptor is typically characterised as being a high wind and wave energy environment (CSIRO 2016). IFO/HFO from a spill has the potential to coat the substrate or become stranded by receding tides – but incoming tides also have the potential to remove deposited oil (Law et al 2011). CSIRO (2016) note that rocky shorelines are not considered sensitive environments, and IPIECA (2017) state that rocky shorelines generally have a diverse and productive intertidal community which are considered resilient to oil spills and short-term oil persistence. WA DoT (2018) note that rocky shorelines are the least susceptible of shoreline types to long term impacts from a spill. As such, this receptor is not expected to have issues relating to recovery from an oil spill. The potential consequence for rocky shorelines is considered to be Minor.
Macro-Algae and Seagrass	Moderate	3	Macroalgae and seagrass may be exposed to significant concentrations of surface fresh and/or weathered/entrained IFO/HFO, however entrained and dissolved oil would be below impact thresholds from a vessel collision in the Browse Basin. WA DoT (2018) note that dissolved oil causes more impacts to algae than floating oil, as it results in cellular level poisoning. The effect of subjecting seagrass and macroalgae to lethal or sublethal toxic effects of oil can result in mortality, reduced growth rates and impacts to seagrass flowering. Several studies have indicated rapid recovery rates may occur even in cases of heavy oil contamination (Connell et al, 1981; Burns et al. 1993; Dean et al. 1998; Runcie & Riddle 2006). Taylor and Rasheed (2011) reported that seagrass meadows were not significantly affected by an oil spill when compared to a non-impacted reference seagrass meadow. Macroalgae support diverse small invertebrates that are the principal food source for a number of inshore fish (WA DoT 2018). Seagrasses provide energy and nutrients for detrital grazing food webs (WA DoT 2018), act as a refuge for fish and invertebrates, and provide a food source for EPBC species such as dugongs and green turtles (DEC 2007). The potential consequence is considered to be Moderate.
Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)	Significant	4	Intertidal habitat may be exposed to significant concentrations of surface fresh and/or weathered/entrained IFO/HFO, however entrained and dissolved oil would be below impact thresholds from a vessel collision in the Browse Basin. The effect of IFO/HFO on this receptor can result in mortality or harm to benthic primary producers and organisms such as EPBC species that rely on these species for food, or rely on the habitat for nesting and roosting. IPIECA (2014) note that dehydration, gastrointestinal problems and anaemia are commonly found in oiled animals, causing potential long-term effects on reproductive success. They further note that the toxic effects of ingested oil generally impacts the liver, whilst volatile fumes damage lungs resulting in debilitating effects (IPIECA 2014). Oiled aquatic EPBC fauna can further suffer hypothermia, irritations, burns, respiratory problems and loss of waterproofing, leading to them moving onto land (i.e. away from their food source) where they have further difficulty thermoregulating and feeding (IPIECA 2017). Specifically, marine reptiles, including turtles and crocodiles can be exposed to hydrocarbons externally in intertidal areas through direct contact; or internally, by ingesting oil, consuming prey containing oil, or inhaling volatile compounds (Milton et al. 2003). Turtle hatchlings may be particularly vulnerable to toxicity and smothering, as they emerge from nests and make their way over the intertidal area to the water (AMSA 2015; Milton et al. 2003). Birds coated in hydrocarbons can suffer damage to external tissues including skin and eyes, as well as internal tissue irritation in their lungs and stomachs (AMSA 2015; WA DoT 2018). Toxic effects may also result where the product is ingested, either through birds' attempts to preen their feathers (Jenssen 1994; Matcott et al. 2019) or ingested as weathered waxy flakes/residues present on shorelines. There is the potential for short to medium term impacts; however, the overall population viability for any protected species would not be threatened from a vessel collision spill. The cumulative potential consequence is considered to be Significant.

Water column			
Lower water column (below photic zone)	None / Insignificant	1	No impact from surface spill of IFO/HFO below 10m (RPS 2014).
Upper water column (in photic zone, including plankton and EPBC foraging in the photic zone)	Minor	2	The upper water column may be exposed to entrained and dissolved hydrocabons above impact thresholds from a vessel collision in the Browse Basin. HFO will result in no exposure above imact thresholds for entrained/disoolved hydrocarbons, however an IFO spill may result in exceedances of the 100ppb entrained oil threshold for up to 5km in the top 10m of the water column (RPS 2014). The effect of entrained and dissolved oil on this receptor include chronic impacts to juvenile fish, larvae and planktonic organisms due to their sensitivity during these life stages, with the worst impacts predicted to occur in smaller species (WA DoT 2018). Whale sharks are filter feeders and are expected to be highly vulnerable to entrained hydrocarbons (Campagna et al 2011) with potential effects including damage to the liver and lining of the stomach and intestines, as well as toxic effects on embryos (Lee 2011). Marine mammals, marine reptiles and marine avifauna could also be impacted through entrained and dissolved hydrocarbon exposure, primarily through ingestion during foraging activities (AMSA 1998). The upper water column is considered to be very important habitat for EPBC species as a large number of BIAs for marine fauna are present in the Browse Basin. It is expected that the upper water column will recover quickly as a vessel collision spill is unlikely to cause significant or cumulative impacts. Impacts to the upper water column from an IFO/HFO spill will be short-term and highly localised. Therefore, the consequence to the upper water column is considered to be Minor.
Water surface, including foraging areas for EPBC listed species	Moderate	3	The water surface will be exposed to fresh and weathered/emulsified IFO/HFO above impact thresholds from a vessel collision in the Browse Basin. Fresh and weathered oil can impact marine mammals surfacing, as they are vulnerable to oil exposure. Blue whales and humpback whales (baleen whales), that filter-feed near the surface, could potentially ingest oil. Oil may also foul the fibres of baleen whales impairing food gathering efficiency or fouling prey with hydrocarbons (AMSA 2015). Turtles can be exposed to hydrocarbons if they surface within the spill, resulting in direct contact with the skin, eyes, and other membranes, as well as the inhalation of vapours or ingestion (Milton et al. 2003). Floating oil is considered to impact reptiles more than entrained/dissolved oil because reptiles hold their breath underwater and are unlikely to directly ingest dissolved oil (WA DoT 2018). Other aspects of turtle behaviour, including a lack of avoidance behaviour, indiscriminate feeding in convergence zones, and large, pre dive inhalations, make them vulnerable to spilled oil (AMSA 2015). Hatchlings spend more time on the surface than older turtles, thus increasing the potential for contact with oil slicks (Milton et al. 2003). Aquatic migratory birds are among the most vulnerable and visible species to be affected by surface oil, with oil impacts frequently leading to long-term physiological changes potentially resulting in lower reproductive rates or survival rates (Fingas 2012). The probability of lethal effects is dependent on factors such as timing, location, oceanographic and weather patterns, and the movements of species that forage, feed, nest and inhabit that area (IPIECA 2014), the amount of time spent on the water surface as well as any oil avoidance behaviour (French-McCay 2009). Direct contact with surface hydrocarbons may break down the ability of plumage to maintain body heat, resulting in direct and indirect impacts such as hypothermia, dehydration, drowning and starvation (AMSA 2015; Matcott et al, 2019; Jenssen 1994; IPIECA 2014; ITOPF 2011). Birds resting at the sea surface or surface plunging can be impacted by oil resulting in damage to external tissues, including skin and eyes, and internal tissue irritation in lungs and stomachs (Clark 1984; WA DoT 2018). Toxic effects may also result where hydrocarbons are ingested, as birds attempt to preen their feathers (Jenssen 1994; Matcott et al. 2019). The water surface is considered an important receptor where EPBC listed species forage. It is expected to recover from oil impacts with time, and there is potential that there could be cumulative impacts through bioaccumulation up the food chain from a surface spill of IFO/HFO. The consequence is considered to be Moderate.
Air	None / Insignificant	1	Air may be exposed to fresh surface IFO/HFO above impact thresholds from a vessel collision in the Browse Basin. IFO has low concentrations of aromatic hydrocarbons, and HFO has very low concentrations of aromatic hydrocarbons (RPS 2014). Although species such as cetaceans and marine reptiles could also be affected by harmful vapours during pre-dive inhalations (Milton et al. 2003), the risk of exposure is only present in the first few hours after the spill. Therefore, there is a low likelihood that local concentrations of atmospheric volatiles would exceed levels that would have the potential to cause harmful impacts to air breathing marine fauna. The receptor is not considered to be sensitive, thus is expected to recover in a very short period of time, as the evaporated hydrocarbons are rapidly dispersed by the wind, and evaporation from IFO/HFO will very rapidly reduce with time as oil weathers and emulsifies. Only a very localised area, immediately above the freshest parts of the oil slick, in the very initial states of the spill, would be impacted by evaporating hydrocarbons. The potential therefore consequence is considered to be Insignificant.
Socio-economic			
Commercial demersal fisheries	Moderate	3	Commercial demersal fisheries may be exposed to surface, weathered, entrained and limited dissolved IFO/HFO above impact thresholds from a vessel collision in the Browse Basin. Very limited entrained/dissolved hydrocarbons are expected, and none deeper than 10 metres (RPS 2014). The effect of shallow entrained/dissolved on this receptor includes the ability to cause economic loss (through indirect loss of stock and perceived tainting of stock by oil) (WA DoT 2018), impede access to fishing areas from the implementation of an exclusion zone during a spill response; impact seafood quality and employment; plus negatively impact lines and nets (ITOPF 2011). The economic impact from an oil spill is dependent on the species being cultured, as species have different recovery rates. WA DoT (2018) note that dissolved oil will impact finfish, taking 6-8 years for fisheries to recover (due to the time it takes for hatchlings to reach maturity) (WA DoT 2018), however due to limited dissolved components during an IFO/HFO spill, these impacts are unlikely. This receptor is considered to be important, however a vessel collision spill is unlikely to cause significant impacts to demersal fisheries due to the shallow, localised and very limited entrained oil affected area. The real and perceived consequence is considered to be Moderate.
Shallow commercial fisheries (including aquaculture)	Moderate	3	Shallow commercial fisheries (including aquaculture) may be exposed to surface, weathered, entrained and limited dissolved IFO/HFO above impact thresholds from a vessel collision in the Browse Basin. Very limited entrained/dissolved hydrocarbons are expected, and none deeper than 10 metres (RPS 2014). The effect of IFO/HFO spills on this receptor includes the ability to cause economic loss (through indirect loss of stock and perceived tainting of stock by oil) (WA DoT 2018), impede access to fishing areas from the implementation of an exclusion zone during a spill response; impact seafood quality and employment; plus negatively impact lines and nets (ITOPF 2011). The economic impact from an oil spill is dependent on the stock being cultured, as species have different recovery rates. DoT (2018) note that dissolved oil will have the greatest impact, with oyster farms potentially taking 3-4 years to recover from a spill (DoF 2013), whilst finfish farms could take 6-8 years to recover due to the time it takes for hatchlings to reach maturity. WA DoT (2018) note that the pearling industry relies almost exclusively on sourcing pearl oysters from Eighty Mile Beach (south of Broome) and an area off the Lacepede Islands. There is also other aquaculture in the region including trochus and barramundi (Fletcher et al 2017). WA DoT (2018) note that some wild stocks aquaculture species such as mussels are impacted more by dissolved oil than floating oil due to being filter feeders. however due to limited dissolved components during an IFO/HFO spill, these impacts are unlikely. This receptor is considered to be important however a vessel collision spill in the Browse Basin unlikely to cause any significant impacts to shallow commercial fisheries (including aquaculture) due to the limited and localised surface and very limited shallow entrained oil and remoteness of the shallow commercial fishing areas and aquaculture to potential release locations. Therefore, the real and perceived consequence is considered to be Moderate.
Recreational fisheries	Moderate	3	Recreational fisheries may be exposed to surface, weathered, entrained and limited dissolved IFO/HFO above impact thresholds from a vessel collision in the Browse Basin. Very limited entrained/dissolved hydrocarbons are expected, and none deeper than 10 metres (RPS 2014). The effects of IFO/HFO on this receptor includes negatively impacting nets and lines (ITOPF 2011), impeding access to fishing areas from the implementation of an exclusion zone during a spill response and impacting seafood quality and quantity. Recreational fishing is generally concentrated around readily accessible coastal settlements along the Kimberley and NT coastlines (such as Broome, Wyndham and Darwin) and there is little recreational fishing around the offshore Browse Basin due to the distance from land, lack of features of interest and deep waters. Offshore islands, coral reef systems and continental shelf waters of the Browse Basin however are increasingly being targeted by fishing based charter vessels (Fletcher and Santoro 2014) with extended fishing charters operating during certain times of the year. This receptor is considered to be important, however a vessel collision spill is unlikely to cause significant impacts to recreational fisheries due to the limited and localised surface and very limited shallow entrained oil affected area and very limited recreational fishing in the offshore Browse Basin. The real and perceived consequence is considered to be Moderate.
Cultural heritage			
Aboriginal heritage (cultural practices, sites and fishing / foraging)	None / Insignificant	1	Aboriginal heritage including special places, cultural landscapes, practices and fishing/foraging along the Kimberley and NT coastline are highly unlikely to be impacted by surface and weathered IFO/HFO above impact thresholds from a vessel collision in the Browse Basin. The effect of surface weathered IFO/HFO on this receptor includes physically degrading a site, disrupting the harvesting of fish, and area closures could displace Aboriginal people and have implications on cultural identity, health and wellbeing. The receptor is important however is very remote from any potential vessel collision location and the recovery is expected to be short to medium term. Therefore, consequence is considered to be Insignificant.
Indonesian traditional fishing	None / Insignificant	1	Indonesian traditional fishing areas may be exposed to surface, weathered, entrained and limited dissolved IFO/HFO above impact thresholds from a vessel collision in the Browse Basin. Very limited entrained/dissolved hydrocarbons are expected, and none deeper than 10 metres (RPS 2014).. Indonesian traditional fishing occurs within the MoU box which covers Scott Reef and surrounds, Seringapatam Reef, Browse Island, Ashmore Reef, Cartier Island and various banks and shoals. The effect of IFO/HFO on these receptor could include reduction and contamination of target species such as sea cucumbers (bêche-de-mer), trochus (top shell snail), reef fish. Exclusion zones during the spill response may also affect access to fishing locations, even if the target species are not affected by the spill. This receptor is considered to be important however a vessel collision spill is unlikely to cause significant impacts to Indonesian traditional fishing due to the limited and localised surface and very limited shallow entrained oil affected area. The real and perceived consequence is considered to be Insignificant.

Containment and Recovery

Overall statement of likelihood of success of Contain and Recovery (C&R):

Aim: This strategy aims to collect oil from the ocean surface using booms and skimmers, generally at or near the release location, where oil concentrations are highest. Floating booms are used to corral and concentrate spilled floating oil into a surface thickness that will allow for mechanical removal (i.e. pumping oil into temporary storage) by devices such as skimmers (IPIECA 2015).

Type of slick: Surface oil is in the form of Group IV (IFO/HFO) floating slicks which have a high viscosity and will not rapidly spread into sheens. Surface oil concentrations will be approximately 25 g/m2 at 300 km, 10 g/m^2 (~0.01mm, which equates to Bonn code 1/2) up to approximately 500 km and down to below 1 g/m^2 up to approximately 1200 km from the spill site (RPS 2014). With increasing wind conditions, IFO and HFO will rapdily increase in viscocity and emulsify. Due to the high viscosity of IFO-180, entrained oil concentrations may exceed 100ppb for up to 5km, and may exceed 10 ppb for up to 50km from an IFO spill location (RPS 2014). Due to the very high viscosity of HFO 380, no entrainment is expected (RPS 2014). IFO-180 has low concentrations of soluble aromatic hydrocarbons, and this component will tend to evaporate from the slicks. Hence, low concentrations (<6ppb) are forecast in the water upper water column (RPS 2014), with no dissolved factions expected in the lower water column or near deep seabed. As HFO has even lower concentrations of soluble aromatic hydrocarbons than IFO, no dissolved fractions in the water column are expected (RPS 2014).

Likely success/effectiveness against slick: O'Brien (2002) notes that spreading of oil is the main obstacle to a successful at sea contain and recovery response. IFO/HFO oil do not spread rapidly, and as such, booming and recovery with skimmers is considered a viable response option. Generally oil needs to be >100 g/m^2 (>0.1mm, which equates to Bonn code 4/5) to feasibly corral oil with a boom and achieve any significant level of oil recovery with skimmers (O'Brien 2002), as booms have limited effect against thin oil films and no effect against a subsurface plume (ITOPF 2011). In the context of the Browse Basin, even with high sea surface and air temperatures in all seasons, the spreading of any IFO/HFO spill is not expected to be rapid. IFO/HFO spilled from a vessel collision would therefore remain at a thickness of >100g/m^2 for a reasonable period of time, making C&R a practical option (IPIECA 2017). Where there is any significant IFO/HFO slick, flammable/toxic vapours are not likely to be present, (except possibly in the first few hours), and therefore explosive limits or VOC exposure thresholds are not expected to be exceeded. Due to the thick surface slicks, moderate rates of recovery would be expected, provided the right weather conditions. IPIECA (2015) state that efficiency of contain and recover operations (for any oil type) can vary widely due to operational, environmental and logistical constraints, but usually it is limited to recovering approximately only 5-20% of the initial spilled volume. Contain and recovery is therefore considered a feasible response strategy for a Group IV (IFO/HFO) spill.

Resource Compartment (including values dependent on the resource compartment)	Impact Modification Score		Justification for Impact Modification Score
		B	
Subtidal Benthic Communities			
Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)	Minor mitigation of impact	1	C&R may result in a minor (5-20%) reduction in localised surface oil which may have a minor positive outcome in reducing future entrained oil in the upper water column including submerged BBPH.
Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)	No or insignificant alteration of impact	0	C&R occurs on the surface and has no impact on entrained oil affecting deep sea features.
Deep-sea unconsolidated muds and sands	No or insignificant alteration of impact	0	C&R occurs on the surface and has no impact on entrained oil affecting deep sea unconsolidated muds and sands.
Intertidal seabed			
Intertidal Coral Reef	Minor mitigation of impact	1	C&R may result in a minor may result in a minor (5-20%) reduction on oil on surface, resulting in minor reduction in surface and entrained oil reaching intertidal zones.
Mangrove/Mudflats/Samphires	Minor mitigation of impact	1	
Sandy Beach	Minor mitigation of impact	1	
Rocky Shoreline	Minor mitigation of impact	1	
Macro-Algae and Seagrass	Minor mitigation of impact	1	
Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)	Minor mitigation of impact	1	
Water column			
Lower water column (below photic zone)	No or insignificant alteration of impact	0	C&R occurs on the surface and has no impact on entrained oil affecting the lower water column.
Upper water column (in photic zone)	Minor mitigation of impact	1	C&R may result in a minor (5-20%) reduction in localised surface oil, which may have a minor positive outcome in reducing future entrained oil in the upper water column.
Water surface	Minor mitigation of impact	1	C&R may result in a minor (5-20%) reduction in localised surface oil.
Air	No or insignificant alteration of impact	0	Due to the very low aromatic hydrocarbon content of IFO/HFO, evaporation is expected to be low. Therefore, C&R activities would not result in any significant change to local atmospheric VOC concentrations.

Socio-economic			
Commercial demersal fisheries	No or insignificant alteration of impact	0	C&R may result in a minor (5-20%) reduction in localised surface oil which may have a minor positive outcome on entrained oil in the upper watercolum, however would resulting in no change to oil exposure to demersal fish communities.
Shallow commercial fisheries (including aquaculture)	Minor mitigation of impact	1	C&R may result in a minor reduction in localised surface oil which may have a minor positive outcome in reducing future entrained oil in the upper water column including shallow commercial and recreational fisheries.
Recreational fisheries	Minor mitigation of impact	1	
Cultural heritage			
Aboriginal heritage (cultural practices, sites and fishing / foraging)	No or insignificant alteration of impact	0	C&R may result in a minor reduction in localised surface oil which may have a minor positive outcome in reducing future entrained oil in the upper water column. However, due to distance to aboriginal cultural heritage receptors, the impact mitigation potential is considered to be insignificant.
Traditional Indonesian fishing	Minor mitigation of impact	1	C&R may result in a minor reduction in localised surface oil which may have a minor positive outcome in reducing future surface oil and entrained oil in the upper water column reaching shallow traditional fishing habitats.

Protect and Deflect

Overall statement of likelihood of success of Protect and Deflect (P&D):

Aim: This strategy aims to use physical barriers to exclude or restrict the spill contacting specific sensitive receptors or to deflect the spill from these locations; typically onto less sensitive areas.

Type of slick: Surface oil is in the form of Group IV floating slicks which have a high viscosity and will not rapidly spread into sheens. Surface oil concentrations will be approximately 25 g/m2 at 300 km, 10 g/m2 (~0.01mm, which equates to Bonn code 1/2) up to approximately 500 km and down to below 1 g/m2 up to approximately 1200 km from the spill site (RPS 2014). With increasing wind conditions, IFO and HFO will rapdily increase in viscocity and emulsify. Due to the high viscocity of IFO-180, entrained oil concentrations may exceed 100ppb for up to 5km, and may exceed 10 ppb for up to 50km from an IFO spill location (RPS 2014). Due to the very high viscosity of HFO 380, no entrainment is expected (RPS 2014). IFO-180 has low concentrations of soluble aromatic hydrocarbons, and this component will tend to evaporate from the slicks. Hence, low concentrations (<6ppb) are forecast in the water upper water column (RPS 2014), with no dissolved factions expected in the lower water column or near deep seabed. As HFO has even lower concentrations of soluble aromatic hydrocarbons than IFO, no dissolved fractions in the water column are expected (RPS 2014).

Likely success/effectiveness against slick: Booms could be used to protect and deflect surface spills away from sensitive habitats. Generally oil needs to be >100 g/m^2 (>0.1mm, which equates to Bonn Code 4/5) to feasibly corral oil with a boom (O'Brien 2002), as would be required for a P&D response. IFO/HFO slicks and emulsions on the ocean surface from a vessel collision may reach intertidal shorelines at >100 g/m^2. Even in a scenario where the best equipment is available, shoreline protect and deflect activities at Browse Island or other exposed remote shoreline locations, would be technically challenging due to the general exposure to unfavourable sea conditions, large tidal range and shallow coral reefs. Generally protect and deflect is limited to sheltered waters, not exposed reef/beach environments. Only under exceptionally calm sea-states and appropriate tides would it be safe to conduct vessel activities to carry-out an effective protect and deflect operation at remote shorelines. MetOcean conditions required for this technique to be successful include <1 m sea-state and low surface currents - but these are frequently exceeded at remote offshore locations in the Browse Basin region. In addition, given the size of the offshore island shorelines (e.g. Browse Island, one of the smallest offshore islands, has an intertidal zone 3km in diameter, 7km in circumference), a substantial number of booms would be needed to be deployed to protect the shorelines, or deflect oil into a collection point on a beach. Anchoring of booms would most likely result in additional damage to the subtidal and intertidal environment (coral reef) surrounding most offshore islands, due to anchor chain drag. Booms themselves would also drag around on the coral intertidal reef during periods of lower tides, potentially resulting in significant physical damage to the benthos of the reef platform and also result in damage to booms. Booms could potentially be held in place by vessels however due to widths of shorelines requiring protection this would most likely require an unfeasibly large number of vessels, and at low tide this isn't practicable in intertidal zones. Most offshore island shorelines would be expected to have some ability to 'self clean' accumulated IFO/HFO slicks, due to the coarse substrate, the high wave energy and high tidal regime (Fingas 2012), further reducing the impact mitigation potential of protect and deflect at these locations. As a result of the above mentioned factors, protect and deflect may result in some deflection or recovery of Group IFO/HFO slicks at remote intertidal/shoreline habitats.

Resource Compartment (including values dependent on the resource compartment)	Impact Modification Score		Justification for Impact Modification Score
		B	
Subtidal Benthic Communities			
Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)	No or insignificant alteration of impact	0	P&D occurs on the surface at a shoreline location and will have insignificant impact on entrained oil affecting subtidal benthic primary producer habitat.
Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)	No or insignificant alteration of impact	0	P&D occurs on the surface at a shoreline location and has insignificant impact on entrained oil affecting deep sea features.
Deep-sea unconsolidated muds and sands	No or insignificant alteration of impact	0	P&D occurs on the surface at a shoreline location and has insignificant impact on entrained oil affecting deep sea unconsolidated muds and sands.
Intertidal seabed			
Intertidal Coral Reef	Minor additional impact	-1	P&D may result in a minor reduction of slicks of weathered/emulsified IFO/HFO reaching intertidal receptors. However, anchoring extensive boom arrays would most likely result in physical damage to subtidal and intertidal coral reefs.
Mangrove/Mudflats/Samphires	Moderate mitigation of impact	2	P&D is a proven method of preventing or reducting the impact of floating slicks from reaching intertidal receptors, particularly if a creek-mouth can be boomed to protect a wetland/mangrove community upstream of the creek-mouth. Due to the extensive scale of mangrove communities along the mainland and islands of the Kimberley and NT coastline, only small areas of mangroves could be protected, not the entire habitat. However, if the most important habitats are protected, a significant positive impact mitigation potential can be achieved. Anchors/anchor chains also have the potential to damage mangrove aerial root structures and disturb other fragile low-energy shorelines, therefore care would be required to prevent additional impacts.

Sandy Beach	Minor mitigation of impact	1	P&D may result in a minor reduction of slicks of weathered/emulsified IFO/HFO reaching intertidal receptors. A correctly executed P&D activity may result in a positive outcome compared to natural weathering.

Rocky Shoreline	Minor mitigation of impact	1	P&D may result in a minor reduction of slicks of weathered/emulsified IFO/HFO reaching intertidal receptors. A correctly executed P&D activity may result in a positive outcome compared to natural weathering.
Macro-Algae and Seagrass	Minor additional impact	-1	P&D may result in a minor reduction of slicks of weathered/emulsified IFO/HFO reaching intertidal receptors. However, anchoring extensive boom arrays would most likely result in physical damage to subtidal and intertidal seagrass and macro-algaie.
Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)	Moderate mitigation of impact	2	P&D can achieve a reduction of slicks of weathered/emulsified IFO/HFO reaching intertidal receptors. A correctly executed P&D activity may result in a positive outcome compared to natural weathering, including potential reduction of impact on protected species such as marine avifauna and turtles who utilise these habitats. This is espeically the case for receptors where a creek-mouth can be easily boomed to protect a large area of important habitat further upstream.
Water column			
Lower water column (below photic zone)	No or insignificant alteration of impact	0	P&D does not reduce the amount of entrained oil affecting the lower water column.
Upper water column (in photic zone)	No or insignificant alteration of impact	0	P&D does not reduce the amount of entrained oil affecting the upper water column.
Water surface	No or insignificant alteration of impact	0	P&D would only occur near shorelines and would not result in any significant reduction to the volume of oil on the water surface.
Air	No or insignificant alteration of impact	0	P&D would only occur at shorelines remote form the spill release location. The weathered slick will not have any significant volatile components remaining, and therefore P&D would have no effect on local atmospheric conditions.
Socio-economic			
Commercial demersal fisheries	No or insignificant alteration of impact	0	P&D would result in insignificant reduction in entrained oil, resulting in no change to oil exposure to commercial demersal fisheries.
Shallow commercial fisheries (including aquaculture)	No or insignificant alteration of impact	0	P&D would result in insignificant reduction in oil on surface or entrained oil, resulting in no change to oil exposure to shallow commercial fisheries including aquaculture sites.
Recreational fisheries	No or insignificant alteration of impact	0	P&D would result in insignificant reduction in oil on surface or entrained oil, resulting in no change to oil exposure to fish communities, thus no change to recreational fishing.
Cultural heritage			
Aboriginal heritage (cultural practices, sites and fishing / foraging)	No or insignificant alteration of impact	0	P&D would result in insignificant reduction in oil on surface and entrained oil, resulting in no change to impacts on Aboriginal heritage.
Traditional Indonesian fishing	No or insignificant alteration of impact	0	P&D would result in insignificant reduction in oil on surface and entrained oil, resulting in no change to impacts on Indonesian traditional fishing areas.

Shoreline Clean-Up

Overall statement of likelihood of success of Shoreline Clean-Up:

Aim: Using various physical means to clean up oil from affected shorelines to reduce impacts on sensitive receptors or to avoid any reintroduction of the hydrocarbon to the marine environment. It is often viewed as a three step process, with the first phase involving bulk collection of oil floating against the shoreline or stranded on it; phase two involving in-situ treatment of shoreline substrate and phase three involving removal of any remaining residues (final polish) (IPIECA 2015).

Type of slick: Surface oil is in the form of Group IV floating slicks which have a high viscosity and will not rapidly spread into sheens. Surface oil concentrations will be approximately 25 g/m2 at 300 km, 10 g/m2 (~0.01mm, which equates to Bonn code 1/2) up to approximately 500 km and down to below 1 g/m2 up to approximately 1200 km from the spill site (RPS 2014). With increasing wind conditions, IFO and HFO will rapdily increase in viscocity and emulsify. Due to the high viscocity of IFO-180, entrained oil concentrations may exceed 100ppb for up to 5km, and may exceed 10 ppb for up to 50km from an IFO spill location (RPS 2014). Modelling of a vessel collision in Permit Areas in the Browse Basin indicate that shoreline contact could occur in <24 hours, within total volumes of oil ashore up to 300 m3.

Likely success/effectiveness against slick: Shoreline clean-up has been consistently found to not enhance ecological recovery of oiled coastlines (Sell et al 1995) but it may protect other resources in the area, such as birds, marine mammals or subtidal habitats including coral reefs or fish farms (CSIRO 2016). Choosing a particular clean-up technique is dependent on factors such as shoreline type, exposure, sensitivity, amount of oil, persistence of oil, toxicity of oil and rate of natural oil removal (IPIECA 2015). Mechanical cleaning is generally not an appropriate technique for offshore/remote shorelines, and manual techniques involving rakes and shovels would likely be required. The clean-up of IFO/HFO spills from a beach or shoreline is likely to be difficult, generating high volumes of waste in comparison to the oil recovered. Browse Island and other similar offshore shorelines would be expected to have some ability to naturally 'self-clean', due to the coarse substrate present and the high wave energy and high tidal regime (Fingas 2012), however due to the adhesivness and persistence of IFO/HFO slicks, a shoreline clean-up to assist with natural weathering may be warranted. Typically, inaccessible rocky coves are highly exposed and are best left to naturally clean (IPIECA 2015). ITOPF (2011) also note that for a number of sensitive shoreline types, such as mangroves, natural cleaning is the preferred option in order to minimise the damage caused from clean-up activities. Thus shoreline clean-up would be most effective in areas which are expected to receive large amounts of shoreline oil; where chosen activities don't physically break/damage sensitive habitat such as coral or mangroves; and in areas which are not expected to readily self clean a persistent slick.

Resource Compartment (including values dependent on the resource compartment)	Impact Modification Score		Justification for Impact Modification Score
		B	
Subtidal Benthic Communities			
Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)	No or insignificant alteration of impact	0	Shoreline clean-up will have no impact on entrained oil in benthic primary producer habitat within subtidal areas.
Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)	No or insignificant alteration of impact	0	Shoreline clean-up will have no impact on entrained oil affecting filter feeding communities within subtidal areas.
Deep-sea unconsolidated muds and sands	No or insignificant alteration of impact	0	Shoreline clean-up will have no impact on entrained oil affecting deep-sea unconsolidated muds and sands in subtidal areas.
Intertidal seabed			
Intertidal Coral Reef	Minor additional impact	-1	Shoreline clean-up on an intertidal coral reef would result in physical damage/breaking of coral structures, therefore a net damage to the eco-system.
Mangrove/Mudflats/Samphires	Minor additional impact	-1	Shoreline clean-up within mangrove/low energy ecosystems is likely to result in more physical damage/breaking of mangrove root structures than benefit from any oil removed.
Sandy Beach	Moderate mitigation of impact	2	Shoreline clean-up of sandy beaches is a well understood, well documented spill response technique, which can reliably remove thick oil from the eco-system. This is beneficial for species such as turtles who nest on sandy beaches. Natural weathering on high energy beaches may be effective, however shoreline clean-up may significantly assist the natural weathering processes.
Rocky Shoreline	Minor mitigation of impact	1	Shoreline clean-up of rocky shorelines is a well understood, well documented spill response technique, which has the ability to remove some oil from the eco-system. However, certain techniques like steam cleaning and high pressure blasting are known to cause more harm than allowing the oil to naturally weather. Therefore, this technique would likely be successful, provided the correct clean-up techniques are chosen.

Macro-Algae and Seagrass	Minor additional impact	-1	Shoreline clean-up within intertidal macro-algae/seagrass ecosystems would likely result in more physical disturbance to plant/root structures than benefit from any oil removed.
Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)	Moderate mitigation of impact	2	If it is deemed that the amount of hydrocarbons expected to impact shorelines is large enough that a shoreline clean up will have positive impacts, then the removal of persistent oil from the intertidal zones would likely result in reduction in harm to the benthic primary producers and associated food sources utilised by foraging protected fauna such as seabirds. Also, removal of persistent oil reaching a turtle nesting beach would be of benefit to turtle nesting success. Caution is required, as additional physical damage can occur in sensitive intertidal environments, and the general presence of responders can result in additional disturbance to natural wildlife behaviours and processes, especially seabirds and turtle nesting etc.
Water column			
Lower water column (below photic zone)	No or insignificant alteration of impact	0	Shoreline clean-up will have insignificant impact on entrained oil in the lower water column.
Upper water column (in photic zone)	No or insignificant alteration of impact	0	Shoreline clean-up will have insignificant impact on entrained oil in the upper water column.
Water surface	No or insignificant alteration of impact	0	Shoreline clean-up will have insignificant impact on thin surface slicks on the water surface.
Air	No or insignificant alteration of impact	0	As oil will have significantly weathered by the time it reaches a shoreline, clean-up activities will result in no net change to impacts to air quality.
Socio-economic			
Commercial demersal fisheries	Minor mitigation of impact	1	Reduction in oil remobilising from a shoreline into intertidal habitats may result in less harm to intertidal fish nurseries and foraging habitats. However damage to these ecosystems could occur, through physical damage associated with shoreline clean-up in sensitive intertidal environments.
Shallow commercial fisheries (including aquaculture)	Minor mitigation of impact	1	Reduction in oil remobilising from a shoreline into intertidal habitats may result in less harm to intertidal fish nurseries and foraging habitats. However damage to these ecosystems could occur, through physical damage associated with shoreline clean-up in sensitive intertidal environments.
Recreational fisheries	Minor mitigation of impact	1	Reduction in oil remobilising from a shoreline into intertidal habitats may result in less harm to intertidal fish nurseries and foraging habitats. However damage to these ecosystems could occur, through physical damage associated with shoreline clean-up in sensitive intertidal environments.
Cultural heritage			
Aboriginal heritage (cultural practices, sites and fishing / foraging)	Minor mitigation of impact	1	Shoreline clean-up may reduce oil damage to Aboriginal heritage sites along the Kimberley / NT coastline, however care would be required to ensure important sites are not damaged during the clean-up process.
Traditional Indonesian fishing	Minor mitigation of impact	1	Reduction in oil remobilising from a shoreline into intertidal habitats may result in less harm to intertidal fish nurseries and foraging habitats. However damage to these ecosystems could occur, through physical damage associated with shoreline clean-up in sensitive intertidal environments.

Chemical Dispersant - Surface

Overall statement of likelihood of success of Chemical Dispersant:

Aim: To remove oil from the sea's surface via dispersant spraying from vessels and aircraft, thus reducing the amount of oil reaching birds, mammals and other organisms - as well as coastal habitats, socioeconomic features and shorelines (IPIECA 2015c).

Type of slick: Surface oil is in the form of Group IV floating slicks which have a high viscosity and will not rapidly spread into sheens. Surface oil concentrations will be approximately 25 g/m2 at 300 km, 10 g/m2 (~0.01mm, which equates to Bonn code 1/2) up to approximately 500 km and down to below 1 g/m2 up to approximately 1200 km from the spill site (RPS 2014). With increasing wind conditions, IFO and HFO will rapdily increase in viscocity and emulsify. Due to the high viscocity of IFO-180, entrained oil concentrations may exceed 100ppb for up to 5km, and may exceed 10 ppb for up to 50km from an IFO spill location (RPS 2014). Due to the very high viscocity of HFO 380, no entrainment is expected (RPS 2014). IFO-180 has low concentrations of soluble aromatic hydrocarbons, and this component will tend to evaporate from the slicks. Hence, low concentrations (<6ppb) are forecast in the water upper water column (RPS 2014), with no dissolved factions expected in the lower water column or near deep seabed. As HFO has even lower concentrations of soluble aromatic hydrocarbons than IFO, no dissolved fractions in the water column are expected (RPS 2014).

Likely success/effectiveness against slick: The National Research Council (2005) notes that the window to use dispersants is early, typically within hours to 2 days of a spill, then after that, weathering makes oil more difficult to disperse (due to increased viscosity). Rapid dispersion of dispersant-treated oil begins at a wind speed of approximately 7 knots with wave heights of 0.2 to 0.3 metres (IPIECA 2015c). Conditions where wave energy is too low, oil droplets may resurface after being applied with dispersant due to oil not being effectively dispersed into the water column. Dispersant becomes challenging in high winds and rough seas, where floating oil will be over-washed or temporarily submerged (IPIECA 2015c). Whilst dispersants reduce the amount of oil on the surface that can affect wildlife, they also increase the exposure of dispersed oil in the upper water column to other wildlife.

Generally oil slicks needs to be >100 g/m^2 (>0.1mm, which equates to Bonn code 4/5) to feasibly achieve a successfully dispersant operation (IPIECA 2015c). In the context of the Browse Basin, even with high sea surface and air temperatures in all seasons, the spreading of any IFO/HFO spill is not expected to be rapid. IFO/HFO spilled from a vessel collision would therefore remain at a thickness of >100g/m2 for a reasonable period of time, making surface dispersant application a practical option. Where there is any significant IFO/HFO slick, flammable/toxic vapours are not likely to be present, (except possibly in the first few hours), and therefore explosive limits or VOC exposure thresholds are not expected to be exceeded. Therefore, surface dispersant application on a IFO/HFO slick is potentailly a feasible response strategy. Dispersed oils typically remain within the top 30m of the water column (AMSA 2010), limiting their impact to deep water receptors. Modelling (RPS APASA 2014b) incicates that if dispersant is applied too close to a submerged receptor, dispersed hydrocarbon concentrations are likely to exceed impact thresholds, however with increasing distance, and/or time for dispersed oil to reach a receptor, a significant decrease in the recieved oil concentration is observered. Approximately 20km was the safe threshold determined for surface dispersant application, based on modelling (RPS APASA 2014b).

Resource Compartment (including values dependent on the resource compartment)	Impact Modification Score		Justification for Impact Modification Score
		B	
Subtidal Benthic Communities			
Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)	Minor additional impact	-1	Surface dispersant and additional entrained oil would result in negative impacts to shallow water BPPH, in the top 30m of the water column. However, impacts would be minor, provided dispersant applied at a significant distance from the BPPH to enable sufficient dilution of the dispersed oil.
Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)	No or insignificant alteration of impact	0	Surface dispersant would result in an insignificant increase in any additional oil reaching deep water locations, regardless of chemical dispersant application on the surface.
Deep-sea unconsolidated muds and sands	No or insignificant alteration of impact	0	
Intertidal seabed			
Intertidal Coral Reef	Minor additional impact	-1	Surface dispersant and additional entrained oil would result in negative impacts to shallow water corals, in the top 30m of the water column. However, impacts would be minor, provided dispersant applied at a significant distance from the BPPH to enable sufficient dilution of the dispersed oil.
Mangrove/Mudflats/Samphires	Minor mitigation of impact	1	Surface dispersant would result in a reduction in the 'stickiness' of oil, resulting in less smothering of mangroves, samphires and other intertidal vegetation. As mangroves are more susceptible to smothering than toxic effects of dissolved oil, surface dispersant would result in a positive outcome for these community types.

Sandy Beach	Minor mitigation of impact	1	Surface dispersant would result in an increase in entrainment resulting in less oil arriving on a shoreline. Also, dispersant would result in a reduction in the 'stickiness' of oil, resulting in potentailly less oil sticking to a shoreline, however it may also make the shoreline clean-up task more difficult, potentially resulting in secondary impacts due to disturbance to the shoreline during the clean-up (especially lower energy beaches).
Rocky Shoreline	Minor mitigation of impact	1	Surface dispersant would result in an increase in entrainment resulting in less oil arriving on a rocky shoreline. Also, dispersant would result in a reduction in the 'stickiness' of oil, resulting in potentailly less oil sticking to a rocky shoreline.
Macro-Algae and Seagrass	Minor additional impact	-1	Surface dispersant and additional entrained oil would result in negative impacts to shallow water seagrass and macro-algae, in the top 30m of the water column. However, impacts would be minor, provided dispersant applied at a significant distance from the BPPH to enable sufficient dilution of the dispersed oil.
Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)	Moderate mitigation of impact	2	Surface dispersant may have a combination of positive and negative effects to intertidal seabed habitats. However, as a key factor associated with dispersant use on persistent IFO/HFO slicks is making the oil less 'sticky' it would result in less smothering of wildlife using that shoreline.
Water column			
Lower water column (below photoic zone)	No or insignificant alteration of impact	0	Surface dispersant would result in an insignificant increase in any additional oil reaching deep water locations, regardless of chemical dispersant application on the surface.
Upper water column (in photic zone)	Minor additional impact	-1	Surface dispersant may cause marine organisms inhabiting the upper water column to be exposed to dispersed oil which can potentially have toxic effects.
Water surface	Minor mitigation of impact	1	Surface dispersant could reduce the exposure of fauna on the ocean surface to thick, persistent IFO/HFO slicks. The dispersant would make the oil less 'sticky' and therefore, result in less smothering of wildlife on the ocean surface.
Air	No or insignificant alteration of impact	0	A very slight reduction in VOCs in local atmosphere could occur as a result of dispersant application and additional entrainment. However additional chemical dispersant mist in the local atmosphere would likely offset any reduction in VOCs.
Socio-economic			
Commercial demersal fisheries	No or insignificant alteration of impact	0	Surface dispersant would result in an insignificant increase in any additional oil reaching deep water locations, regardless of chemical dispersant application on the surface.
Shallow commercial fisheries (including aquaculture)	Minor additional impact	-1	Surface dispersant may result in a minor increased in entrained oil concentration in the shallow water column, therefore potentially exposing shallow commerical fisheries to increased entrained hydrocarbons.
Recreational fisheries	Minor additional impact	-1	Surface dispersant may result in a minor increased in entrained oil concentration in the shallow water column, therefore potentially exposing shallow recreational fisheries to increased entrained hydrocarbons.
Cultural heritage			
Aboriginal heritage (cultural practices, sites and fishing / foraging)	No or insignificant alteration of impact	0	As any surface dispersant application would occur within offshore waters, surface dispersant application would result in an insignificant change in dispersed/entrained oil reaching traditional Aboriginal areas of the Kimberley and NT coastline.

Traditional Indonesian fishing	Minor additional impact	-1	Surface dispersant may result in a minor increased in entrained oil concentration in the shallow water column, therefore potentially exposing shallow traditional Indonesian fisheries to increased entrained hydrocarbons.

Pre-Contact Wildlife Response (Hazing and Translocation)

Overall statement of likelihood of success of Pre-contact OWR (hazing and relocation/displacement):

Aim: Hazing involves discouraging animals from entering oiled areas by encouraging them to move into low-risk unoiled areas, in an attempt to prevent them from becoming oiled (IPIECA 2017). Hazing techniques include vessels generating underwater noise and motion, vessel air horns making above-water noise and fire hoses directing streams in front of fauna. Translocation/displacement involves removing wildlife who are at risk of becoming oiled from the spill environment in an attempt to prevent them from becoming oiled (IPIECA 2017). This includes holding animals in captivity until the risk of oiling is over, or relocating them to another area not affected by the oil spill (IPIECA 2017).

Type of slick: Surface oil is in the form of Group IV floating slicks which have a high viscosity and will not rapidly spread into sheens. Surface oil concentrations will be approximately 25 g/m2 at 300 km, 10 g/m2 (~0.01mm, which equates to Bonn code 1/2) up to approximately 500 km and down to below 1 g/m2 up to approximately 1200 km from the spill site (RPS 2014). With increasing wind conditions, IFO and HFO will rapdily increase in viscocity and emulsify. Due to the high viscocity of IFO-180, entrained oil concentrations may exceed 100ppb for up to 5km, and may exceed 10 ppb for up to 50km from an IFO spill location (RPS 2014). Modelling of a vessel collision in Permit Areas in the Browse Basin indicate that shoreline contact could occur in <24 hours, within total volumes of oil ashore up to 300 m3.

Likely success/effectiveness against slick: Wildlife hazing in the open ocean is inherently unlikely to be effective due to a number of limitations;

1) effectiveness depends upon the deployment of numerous ocean-going vessels (as opposed to smaller vessels which can be used near to the shore);
2) against a spreading plume (i.e. away from the immediate source of the spill), the technique becomes entirely impracticable;
3) there are some potential safety issues associated with an spill, incluing IFO/HFO and vessel masters will not approach the source of the spill, or fresh areas of slick, while the spill is still ongoing; and
4) without the constraints of a shoreline or other geographical feature, the technique may cause wildlife to move into other areas of the spill area instead of away from it.

Wildlife hazing is most suitable when used near sensitive shoreline habitats against persistent oily slicks, such as IFO, HFO or crude oil spills. In regard to wildlife translocation, IPIECA (2014) advise that the difficulty of capturing wildlife safely and maintaining their health during relocation should not be underestimated, and that working with live or dead animals has health and safety issues including potential injuries (bites, scratches) or zoonotic diseases. Risks to wildlife are high during pre-emptive capture and the risks of oiling need to be weighed against the risk of injury, death etc. (IPIECA 2014). The translocation of turtles from beaches and islands would likely require the capture of large numbers of hatchlings, followed by translocation to a location far from the slick (to prevent surface oil impacts on released hatchlings). The prolonged retention of hatchlings has been demonstrated to be detrimental to hatchling swimming speed and survival, even in short periods (6 hours) of retention (Pilcher and Enderby 2001). Attempting to capture large numbers (or an entire flock) of healthy seabirds would be very challenging, if not impossible (DPaW 2014), especially at a remote shoreline location (such as Browse or Cartier Island). There is no practicable method to capture healthy seabirds at sea (DPaW 2014). Potential harm to healthy seabirds could occur during the capture process. Any seabirds released would likely fly back to the shoreline from which they originally were captured. Therefore, long term veterinary care (feeding etc.) would be required for any successfully captured birds, until spill weathering or remediation has occurred and it was safe to release the animals. An evaluation would need to be undertaken, to ensure the released animals do not pose a disease risk (human/zoonotic diseases), to the wild population into which they are released.

Resource Compartment (including values dependent on the resource compartment)	Impact Modification Score		Justification for Impact Modification Score
		B	
Subtidal Benthic Communities			
Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Deep-sea unconsolidated muds and sands	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Intertidal seabed			
Intertidal Coral Reef	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Mangrove/Mudflats/Samphires	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Sandy Beach	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Rocky Shoreline	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Macro-Algae and Seagrass	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.

Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)	Minor mitigation of impact	1	Wildlife hazing of flocks of seabirds may temporarily prevent oiling of individuals or small proportions of a local/regional populations, however it is not likely effective across a broad geographical area. Even conducting wildlife hazing in the nearshore environment at an isolated location such as Browse Island would be of logistically challenging and potentially not result in any significant impact mitigation. Hazing of seabirds to prevent them landing on an oiled shoreline may temporarily prevent impacts, whilst shoreline clean-up is occurring. Capture and translocation of turtle hatchlings away from the oiled shoreline, and release in the open ocean is potentially feasible. Therefore, undertaking pre-contact oiled wildlife response at a shoreline may reduce the number of protected species of a local population from being oiled.

Water column			
Lower water column (below photic zone)	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Upper water column (in photic zone)	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Water surface	No or insignificant alteration of impact	0	Wildlife hazing and/or translocation of seabirds or other megafauna, such as cetaceans and turtles in the open ocean, using vessel presence, vessel noise or at sea capture is highly unlikely to be successful. It may be possible to temporarily (minutes / hours), prevent a few individuals of a protected species from entering a small geographic area affected by a slick. However, over the longer term, there would be no alteration to the level of oiling of wildlife populations using this strategy in the open ocean.
Air	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Socio-economic			
Commercial demersal fisheries	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Shallow commercial fisheries (including aquaculture)	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Recreational fisheries	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Cultural heritage			
Aboriginal heritage (cultural practices, sites and fishing / foraging)	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Traditional Indonesian fishing	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.

Post Contact Oiled Wildlife Response

Overall statement of likelihood of success of Post-contact OWR:

Aim: Post-contact wildlife response involves capturing oiled wildlife - and if necessary, cleaning, rehabilitating and releasing them.

Type of slick: Surface oil is in the form of Group IV floating slicks which have a high viscosity and will not rapidly spread into sheens. Surface oil concentrations will be approximately 25 g/m2 at 300 km, 10 g/m2 (~0.01mm, which equates to Bonn code 1/2) up to approximately 500 km and down to below 1 g/m2 up to approximately 1200 km from the spill site (RPS 2014). With increasing wind conditions, IFO and HFO will rapdily increase in viscocity and emulsify. Due to the high viscosity of IFO-180, entrained oil concentrations may exceed 100ppb for up to 5km, and may exceed 10 ppb for up to 50km from an IFO spill location (RPS 2014). Modelling of a vessel collision in Permit Areas in the Browse Basin indicate that shoreline contact could occur in <24 hours, within total volumes of oil ashore up to 300 m3.

Likely success/effectiveness against slick: Capture, relocation, assessment, cleaning and rehabilitation of oiled wildlife has the ability to increase the survival of individuals. ITOPF (2011) note that there are many cases where oiled turtles have been cleaned successfully and returned to the water. Any seabirds captured, cleaned and released would likely fly back to the shoreline from which they originally were captured. Once oiled, it is generally agreed that birds have a very low survival rate, even when rescue and cleaning is attempted (Bourne et al. 1967; Holmes and Cronshaw 1977; Croxall 1977; Ohlendorf et al. 1978; Chapman, 1981; Ford et al., 1982; Samuels and Lanfear, 1982; Varoujean et al., 1983; Ford, 1985; Evans and Nettleship 1985; Fry 1987; Seip et al. 1991; Anderson et al. 2000). French-McCay (2009) produced mortality estimates of 99% for surface swimmers, 35% for aerial divers and raptors, and 5% for aerial seabirds. Samuels and Lanfear (1982) estimated that 95% of oiled seabirds die. ITOPF (2011) note that penguins and pelicans are often the exception as they are generally more resilient than many other species, however they are not present in the Browse Basin. IPIECA (2014) advise working with live or dead animals has health and safety issues including potential injuries (bites, scratches) or zoonotic diseases. An evaluation would need to be undertaken, to ensure any released animals do not pose a disease risk (human/zoonotic diseases), to the wild population into which they are released.

Resource Compartment (including values dependent on the resource compartment)	Impact Modification Score		Justification for Impact Modification Score
		B	
Subtidal Benthic Communities			
Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Deep-sea unconsolidated muds and sands	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Intertidal seabed			
Intertidal Coral Reef	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Mangrove/Mudflats/Samphires	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Sandy Beach	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Rocky Shoreline	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Macro-Algae and Seagrass	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)	Minor mitigation of impact	1	Post-contact OWR has the ability to increase the likelihood of survival of oil-affected EPBC species (individuals, or small proportion of a local population) in the intertidal/shoreline habitats. However, the seabird species of the Browse Basin are generally not expected to survive the capture, cleaning and rehabilitation process. Capture, cleaning and release of marine turtles would have a greater likelihood of success.
Water column			
Lower water column (below photic zone)	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Upper water column (in photic zone)	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Water surface	Minor mitigation of impact	1	It is possible that some individuals of protected species, which have been oiled and are unable to fly, could be captured in the open ocean and relocated to an oiled wildlife treatment facility. Therefore, whilst there is a very low probability of survival, under the right circumstances a positive environmental outcome, for a limited number of individuals of a protected species could be achieved.
Air	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.

Socio-economic			
Commercial demersal fisheries	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Shallow commercial fisheries (including aquaculture)	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Recreational fisheries	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Cultural heritage			
Aboriginal heritage (cultural practices, sites and fishing / foraging)	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Traditional Indonesian fishing	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.

In Situ Burn

Overall statement of likelihood of success of In-situ burn (ISB):

Aim: In-site burning rapidly removes the volume of spilled oil's hydrocarbon vapours in place, via combustion or burning (IPIECA 2016). This technique reduces the need to collect, store, transport and dispose recovered oil, plus it can shorten the overall response time (IPIECA 2016).

Type of slick: Surface oil is in the form of Group II floating slicks which have a low viscosity and rapidly spread into a thin sheen. They will be approximately 10 g/m^2 up to approximately 25 km from the spill site and approximately 1 g/m^2 up to approximately 110 km from the spill site.

Likely success/effectiveness against slick: ISB requires wave heights typically below 1 m and wind speeds below 10 knots (IPIECA 2016) which are frequently exceeded at remote offshore locations in the Browse Basin region. Overseas experience shows that burns can be conducted safely, but the most discernible disadvantage is the resulting dark smoke plumes caused by the combustion of oil (IPIECA 2016). Carbon dioxide, soot (PM 2.5), water, polyaromatic hydrocarbons, volatile organic compounds, carbonyls, carbon monoxide, sulphur dioxide and potentially other gases can result from an in-situ burn, which has the potential to affect human and animal health (IPIECA 2016). IPIECA (2016) note that tests and information from previous burns indicate that ISB has little effect on water quality. Burn residue (i.e. burned oil depleted of volatiles and precipitated soot) rarely sinks and smothers benthic species (IPIECA 2016). IPIECA (2016) further note that burn residue is less toxic to aquatic biota than weathered oil.

To implement an effective in-situ burn response, a minimum surface hydrocarbon thickness of 2-5 mm (2000 - 5000 g/m^2) is required to be present. Booms would be required to corral the spill, in an attempt to generate additional oil thickness, but this in turn may result in an exceedance of the VOC exposure thresholds for the workforce, and also may result in concentrations exceeding the lower explosive limit (however this is quite unlikley for IFO/HFO). Given this, and the lack of suitable booms available for in-situ burns in Australia, implementation of this response in an open ocean, high current environment is not considered to be safe, effective or feasible.

Resource Compartment (including values dependent on the resource compartment)	Impact Modification Score		Justification for Impact Modification Score
		B	
Subtidal Benthic Communities			
Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)			
Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)			
Deep-sea unconsolidated muds and sands			
Intertidal seabed			
Intertidal Coral Reef			
Mangrove/Mudflats/Samphires			
Sandy Beach			
Rocky Shoreline			
Macro-Algae and Seagrass			
Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)			
Water column			
Lower water column (below photic zone)			
Upper water column (in photic zone)			
Water surface			
Air			

Socio-economic			
Commercial demersal fisheries			
Shallow commercial fisheries (including aquaculture)			
Recreational fisheries			
Cultural heritage			
Aboriginal heritage (cultural practices, sites and fishing / foraging)			
Traditional Indonesian fishing			

References

Anderson, D. W., Newman, S.H., Kelly, P.R., Herzog, S.K. and Lewis, K.P. 2000. An Experimental Soft-Release of Oil-Spill Rehabilitated American Coots (Fulica americana): I. Lingering Effects on Survival, Condition and Behavior. Environmental Pollution 107: 285–294.

RPS APASA. 2014. Ichthys Offshore Operations Gasp Analysis - Quantiative Spill Risk Assessment. J0312 - Rev0. Prepared for INPEX Operations Australia Pty. 04/08/2014

RPS APASA. 2014b. INPEX – *Ichthys GEP Vessel Spills – Dispersant Application Modelling Study.* Job Ref# J0293. Report prepared by RPS APASA for INPEX Operations Australia, Perth, Western Australia.

Asia-Pacific Applied Science Associates (APASA). 2012. Basset Deep Well: Quantitative Spill Risk Assessment. J0172 Rev 2. Prepared for INPEX Operations Australia Pty 27/11/2012

Australian Maritime Safety Authority (AMSA). 2010. *Montara Well Release Monitoring Study S7.2 Oil Fate and Effects Assessment Modelling of Chemical Dispersant Operation.* Prepared for: PTTEP Australasia. 4 October 2010.

Australian Maritime Safety Authority (AMSA). 2015. *The Effects of Maritime Oil Spills on Wildlife including Non-avian Marine Life*. Accessed online 14/11/2018 at <http://www.amsa.gov.au/environment/maritime-environmental-emergencies/national-plan/general-information/oiled-wildlife/marine-life/index.asp>.

Australian Maritime Safety Authority (AMSA). 1998. National Plan (document now superseded): *The effects of maritime oil spills on wildlife including non-avian marine life*. Accessed 16 July 2015 at <https://www.amsa.gov.au/environment/maritime-environmental-emergencies/national-plan/General-Information/oiled-wildlife/marine-life/index.asp>.

Bourne, W.R.P., Parrack J.D. and Potts G.R. 1967. Birds Killed in the Torrey Canyon Disaster. Nature 215: 1123–1125.

Burns, K.A., Garrity, S.D. and Levings, S.C. 1993. How many years before mangrove ecosystems recover from catastrophic oil spills? *Marine Pollution Bulletin.* 26(5):239–248

Campagna, C., Short, F.T., Polidoro, B.A., McManus, R., Collette, B.B., Pilcher, N.J., Mitcheson, Y.S., Stuart, S.N. and Carpenter, K.E. 2011. Gulf of Mexico oil blowout increases risks to globally threatened species. *BioScience* 61:393–397.

Chapman, B.R. 1981. *Effects of the Ixtoc I Oil Spill on Texas Shorebird Populations*. pp. 461–465 in American Petroleum Institute, Proceedings of the 1981 Oil Spill Conference. American Petroleum Institute, Washington, D.C.

Clark, R.B. 1984. Impact of oil pollution on seabirds. Environmental Pollution 33:1–22.

Connell, D.W., Miller, G.J. and Farrington, J.W. 1981. Petroleum hydrocarbons in aquatic ecosystems—behavior and effects of sublethal concentrations: Part 2. *Critical Reviews in Environmental Science and Technology* 11(2):105–162.

Commonwealth Scientific and Industry Research Organisation (CSIRO). 2016. Oil spill monitoring handbook. CSIRO Publishing, Clayton South, Victoria.

Croxall, J.P. 1977. *The Effects of Oil on Seabirds*. Rapport Procès-Verbal Reunion Conseil International pour L'Exploration de la Mer 171: 191–195.

Dean, T.A., Stekoll, M.S., Jewett, S.C., Smith, R.O. and Hose, J.E. 1998. Eelgrass (Zostera marina L.) in Prince William Sound, Alaska: effects of the Exxon Valdez oil spill. Marine Pollution Bulletin 36: 201–210.

DoF. 2013. Pearl Oyster, Webpage managed by the Department of Fisheries Western Australia, accessed December 2017. Last updated 24 April 2013. [http://www.fish.wa.gov.au/Species/Pearl-Oyster/Pages/default.aspx]

Department of Environment and Conservation (DEC). 2007. Management Plan for the Montebello/Barrow Islands Marine Conservation Reserves 2007–2017: Management Plan No. 55. Department of Environment and Conservation, Perth, Western Australia

Department of Environment and Conservation (DEC) and Marine Parks and Reserves Authority (MPRA). 2005. Management Plan for the Ningaloo Marine Park and Muiron Islands Marine Management Area 2005–2015. Department of Environment and Conservation and Marine Parks and Reserves Authority. Perth, Western Australia.

Department of the Environment, Water, Heritage and the Arts (DEWHA). 2008. North Marine Bioregional Plan bioregional profile: a description of the ecosystems, conservation values and uses of the North Marine Region.

Department of Parks and Wildlife (DPaW). 2014. *Western Australian Oiled Wildlife Response Plan (WAOWRP*). Department of Parks and Wildlife, Perth, WA.

Duke, N., Burns, K,. Swannell, J., Dalhaus, O. and Rupp, R. 2000. Dispersant use and a bioremediation strategy as alternative means of reducing impacts of large oil spills on mangroves: the Gladstone field trials. *Marine Pollution Bulletin*. Vol 41, Issues 7–12:403–412.

Evans, P.G.H. and Nettleship, D.N. 1985. *Conservation of the Atlantic Alcidae*. pp. 427–488 in Nettleship, D.N. and Birkhead, T.R. (eds.). The Atlantic Alcidae. Academic Press, London, UK.

Fingas. 2012. The Basics of Oil Spill Cleanup – Third Edition. CRC Press. Boca Raton, Florida.

Fletcher WJ, Mumme MD and Webster FJ (eds). 2017. Status Reports of the Fisheries and Aquatic Resources of Western Australia 2015/6: The State of the Fisheries. Department of Fisheries, Western Australia.

Fletcher, W.J. and Santoro, K. (eds). 2014. Status reports of the fisheries and aquatic resources of Western Australia 2013/14: The state of the fisheries. Department of Fisheries, Western Australia.

Ford, R.G., Wiens, J.A., Heinemann D. and Hunt G.L. 1982. Modelling the Sensitivity of Colonially Breeding Marine Birds to Oil Spills: Guillemot and Kittiwake Populations on the Pribilof Islands, Bering Sea. *Journal of Applied Ecology* 19:1–31.

Ford, R.G. 1985. *A Risk Analysis Model for Marine Mammals and Seabirds: A Southern California Bight Scenario*. Final Report to U.S. Department of the Interior, Minerals Management Service MMS 85-0104, Pacific OCS Region, Los Angeles, CA.

French-McCay, D.P. 2009. State of the art and research needs for oil spill impact assessment modelling. pp. 601-653, 2009 in Proceedings of the 32nd AMOP Technical Seminar on Environmental Contamination and Response, Emergencies Science Division, Environment Canada, Ottawa, ON, Canada.

Fry, D.M. 1987. *Seabird Oil Toxicity Study*. Report submitted by Nero and Associates, Inc. to Minerals Management Service, U.S. Department of Interior, Washington, D.C., USA.

Fucik, K.W., Bight, T.J. and Goodman K.S. 1984. Measurements of damage, recovery, and rehabilitation of coral reefs exposed to oil. pp. 115–134 in Cairns Jr., J. and Buikema Jr., A.L. (eds.), *Restoration of Habitats Impacted by Oil Spills*, Butterworth Publishers, Boston, MA.

Guzman H.M., Burns K.A., Jackson B.C. 1994. Injury, regeneration and growth of Caribbean reef corals after a major oil spill in Panama. Marine Ecology Progress Series 105, 231–241.

Hayes M., Hoff R., Michel J., Scholz D. and Shigenaka G. 1992. An introduction to Coastal Habitats and Biological Response to an Oil Spill. Report prepared by the Hazardous Materials Response and Assessment Division National Oceanic and Atmospheric Administration.

Hoff, R. and Michel, J. 2014. Oil spills in mangroves: planning and response considerations. US Department of Commerce. National Oceanic and Atmospheric Administration (NOAA), Seattle, Washington.

Holmes, W.N. and Cronshaw, J. 1977. *Biological Effects of Petroleum on Marine Birds*. pp. 359–398 in Malins, D.C. (ed.), Effect of petroleum on arctic and subartic marine environments and organisms. Vol. II: Biological effects. Academic Press, New York, USA.

Hook S.E., Osborn H.L., Spadaro D.A., Simpson S.L. 2014b. Assessing mechanisms of toxicant response in the amphipod Melita plumulosa through transcriptomic profiling. Aquatic
Toxicology 146, 247–257. doi:10.1016/j.aquatox.2013.11.001

International Petroleum Industry Environmental Conservation Association (IPIECA). 2014. Wildlife resopnse preparedness. IPIECA-IOGP Good Practice Guide Series,
Oil Spill Response Joint Industry Project (OSR-JIP). IOGP Report 516. London, UK.

International Petroleum Industry Environmental Conservation Association (IPIECA). 2015a. A guide to oiled shoreline clean-up techniques. IPIECA-IOGP Good Practice Guide Series, Oil Spill Response Joint Industry Project (OSR-JIP). IOGP report 521. London, UK.

International Petroleum Industry Environmental Conservation Association (IPIECA). 2015b. At-sea containment and recovery. IPIECA-IOGP Good Practice Guide Series,
Oil Spill Response Joint Industry Project (OSR-JIP). IOGP report 522. London, UK.
International Petroleum Industry Environmental Conservation Association (IPIECA). 2015c. Dispersants: surface application. IOGP report 532. London, UK.

International Petroleum Industry Environmental Conservation Association (IPIECA). 2017b. Key principles for the protection, care and rehabilitation of oiled wildlife. IPIECA-IOGP Good Practice Guide Series, Oil Spill Response Joint Industry Project (OSR-JIP). IOGP Report 583. London, UK.
International Tanker Owners Pollution Federation (ITOPF). 2011. Effects if Oil Pollution on the Marine Environment - Technical Information Paper. Published by the International Tanker Owners Pollution Federation Limited, London UK.

Jenssen, B.M. 1994. Review article: Effects of oil pollution, chemically treated oil, and cleaning on the thermal balance of birds. *Environmental Pollution*, 86:207–215.

Law R.J., Kirby M.F., Moore J., Barry J., Sapp M., Balaam J. 2011. PREMIAM – pollution response in emergencies marine impact assessment and monitoring: post-incident monitoring guidelines. In Science Series Technical Report No. 146. Cefas, Lowestoft, UK, <www.cefas.defra.gov.uk/premiam>.

Lee, K. 2011. *Toxicity Effects of Chemically Dispersed Crude Oil on Fish*. International Oil Spill Conference Proceedings 2011(1):163.

Matcott, J., Baylis, S., and Clarke, R.H. 2019. The Influence of Petroleum oil films on the feather structure of tropical and temperate seabird species. Marine Pollution Bulletin 138: 135-144.

Milton, S., Lutz, P. and Shigenaka G. 2003. Oil Toxicity and Impacts on Sea Turtles. In Shigenaka, G. (ed.), *Oil and Sea Turtles: Biology, Planning, and Response*. National Oceanic and Atmospheric Administration (NOAA), Seattle, Washington.

Montagna P.A., Baguley J.G., Cooksey C., Hartwell I., Hyde .LJ., Hyland J.L. et al. 2013. Deep-sea benthic footprint of the Deepwater Horizon blowout. PLoS One 8, e70540. doi:10.1371/journal.pone.0070540

Murawski S.A., Hogarth W.T., Peebles EB, Barbeiri E. 2014. Prevalence of external skin lesions and polycyclic aromatic hydrocarbon concentrations in Gulf of Mexico fishes, post
Deepwater Horizon. Transactions of the American Fisheries Society 143, 1084–1097.

National Research Council (NRC). 2005. Oil Spill Dispersants: Efficacy and Effects. The National Academies Press. Washington, DC.

Negri, A.P. and Heyward, A.J. 2000 Inhibition of fertilization and larval metamorphosis of the coral *Acropora millepora* (Ehrenberg, 1834) by petroleum products. *Marine Pollution Bulletin* 41(7–12):420–427.

O'Brien, M. 2002. At-sea recovery of heavy oils - A reasonable response strategy? 3rd Forum on High Density Oil Spill response. The International Tanker Owners Pollution Federation Limited (ITOPF). London, UK.

Ohlendorf, H.M., Risebrough R.W. and Vermeer, K. 1978. *Exposure of Marine Birds to Environmental Pollutants*. U.S. Fish and Wildlife Service Wildlife Research Report 9.

Peters E.C., Gassman N.J., Firman J.C., Richmond R.H., Power EA .1997. Ecotoxicology of tropical marine ecosystems. Environmental Toxicology and Chemistry 16, 12–40. doi:10.1002/etc.5620160103

Pie HV, Heyes A, Mitchelmore C.L. 2015. Investigating the use of oil platform marine fouling invertebrates as monitors of oil exposure in the Northern Gulf of Mexico. The Science of the Total Environment 508, 553–565. doi:10.1016/j.scitotenv.2014.11.050

Pilcher N.J., and Enderby. S. 2001. Effects of prolonged retention in hatcheries of green turtle (Chelonia mydas) hatchling swimming speed and survival. Journal of Herpetology. 35(4): 633–638.

RPS. 2018. WA-343-P Quantitative Spill Risk Assessment. West Perth, Western Australia.

Runcie, J.W. and Riddle, M.J. 2006. Diel variability in photosynthesis of marine macroalgae in ice-covered and ice-free environments in East Antarctica. European Journal of Phycology 41(2):223–233.

Samuels, W.B. and Lanfear K.J. 1982. Simulations of seabird damage and recovery from oil spills in the northern gulf of Alaska. Journal of Environmental Management 15: 169–182.

Seip, K.L., Sandersen, E., Mehlum, F. and Ryssdel, J. 1991. Damages to seabirds from oil spills: comparing simulation results and vulnerability indexes. Ecological Modellin, 53: 39–59.

Sell D, Conway L, Clark T, Picken GB, Baker JM, Dunnet GM. 1995 Scientific criteria to optimize oil spill cleanup. International Oil Spill Conference Proceedings 1995(1), 595–610.

Shigenaka, G. 2001. *Toxicity of Oil to Reef Building Corals: A Spill Response Perspective*. National Oceanic and Atmospheric Administration (NOAA) Technical Memorandum, National Ocean Service, Office of Research and Restoration 8, Seattle, USA.

Simberloff, D. 2009. The role of propagule pressure in biological invasions. The Annual Review of Ecology, Evolution, and Systematics 40:81-102.

Taylor H and Rasheed M. 2011. Impacts of a fuel oil spill on seagrass meadows in a subtropical port, Gladstone, Australia – The value of long-term marine habitat monitoring in high risk areas. Marine Pollution Bulletin 63:431-437.

Varoujean, D.H., Baltz, D.M., Allen, B., Power, D., Schroeder, D.A. and Kempner, K.M. 1983. *Seabird-Oil Spill Behavior Study*. Report by Nero and Associates, Inc. to U.S. Department of the Interior, Minerals Management Service, Reston, VA.

WA Department of Transport (WA DoT). 2018. Provision of Western Australian Marine Oil Pollution Risk Assessment - Protection Priorities - Protection Priority Assessment for Zone 1: Kimberley - Draft Report. Perth, Western Australia.

Woodside Energy Ltd. 2014. Browse FLNG Development, Draft Environmental Impact Statement. EPBC 2013/7079. November 2014. Woodside Energy Ltd., Perth, Western Australia.

Zieman, J.C., Orth, R., Phillips, R.C., Thayer, G. and Thorhaug, A. 1984. The effects of oil on seagrass ecosystems. pp. 37–64 in Cairn, J. and Buikema, A.L. (eds), Restoration of Habitats Impacted by Oil Spills. Butterworth, Boston, USA.